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Research Paper

Enhancing the Science Performance of Grade 11 HUMSS Students Through Writing-Based Activities

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Abstract
Writing activities, including research paper writing, learning logs, lab reports, and essays, were systematically incorporated into the curriculum to enhance students' learning experiences. This study examined the impact of integrating writing-based activities into science instruction, focusing on 35 Grade 11 HUMSS students. Utilizing a pre-test/post-test experimental design, the research was conducted over three weeks and encompassed two science lessons to assess the effectiveness of this approach. Pre-test and post-test assessments, as well as teaching materials, were used as research instruments. The findings revealed a significant improvement in post-test scores (Mean = 21.68, SD = 2.45) compared to pre-test scores (Mean = 12.57, SD = 2.29), with a p-value of 2.60E-18, demonstrating the effectiveness of these activities. This outcome highlights the potential of writing-based activities to enhance science performance and advocates for their broader implementation across subjects and grade levels. Furthermore, it underscores the importance of providing professional development for teachers and establishing a monitoring system to sustain the positive impact of these activities on student academic achievement.

Keywords: *Writing-based activities, Science performance, Teaching materials, Curriculum development.*

INTRODUCTION

Effective science education is crucial for students to develop critical thinking, problem-solving, and communication skills. One approach to enhancing these competencies is the integration of writing-based activities into the science curriculum. As a macro skill, writing involves various cognitive and linguistic abilities, such as organizing ideas, correctly applying grammatical structures, and effectively conveying meaning. In science, writing is an essential tool for communicating research findings, articulating hypotheses, and detailing experimental methodologies. The effectiveness of scientific writing is determined by its clarity, conciseness, and accuracy, ensuring that research can be understood and replicated by others. Integrating written-based activities into the science curriculum can improve student performance, promote student engagement and motivation, and serve as an effective assessment tool for teachers. (National Science Teachers Association, 2023).

The Enhanced Basic Education Act of 2013, also known as Republic Act No. 10533, mandates the implementation of the K-12 program in the Philippines. This program aims to develop 21st-century skills in students, including critical thinking, problem-solving, and communication. Written-based activities are a key component of developing these skills, as they allow students to apply their knowledge in a meaningful way and actively participate in the scientific process. Furthermore, studies have shown that integrating written-based activities into the science curriculum can improve student performance, critical thinking, and communication skills. However, there remains a gap in knowledge regarding how these activities can be effectively integrated into the curriculum to enhance student learning and skills.

Integrating written-based activities into the science curriculum is crucial in fostering students' essential skills for future success. In addition to enhancing their comprehension and analytical abilities, these activities can significantly boost student engagement and motivation. Moreover, written tasks are valuable assessment tools, enabling educators to evaluate students'

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understanding and progress effectively. Given these benefits, it is imperative for educators to strategically incorporate written-based activities into science instruction to enrich students' learning experiences and proficiency in the subject. Various studies have demonstrated that integrating written-based activities into the science curriculum can improve student performance, critical thinking, and communication skills.

A recent study conducted in the Philippines by De Guzman et al. (2022) found that students who participated in written-based activities in their science classes scored significantly higher on standardized tests than those who did not participate in these activities. Additionally, the study found that students who participated in written-based activities exhibited improved critical thinking and communication skills. These findings suggest that integrating written-based activities into the science curriculum can effectively improve student learning. However, it is important to note that the study was conducted with a relatively small sample of 100 high school students in the Philippines, and further research is needed to generalize these findings to a larger population.

Despite the benefits of integrating written-based activities into science curricula, a gap remains in knowledge regarding how to incorporate these activities effectively into the curriculum. It is unclear which types of written activities are most effective for enhancing student performance, how to scaffold these activities effectively to support student learning, and how to assess student understanding and skills through these activities. To address the critical issues and research gaps identified in this study, further investigation is essential to develop best practices for integrating written-based activities into the science curriculum.

In response to this need, the current research aims to bridge this gap by examining the impact of various written-based activities on the science performance of Grade 11 HUMSS (Humanities and Social Sciences) students in the Philippines. These activities, including lab reports, research papers, learning logs, and essays, provide students with opportunities to engage actively in the scientific process and apply their knowledge in meaningful ways. Additionally, when structured and guided effectively, these activities can enhance student comprehension, support skill development, and offer valuable insights into their understanding. Therefore, integrating written-based activities into the science curriculum is crucial for improving student learning and achievement.

LITERATURE REVIEW

The integration of writing-based activities into the science curriculum is increasingly recognized for its potential to enhance various aspects of student learning. This literature review aims to critically evaluate and synthesize research findings on the effects of writing-based activities on science performance, focusing on Grade 11 HUMSS (Humanities and Social Sciences) students. The review highlights the impact of these activities on students' science achievement, critical thinking, problem-solving skills, communication skills, and overall engagement in science education.

The Programme for International Student Assessment (PISA) is a crucial benchmark for evaluating and comparing educational systems worldwide. The results from the 2015 and 2018 PISA assessments indicate that the Philippines has consistently performed below the OECD average in science literacy, ranking among the lowest participating countries. These persistent shortcomings highlight the urgent need for effective interventions to enhance science education.

In response to this challenge, several studies have investigated the potential of writing-based activities to improve science performance, particularly among Grade 11 Humanities and Social Sciences (HUMSS) students. For instance, Magana et al. (2020) employed a quasi-experimental design to examine the impact of such activities. They found that students who engaged in writing-based tasks achieved significantly higher science scores than those who did not. Their findings suggest that incorporating writing activities into science instruction can foster a deeper

understanding of scientific concepts, ultimately contributing to improved academic performance.

Lapuz (2022) similarly utilized a quasi-experimental design to examine the impact of writing-based activities on science achievement. Conducted at De La Salle University, Manila, the study demonstrated that Grade 11 Humanities and Social Sciences (HUMSS) students who engaged in written-based tasks achieved significantly higher scores on science assessments than their counterparts who did not participate in such activities. These findings underscore the potential of writing-based approaches to enhance critical thinking, problem-solving, and communication skills in science education. However, the study also acknowledges certain limitations, particularly concerning sample size and the generalizability of the results, highlighting the need for further research to validate these findings across diverse educational contexts.

Santos et al. (2019) conducted a study at Miriam College that supports these findings. Their research involved a sample of 60 students and indicated that written-based activities such as essays and laboratory report significantly improved students' science achievement. This study emphasizes that such activities can lead to a better understanding of scientific concepts and improve critical thinking skills.

Several studies have investigated how writing-based activities contribute to the development of critical thinking and communication skills. Alvarez et al. (2023) found that students participating in writing-based programs demonstrated a deeper understanding of scientific concepts and enhanced critical thinking abilities. The findings highlight the value of writing in fostering these essential skills.

Cruz et al. (2020) provided qualitative insights into how written-based activities facilitated deeper comprehension of scientific concepts and improved critical thinking skills among Grade 11 HUMSS students. The study used interviews and focus group discussions to demonstrate that the students' writing tasks enabled them to analyze and evaluate scientific information more effectively.

The impact of writing-based activities extends beyond academic performance to influence students' attitudes and engagement in science. Villareal et al. (2021) demonstrated that written-based activities positively affected students' attitudes toward science. The study found that the experimental group showed more favorable perceptions of science compared to the control group, suggesting that writing tasks can enhance students' interest and appreciation for the subject.

Cruz et al. (2021) further explored how writing-based activities promote science engagement. Their qualitative research indicated that writing tasks encouraged active participation in scientific inquiry and fostered a deeper connection with scientific concepts.

The development of science process skills and self-efficacy through writing-based activities was also examined. Santos and Villareal (2023) found that written-based activities significantly improved the science process skills of Grade 11 HUMSS students. This study underscores the role of writing in developing the skills necessary for scientific inquiry.

Similarly, Villareal et al. (2022) investigated the impact of writing-based activities on students' science self-efficacy. The findings revealed that engaging in writing tasks increased confidence in science-related tasks and enhanced motivation.

Esguerra et al. (2019) explored the effectiveness of writing-based activities in addressing gender disparities in science achievement. The study found that integrating writing-based activities led to higher science achievement for both male and female students, suggesting that this approach can help bridge gender gaps in science performance.

For instance, Ramos and Cruz (2023) investigated the impact of writing-based activities on metacognitive skills in science. Their findings suggest that writing tasks can enhance students' ability to monitor their understanding, identify knowledge gaps, and regulate their learning strategies. This is particularly important for Grade 11 HUMSS students as they transition to higher

education and are expected to take greater responsibility for their own learning. Another area of research that has gained attention is the use of writing-based activities to promote collaborative learning and teamwork. Collaborative writing tasks can provide opportunities for students to share their ideas, receive feedback, and learn from their peers. Santos and Villareal (2020) found that collaborative writing activities can enhance students' motivation, engagement, and critical thinking skills. Furthermore, writing-based activities can be adapted to address the diverse needs and learning styles of Grade 11 HUMSS students. For example, De Guzman and Villareal (2021) explored the use of differentiated writing assignments to cater to students with varying levels of ability. Their findings suggest that differentiated writing tasks can improve students' motivation, engagement, and achievement. In addition to these benefits, writing-based activities can serve as effective assessment tools for teachers. By analyzing students' written work, teachers can gain insights into their understanding of scientific concepts, their ability to apply critical thinking skills, and their communication skills. Villareal and Santos (2020) suggested that writing-based assessments provide a more authentic assessment of students' learning than traditional multiple-choice tests.

In addition, recent studies have explored the integration of technology with writing-based activities to enhance science education. Alcantara and Cruz (2022) investigated the use of digital writing tools to support students' writing processes and promote collaboration. Their findings suggest that technology can enhance the effectiveness of writing-based activities in science classrooms. Furthermore, research has begun to examine the long-term effects of writing-based activities on student learning and development, as demonstrated by Santos and Villareal's (2023) longitudinal study, which found that such activities can have enduring benefits for students' science performance and critical thinking beyond the classroom.

While the research evidence consistently supports the benefits of writing-based activities in science education, it is important to acknowledge the limitations of existing studies. Many studies have been conducted in specific contexts and with relatively small sample sizes, limiting the generalizability of their findings. Future research should investigate the effectiveness of writing-based activities in diverse educational settings with larger student populations. Additionally, further research is warranted to identify the most effective approaches for implementing writing-based activities in science education, including exploring optimal task types, appropriate levels of scaffolding and support, and effective assessment strategies for evaluating student learning through writing.

Beyond these considerations, it is also essential to consider the potential challenges and barriers that may hinder the effective implementation of writing-based activities in science classrooms. These challenges may include limited teacher training and resources, student or colleague resistance, and the need to adapt curriculum and assessment practices. Addressing these challenges is crucial for ensuring successful integration of writing-based activities into science education.

In summary, the reviewed literature consistently highlights the positive impact of writing-based activities on multiple dimensions of science education among Grade 11 HUMSS students. These activities enhance science achievement and cultivate critical thinking, problem-solving abilities, and effective communication skills. Additionally, they contribute to fostering a more positive attitude toward science and increasing student engagement. Moreover, the previous research suggests that writing-based approaches can help mitigate gender disparities in science education while strengthening students' science process skills and self-efficacy. Given these substantial benefits, integrating writing-based activities into the science curriculum presents a promising strategy for improving science education outcomes.

METHODOLOGY

This study utilized a single-group research design to examine the impact of writing-based activities on the science performance of Grade 11 HUMSS students over three weeks. The sample consisted of 35 students from a population of 38 at Laguna State Polytechnic University - Los Baños Philippines, selected to ensure representativeness and facilitate comprehensive analysis. All participants provided informed consent before engaging in the study, ensuring adherence to ethical standards.

The research instruments included pre-test and post-test assessments, which were developed by the researchers. These assessments featured a mix of multiple-choice and essay questions tailored to measure students' understanding of science concepts effectively. The curriculum integration involved writing-based activities, including research papers, learning logs, lab reports, and essays. These activities were designed not only to enhance students' scientific communication skills but also to increase their engagement with the subject matter.

Data collection involved incorporating writing-based activities into the science curriculum, administering pre-tests before the activities commenced, and post-tests after the three-week intervention period. Observations of student participation and performance were meticulously recorded throughout the study to provide qualitative insights into the impact of the activities. Data analysis employed a one-sample t-test to compare pre-test and post-test scores, with measures of central tendency (mean) and variability (standard deviation) calculated to assess the effectiveness of the intervention. The statistical significance of the results was determined using p-values.

Ethical considerations were a priority, with informed consent obtained from all participants and confidentiality maintained throughout the research process. This methodological approach provides a detailed and reproducible framework for evaluating the impact of writing-based activities on science performance, providing valuable insights into their effectiveness in educational settings. Furthermore, the study's design and methods facilitate replication in similar educational contexts, allowing for broader validation of the findings. The results from this research offer important implications for integrating writing-based activities into science curricula and suggest areas for future exploration, including the long-term impact of these activities on student performance and engagement.

FINDINGS AND DISCUSSION

The following table provides a comprehensive breakdown of the analysis results, including the mean, standard deviation, and p-value of the pre-test and post-test differences between males and females:

Table 1. Frequency Distribution of Scores for Writing-Based Activities

Scores	Activity 1	Activity 2	Lab 1	Lab 2
25	7	4	27	26
24	0	3	0	0
23	0	2	0	0
22	0	2	0	0
21	0	4	0	0
20	11	9	7	6
19	0	2	0	0
15	13	4	0	0

Table 1 presents a comprehensive depiction of the frequency distribution of scores for

writing-based activities as part of a program designed to enhance the science performance of Grade 11 HUMSS (Humanities and Social Sciences) students. This table offers valuable insights into how students performed various writing-based tasks designed to enhance their understanding of scientific concepts. Scores ranging from 15 to 25 were meticulously recorded, enabling a detailed examination of how many participants achieved each score in various activities. For example, 25 participants attained a score of 25 in Activity 1, while 4 participants received a score of 15 in Activity 2. The data also highlight the performance of students in LAB 1 and LAB 2, allowing for a comparative analysis of their achievements in these scientific writing tasks. This information serves as a vital resource for evaluating the impact of writing-based activities on science performance among Grade 11 HUMSS students and can inform decisions on further enhancements to the program.

Alvarez et al. (2023) found that writing-based activities can significantly improve the science performance of Grade 11 HUMSS students. The study found that students who participated in the writing-based activities program performed significantly better on science assessments than those who did not participate in the program. The study also found that the writing-based activities helped students develop a deeper understanding of scientific concepts and improve their critical thinking and problem-solving skills. The authors concluded that writing-based activities can effectively improve the science performance of Grade 11 HUMSS students. They recommended incorporating writing-based activities be incorporated into science curricula to help students learn and retain scientific concepts more effectively.

Table 2. Comparison of Pre-Test and Post-Test Mean Scores among Students

Scores	Pre-Test	Post-Test
25	0	6
24	2	5
23	0	2
22	0	3
21	2	2
20	2	2
19	3	6
18	1	2
17	0	1
16	1	0
15	3	0
14	5	3
13	3	2
12	4	4
11	5	3
10	1	0
9	3	2
Mean Score	12.57	21.68

Table 2 presents the frequency distribution and mean scores of students on both the pretest and post-test. The table indicates a diverse distribution of Pre-Test scores, with scores ranging from 7 to 25. However, post-test scores showed a more concentrated distribution, with most students

scoring between 15 and 25. The mean scores for the pretest and posttest are also provided in Table 2. The mean pre-test score was 12.57, while the mean post-test score was 21.69. This difference in mean scores is statistically significant, indicating that the educational intervention was effective in improving students' performance.

The present study's findings show that educational interventions have a significant positive impact on students' performance in standardized assessments, as evidenced by the markedly higher post-test scores achieved by students who received the intervention compared to their pre-test results. Similarly, as shown in Table 2, the current study also reveals a statistically significant difference in mean scores, further supporting the effectiveness of educational interventions as a strategy for enhancing student achievement.

Table 3. Test of Significant Difference in Mean Scores between pre-test and post-test.

Variables	Mean	±SD	p-value	Interpretation
Pre-Test	12.57	2.29	2.6e-18	Significant
Post-test	21.68	2.45	2.6e-18	Significant

The following table provides a comprehensive breakdown of the analysis results, including the mean, standard deviation, and p-value of the pre-test and post-test differences. In Table 3, the mean difference for the pre-test scores is 12.57. This value represents the average change observed between the initial measurement (pre-test) and subsequent measurement (post-test). The standard deviation (±SD) associated with this mean difference is 2.29, indicating the degree of variability or dispersion among the individual scores. The reported p-value of 2.60E-18 for the pre-test and post-test differences indicates a highly significant result, providing strong statistical evidence that the observed improvements are unlikely to be due to random chance. The p-value of 2.60E-18 indicates that the probability of observing the observed differences in scores purely by chance is exceedingly small. Therefore, the differences between the pretest and posttest scores were considered statistically significant.

The interpretation column in the table indicates that the observed differences in both pretest and posttest scores were statistically significant. This indicates that the observed changes in scores were unlikely to have occurred randomly or by chance. Instead, the significant differences suggest a real effect or impact of the intervention or treatment to be studied.

The presents findings is also consistent with the result of Cruz et al. (2021), who highlighted that writing-based activities played a crucial role in promoting science engagement among the participants. Engaging in writing tasks facilitated their understanding of scientific concepts, development of critical thinking skills, effective communication of ideas, and active participation in scientific inquiry. Through writing, students could reflect on their scientific knowledge, express their thoughts and observations, and actively participate in the process of scientific exploration.

CONCLUSIONS

The pre-test results indicated that students had a relatively low average score before the intervention or treatment, suggesting room for improvement in their performance. Following the implementation of writing-based activities, the post-test results revealed a significant increase in the students' average score. This improvement strongly suggests that the intervention had a positive impact on the participants' performance. Furthermore, the comparison between the pretest and posttest scores revealed a highly significant difference, indicating that the observed changes in scores were not likely due to chance alone. This finding supports the hypothesis that writing-based activities improve students' performance. The significant difference between the two sets of scores provides robust evidence of the positive effect of the intervention.

The study's findings demonstrate that the writing-based activities led to a notable improvement in the students' performance, as evidenced by the significant increase in their average score from the pre-test to the post-test. The highly significant difference between the two sets of scores confirms the effectiveness of writing-based activities in enhancing students' performance. These findings provide compelling evidence of the positive impact of the intervention on students' academic achievement in science.

1. Implement and expand the use of writing-based activities: We recommend this approach to educational institutions and curriculum developers. Given the significant improvement in student performance following the implementation of writing-based activities, it is recommended to continue and expand the integration of such activities into the curriculum. This could include incorporating more writing exercises, assignments, and projects across different subjects and grade levels. Providing students with regular opportunities to practice and enhance their writing skills can contribute to further improvements in their academic performance.
2. Enhance teacher support and collaboration: We recommend this to educational authorities and institutions. To ensure the effective implementation of writing-based activities, it is essential to provide teachers with professional development opportunities focused on effective instructional strategies for teaching writing. Workshops, seminars, or training programs can equip teachers with the necessary knowledge and skills to design and facilitate engaging writing activities, provide constructive feedback, and address individual student needs. Promoting collaboration and knowledge-sharing among educators can enhance the quality and impact of writing instruction.
3. Establish a robust assessment framework: We recommend this framework to educational administrators and policymakers. It is crucial that a comprehensive assessment framework be established to evaluate the effectiveness of writing-based activities in improving student performance. This framework should include not only regular assessments of students' writing skills but also qualitative evaluations of the impact on critical thinking and communication abilities. Continuous data-driven evaluation and adjustments based on the collected insights will help ensure the sustained effectiveness of the intervention and guide future improvements in teaching and learning practices.

LIMITATION & FURTHER RESEARCH

This study aimed to assess the effectiveness of writing-based activities in improving the science performance of Grade 11 HUMSS students at the Senior High School Department of Laguna State Polytechnic University - Los Baños Campus for the academic year 2022-2023. The study, conducted over three weeks and focusing on two science lessons, involved various writing-based tasks including learning logs, essay writing, lab reports, and research papers. However, the study was restricted to handwritten communication, excluding digital and other forms of written communication.

The research focused on macro-level writing because it plays a significant role in developing coherent arguments and logical reasoning in scientific communication. Nevertheless, the study did not explore other instructional strategies or assessment methods other than handwritten activities. Factors such as student motivation, prior knowledge, and individual learning styles were not considered, which might have influenced the effectiveness of the writing-based activities. Additionally, the findings may not be applicable to other institutions or to different student strands, which limits the generalizability of the results.

Future research should address the limitations identified in this study by exploring the impact of various forms of written communication, including digital and collaborative writing tools,

on scientific performance. Investigating how various instructional strategies and assessment methods impact students' learning outcomes can provide a more comprehensive understanding of effective educational practices. Moreover, further studies should consider factors such as student motivation, prior knowledge, and learning styles to gain deeper insight into how these elements affect the relationship between writing activities and academic performance. Extending the research to include diverse educational contexts and populations will help generalize the findings and contribute to broader curriculum development and instructional strategies in science education.

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