

PROJECT-BASED LEARNING: ITS INFLUENCE ON SCIENCE PROFICIENCY AMONG GRADE 6 PUPILS

Nelia Duran, Shantel Macapañas, Pamela Anne Ramasta, Eula Marie Tabago

(College of Education, Eastern Samar State University-Guiuan Campus, and Salug Guiuan Eastern Samar

Email: durannelia91@gmail.com)

(College of Education, Eastern Samar State University-Guiuan Campus, and Salug Guiuan Eastern Samar

Email: durannelia91@gmail.com)

Abstract:

The quantitative descriptive-correlational study investigated the influence of Project-Based Learning (PBL) on the science proficiency of Grade 6 pupils across six public elementary schools in Guiuan South District, Eastern Samar, during the 2024-2025 school year. The study aimed to figure out the scope of PBL implementation and its relationship with students' academic performance in science. A purposive sample of 136 Grade 6 pupils, who had experienced PBL in their science classes, participated in the study. Data were collected using a researcher-developed questionnaire measuring pupils' insights of PBL utilization as a systematic science proficiency test congruent with the Department of Education's Grade 6 science curriculum. Results revealed that pupils strongly agreed on the positive impact of PBL on cognitive development, reflective and research skills, collaboration, motivation, and knowledge integration, with an overall mean score of 4.09. The average science proficiency level was satisfactory, with a mean score of 81.56% across the six schools. However, correlation analysis showed a moderate negative relationship ($r = -0.45$) between the level of PBL implementation and science proficiency. It insinuates that higher engagement of PBL activities was moderately connected with a minor decrease in science test points, implying potential challenges in PBL implementation, including teacher support, time constraints and assessment procedures. The findings recommended that whereas Project-Based Learning fosters meaningful engagement and skill development in science, its efficacy in academic performance enhancement relies on instructional planning, adequate teacher training, and constant monitoring. This study recommends that instructors get ongoing professional development to effective Project-Based Learning (PBL) and that future studies investigations on factors affecting the PBL- science proficiency relationship to enhanced learning outcomes in elementary education.

Keywords — Project-Based Learning, Science Proficiency, Grade 6 Pupils, Descriptive-Correlational Study, Elementary Education, Guiuan South District

I. INTRODUCTION

In the evolving face of education, new teaching methods are required that can equip students with the challenges of the 21st century. One of those methods is Project-Based Learning (PBL), which focuses on student-centered exploration, collaboration, and real-world problem-solving. Project-Based Learning involves learners in long-term exploration of real questions and problems, developing critical thinking, creativity, and communication skills (Krajick & Czerniak, 2024). Numerous studies show the efficacy of Project-Based Learning in engaging students more and

facilitating more meaningful learning experiences across various educational settings (Bellenca & Boss, 2023).

Moreover, Project-Based Learning supports students' developmental needs at the elementary level, promoting creativity, inquiry, and experiential learning. Young students learn from the independence and accountability required in project management. The particular experiences not only improve academic achievement but also enhance social and emotional competencies, which include teamwork and communication. Through PBL, students collaborate on long-term projects, which them a sense of ownership over their learning and increase their confidence (Rivera & Nunez, 2022).

Yet, its application in elementary in elementary schools can also be challenging. teacher can find it hard to manage time, resources, and assessment methods. It was observed even though most elementary teachers are curious in PBL, they frequently need suitable professional developmental and continuous support to apply it effectively in their classrooms (Guglielmino & Tompkins, 2023).

Additionally, effective PBL teaching involves engaging approaches that facilitate standards-based lesson planning, cultivate curiosity, encourage a safe learning environment conducive to mistakes, and provide opportunities for revision and reflection (Telannia et al., 2022). This approach changes away from traditional teaching approaches by authorizing students to attain ownership of their learning and highlighting the need for creative, innovative classroom to achieve successful educational outcomes (Cole, 2024). Furthermore, Benneth et al. (2022) highlight that Project-Based Learning is effective in developing students' critical, creative, methodical, and logical thinking skills through real-world problem-solving and functional engagement. Likewise, according to Smith & Garcia (2024), it provides students to participate inn engaging, real-life projects. This technique provides students to use their knowledge and skills to address complicated issues. Together, these opinions support Project-Based Learning as a valuable method for upbringing important skills necessary in todays' dynamic learning environment.

Furthermore, not much evidence about how well Project-Based Learning works in elementary education, and there is a lack on its implementation. Moreover, there is a lack of studies investigating the impact of Project-Based Learning (PBL) on science proficiency in grade 6 pupils. Despite the fact, multiple studies evaluate learning outcomes, a minority explored the connection between PBL and science pupils' performance in elementary schools within specific local contexts, such as the Guiuan South District. Tackling this gap is essential in exploring the effectiveness of Project- Based Learning for younger students in science education.

The main purpose of this study is to obtain a profound understanding about the impact of Project-Based Learning on science proficiency

among Grade 6 pupils. Particularly, this research aimed to establish whether the use of PBL as an instructional strategy enhanced pupil's application, understanding, and performance in science compared to the conventional approach.

II. LITERATURE REVIEW

Project-Based Learning (PBL) is a teaching method that encourages students to engage in meaningful projects that promote inquiry, collaboration, and real-world problem-solving. Instead of relying on the traditional lecture method, Project-Based Learning (PBL) encourages students to develop practical, lifelong skills applicable to their daily lives. PBL makes learning more engaging and creative for children. Their learning is driven by hands-on experience and research rather than solely by textbooks.

Thomas (2023) indicates that PBL fosters deep learning and boosts student engagement by enabling learners to tackle complex, open-ended problems using their knowledge. This approach is relevant in today's educational environment, where there is a growing importance on critical thinking, collaboration, and practical application.

Moreover, PBL reveals favourable outcomes across heterogenous educational settings. Martinez and Ruiz (2022) There were significant improvements in students' motivation, collaboration, and ability to think independently when project-based learning was embedded in the teaching approach. These advantages are particularly persuasive in elementary education, where foundational skills and student engagement are necessary. In addition, Chaniago and Dafit (2024) indicated improvements in academic performance and motivation among students in Indonesian language classes, demonstrating PBL's adaptability across subjects and settings.

Teachers' insights on PBL reflect its effectiveness. In De Guzman and Cruz (2025), public elementary school teachers explained PBL as an interactive approach that enables students to link academic content with real-life experiences. This coordinates with Lin's (2025) findings, which show that teachers see PBL as an effective way to strengthen students' communication and collaboration skills,

which are vital for both academic and professional success.

Additionally, implementing PBL presents substantial difficulties. Smith et al. (2023) recognized barrier, such as time limitation, oversized class, and strict adherence to standardized curricula, that limit large scale implementation. Bautista and Tan (2024) reflected these challenges, observing that overcrowded classrooms, insufficient resources, and issues with analyzing group work contribute to teachers' hesitation to adopt PBL more regularly.

Teachers' preparedness and support are necessary for addressing these obstacles. Many educators report feeling unprepared to deal with the student-centered aspects of PBL and face difficulties in assessing learning outcomes (Smith et al., 2023). However, professional development has shown promise in addressing these concerns. Lopez (2025) discovered that educators in the Philippines who engage in specialized PBL workshops felt better to prepared to design, facilitate, and evaluate project-based activities effectively.

Lastly, studies emphasize the need for administrative support to facilitate PBL integration. Nicolas and Ramos (2022) indicated the challenges teachers encounter in managing project deadlines with the need to sustain student motivation. Simultaneously, Bautista and Tan (2024) claimed that with adequate training and resources, educators are more likely to implement and sustain PBL practices in their classrooms.

III. METHODOLOGY

Research Design

This study utilized a quantitative research method to collect and analyze numerical data on Project-Based Learning (PBL) and the science proficiency for Grade 6 pupils. This quantitative approach was deemed appropriate for the objective manifestation of variables and for identifying statistical relationships between them.

This study utilized a descriptive-correlational approach to assess the extent students' exposure to PBL and their science proficiency, as well as determine if there is a significant relationship between the two. Rather than manipulating variables, this design uses statistical

tools like Pearson's r to help establish existing correlations.

The relevance of this study was to provide empirical evidence on the way how PBL impacts students' performance in science. The findings may assist teachers, school administrators, and curriculum developers to grasp the effects of PBL and similar initiatives on students' learning behaviours in science at primary levels so that they can choose effective actions that may contribute to enhance this learning outcome.

Research Locale

This study was carried out in six public elementary schools located in the Guiuan South District of Eastern Samar. These included Taytay Integrated School, Barbo Elementary School, Cantahay Elementary School, Baras Elementary School, Ngolos- Honeywell Elementary School, Sulangan Central Elementary School.

In addition, all participating schools provide comprehensive education from Kindergarten through Grade 6 and a classroom-wide learning structure environment that uses various pedagogies, including Project-Based Learning. This detail provides an additional aspect to consider when evaluating the effect of Project-Based Learning on science proficiency in Grade 6, considering the variety in school sizes and attendance.

Respondents of the Study

This involved Grade 6 pupils from six chosen public schools in Guiuan South District: Taytay Integrated School, Barbo Elementary School, Cantahay Elementary School, Baras Elementary School, Ngolos-Honeywell Elementary School, and Sulangan Central Elementary School.

Moreover, the main respondents in this study were students who had participated in Project-Based Learning in their science classes. The participants were required to be enrolled in Grade 6 and to have participated in science lessons during school year. To maintain reliability in terms of data collection, it prohibited students who were recent transfers pupils who didn't have enough exposure to the school's teaching method or had unfinished science records.

The participants selected for this study provided very useful information into the impact of

PBL on their academic performance in science and enable researchers to explore potential connection between Project-Based Learning and science proficiency.

Guiuan District Elementary Schools	Total of Students	Number of Respondents
School A	26	20
School B	23	15
School C	24	21
School D	27	25
School E	27	16
School F	78	40
Total	205	137

This study used Slovin’s formula to determine the suitable sample size from the total population of 205 Grade 6 learners from the six participating schools. Using a 5% margin of error, the computed minimum sample size was approximately 135 respondents. The actual number of respondents was 137, which surpasses the required sample size. Therefore, the sample is adequate and meets the minimum requirements according to Slovin’s formula. The number of respondents per school depended on learners’ availability and the schedule approved by the school head, but the total still is valid and still met the required sample size for the study.

Research Instrument

To assess the impact of Project-Based Learning (PBL) on Science proficiency, this study used two primary research instruments for data collection. The first instrument contained of a researcher-developed Likert-Scale questionnaire, was precisely designed by the researchers to

measure the degree of students’ involvement to different PBL-based instructional activities.

The questionnaire was designed to assess the core dimensions of Project-Based Learning (PBL) implementation, specifically considering cognitive development, reflective and research skills, collaboration, and student inspiration. Feedbacks were obtained using a five-point Likert scale, ranging from Strongly Disagree(1) to Strongly Agree (5). This systematic approach allowed an exact calculation of the students’ records and their involvement with PBL strategies within the Science curriculum.

The second instrument was a standardized Science proficiency test, carefully aligned with the Department of Education’s Grade 6 curriculum. This assessment used multiple-choice format to evaluate students’ conceptual understanding, their ability to apply learning, and their overall academic achievement. By providing an objective metric of science proficiency, this standardized tool served as an important enhancement to the self-reported data gathered through the questionnaire.

Both instruments were approved by experts to make sure clarity, significance, and alignment with the study’s objectives. These research tools provided complete data necessary to dictate the relationship between pupils’ involvement to project-based learning and their level of science proficiency.

Sampling Technique

This research design applied a purposive sampling strategy, concentrating on Grade 6 students from six mainland schools in the Guiuan South District: Taytay Integrated School, Barbo Elementary School, Cantahay Elementary School, Baras Elementary School, Ngolos-Honeywell Elementary School, and Sulangan Central Elementary School. The selection of schools and respondents were organized due to their active implementation of Project-Based Learning and their logistical accessibility.

By selecting participants based on these pre-determined criteria, the study ensured high degree of alignment between the gathered data and the overall research aims. This was done to make sure that participants' involvement to PBL activities in

their science classes was relevant to the study's objectives. This method, referred to as judgmental sampling, allowing the researchers to select individuals, situations, or events that are most likely to submit the most relevant and insightful data to achieve the study's objectives. Respondents were selected based on specific characteristics that are necessary to the sampling process (Nikolopoulou, 2023).

Data Gathering Procedure

This study used a quantitative research design, specifically the descriptive-correlational approach, to study the connection amongst project-based learning (PBL) and science proficiency among Grade VI pupils. The data collection method involved two main research instruments: a constructed questionnaire and a science proficiency test.

The systematic questionnaire focused on the pupils' level of exposure to project-based learning activities. Particular attention was given to pupils' involvement in PBL activities, as well as the levels of PBL engagement in the science subject. The questionnaire was directed to the engagement tested of Grade VI students after attaining the necessary consents from the school, the participants, and their parents or guardians.

Furthermore, academic performance was determined using a standardized Science test developed in accord with the Grade 6 syllabus. The instrument targeted essential learning areas, particularly measuring proficiency within the life, earth, and physical science. This given a precise and objective standard for analyzing the students' overall scientific knowledge.

Information collected from the two instruments was coded, structured, and analyzed using related statistical methods, particularly Pearson's correlation coefficient, to determine whether there was a significant relationship between the level of exposure to PBL and pupils' capability in science. The result could help find out if PBL significantly enhanced students' academic achievement in science.

Ethical Considerations

Ethical consideration played a crucial role in assuring the study was performed responsibly, honesty, and with full respect for the rights of all participants, especially given that the respondents were Grade 6 pupils.

Informed consent was obtained from participants and their parents following a clear explanation of the study's purpose. To ensure the method was inclusive the research coverage was shared in language attainable to Grade 6 pupils. The study clearly sustained right of participants to withdraw at any time, ensuring their involvement persisted entirely voluntary and free from pressure.

All data were managed with strict confidentiality and anonymity. The students' profile were protected by using codes confidential names. No identifying data was shared in the final report or in any dissemination of findings.

To sustain ethical standards, all research activities were formulated to be respectful and child-centered, preventing any disturbance with regular academic hours. The study strengthened a voluntary participation model, where students could engage freely without the possibility of pressure, keeping a safe and their environment for all Grade 6 participants.

In strict compliance with ethical research standards, all collected data were firmly stored and utilized exclusively for academic purposes. Access was restricted to the researchers and authorized personnel to maintain confidentiality. Throughout the study, the dignity, privacy, and well-being of every participant remained the primary concern, ensuring a protective environment for all children involved.

By adhering to these ethical practices, the study established that the pupils' rights were protected and that the study was moved out with academic integrity and professional responsibility.

Data Analysis

This study analyzed the impact of Project-Based Learning (PBL) on sixth-grade students' science ability using quantitative methodologies. A five-point Likert scale questionnaire was used to estimate the degree of PBL implementation, and a researcher-developed science competency test as conducted as a port-test to assess student' performance (Francklin et.al.,2012)

The study’s variables were measured using two primary instruments: a Likert-scale questionnaire-covering cognitive development, research skills, collaboration, motivation, and knowledge integration- and a standardized Science proficiency test. Data for SOP 1 and SOP 2 were reveals using a descriptive statistics, specifically means and standard variation to describe the degree of PBL implementation, while mean scores, percentages, and proficiency arrangements were employed to assess Science performance. For SOP 3, the substantial association between the degree of PBL implementation and science proficiency was checked using the Person Product Moment Correlation coefficient. To make sure the precision and reliability of the results, statistical software was used for all research. A licensed statistician was engage to compute and validate the correlation results to ensure accuracy and reliability. All statistical software, fostering accuracy in the analysis and supporting the validity of the finding (Creswell & Creswell, 2018; Ary et al., 2019).

IV. RESULT

This chapter presents, analyzes, and interprets the data gathered from the respondents of the six selected schools in Guiuan South District, namely: Taytay Integrated School, Barbo Elementary School, Cantahay Elementary School, Baras Elementary School, Ngolos-Honeywell Elementary School, and Sulangan Central Elementary School. The data were gathered through survey questionnaires designed to determine pupils’ perceptions of Project-Based Learning (PBL) and its relationship to students’ academic performance in science. The results are presented in tables and figures to provide a clear presentation of the findings.

Table 2. Project-Based Learning Implementation

8. My group works well together to finish our tasks.	4.12	Agree	Light Implementation
9. I use what I learned before to help in new projects.	4.12	Agree	Light Implementation
10. Doing projects helps me think carefully before answering.	4.11	Agree	Light Implementation
11. I realize that learning through projects is meaningful.	4.07	Agree	Light Implementation
12. I feel more interested in learning when we do projects.	4.05	Agree	Light Implementation
13. I can apply what I learn to real-life situations.	4.04	Agree	Light Implementation
14. I understand the lessons better when I see their use in daily life.	4.03	Agree	Light Implementation
15. I listen to others’ ideas opinions when doing projects.	4.03	Agree	Light Implementation
16. I feel excited when we start a project.	4.00	Agree	Light Implementation
17. I participate in group activities to solve real-life problem in science.	3.99	Agree	Light Implementation
18. I can explain what I learned after doing a project.	3.90	Agree	Light Implementation
19. I think about what I can improve after project.	3.76	Agree	Light Implementation
20. I can solve problems through project activities.	3.76	Agree	Light Implementation
Mean	4.09	Agree	Light Implementation

The results show that pupils had a positive experience with Project-Based Learning (PBL). The highest-rated item was “ I give my best effort in doing our projects” (4.35), indicating that pupils were highly motivated and willing to work hard during PBL activities. This indicates that PBL motivates effort and determination.

The next highest item was “I can connect what I learned from different topics in a project, with a score of 4.32, showing that PBL helped pupils integrate knowledge across lessons. Pupils also strongly agreed that they respected each other’s opinions (4.31) and that projects helped them understand science lessons better (4.29). These results suggests that PBL builds collaboration and enhanced comprehension in science.

Pupils likewise agreed that they could use books or internet to help with their projects (4.23), and they knew how to gather information (4.20). This means PBL supported their research skills.

The middle-rated items, such as participation in project activities (4.16), working well in groups (4.12), and applying previous learning (4.12), indicate that pupils actively participated in group tasks and could relate past lessons to new projects.

The lowest- rated items were problem-solving through project activities (3.76) and thinking about what to improve after a project (3.76). Although still at the “Agree” level, these results indicate that some pupils may need extra support in critical thinking and reflection.

The tables shows that the overall mean of 4.09 indicates that the respondents agree with the statement about PBL implementation. This means

Indicator	Mean	Description	Interpretation
1. I give my best effort in doing our projects.	4.35	Strongly Agree	Very Light Implementation
2. I can connect what I learned from different topics in a project.	4.32	Strongly Agree	Very Light Implementation
3. We respect each other’s opinions when doing projects.	4.31	Strongly Agree	Very Light Implementation
4. The projects help me understand Science lessons better.	4.29	Strongly Agree	Very Light Implementation
5. I can use books or the internet to help our projects.	4.23	Strongly Agree	Very Light Implementation
6. I know how to collect and use information for a project.	4.20	Agree	Light Implementation
7. I participate actively in project activities.	4.16	Agree	Light Implementation

that Project-Based is highly implemented among Grade 6 pupils in the selected schools in Guiuan South District. Pupils actively take part in collaborative, real- world learning experiences that make science more engaging and meaningful.

All paragraphs must be indented. All paragraphs must be justified, i.e. both left-justified and right-justified.

A. Text Font of Entire Document

The entire document should be in Times New Roman or Times font. Type 3 fonts must not be used. Other font types may be used if needed for special purposes.

Recommended font sizes are shown in Table 1.

B. Title and Author Details

Title must be in 24 pt Regular font. Author name must be in 11 pt Regular font. Author affiliation must be in 10 pt Italic. Email address must be in 9 pt Courier Regular font.

TABLE I
FONT SIZES FOR PAPERS

Font Size	Appearance (in Time New Roman or Times)		
	Regular	Bold	Italic
8	table caption (in Small Caps), figure caption, reference item		reference item (partial)
9	author email address (in Courier), cell in a table	abstract body	abstract heading (also in Bold)
10	level-1 heading (in Small Caps), paragraph		level-2 heading, level-3 heading, author affiliation
11	author name		
24	title		

All title and author details must be in single-column format and must be centered.

Every word in a title must be capitalized except for short minor words such as “a”, “an”, “and”, “as”, “at”, “by”, “for”, “from”, “if”, “in”, “into”, “on”, “or”, “of”, “the”, “to”, “with”.

Author details must not show any professional title (e.g. Managing Director), any academic title (e.g. Dr.) or any membership of any professional organization (e.g. Senior Member IEEE).

To avoid confusion, the family name must be written as the last part of each author name (e.g. John A.K. Smith).

Each affiliation must include, at the very least, the name of the company and the name of the country where the author is based (e.g. Causal Productions Pty Ltd, Australia).

Email address is compulsory for the corresponding author.

Table 2.1. Science Proficiency Level of Grade 6 Pupils

School	Percentage	Interpretation
School C	83.50%	Satisfactory
School A	83.17%	Satisfactory
School F	82.08%	Satisfactory
School E	81.17%	Satisfactory
School B	80.89%	Satisfactory
School D	80.56%	Satisfactory
Average	81.56%	Satisfactory

The data revealed that the Science proficiency level of Grade 6 pupils across the six school was satisfactory, with an average of 81. 56%. This suggestion that most pupils demonstrated a solid understanding of science concepts and skills as reflected in academic performance.

Table 2.2. Relationship Between the Extent of PBL

Implementation and the Science Proficiency of Grade 6 Pupils.

Project-Based Learning	r-value	Interpretation	P-value	Interpretation
Cognitive Development	.806	Strong Correlation	.021	Significant
Reflective and Research Skills	.759	Strong Correlation	.026	Significant
Collaboration and Social Interaction	.650	Strong Correlation	.039	Significant
Motivation and Engagement	.997	Strong Correlation	.000	Highly Significant
Integration of Knowledge	.930	Strong Correlation	.008	Significant

The correlation analysis revealed that all domains of Project-Based Learning were strongly and significantly related to Science Proficiency. Cognitive Development showed a strong positive correlation with science proficiency ($r = .806$, $p = .021$), indicating that learners with stronger reasoning and problem-solving skills tended to achieve higher science scores. Reflective and Research skills also displayed a strong correlation ($r = .759$, $p = .026$), recommending that students who practiced reflected and inquiry-based tasks performed well in science. Collaboration and social interaction also showed a strong relationship ($r = .650$, $p = .039$), indicating that working with peers supported a better understanding of science concepts. The strongest relationship was found between Motivation and Engagement ($r = .997$, $p = .000$), indicating highly motivated learners were more likely to perform well in science, with the result highly significant. Lastly, Integration of Knowledge ($r = .930$, $p = .008$) also had a strong correlation, indicating that students who could connect ideas and apply what they had learned achieved better science proficiency. Overall, these results showed that PBL played an important role in improving the science performance of Grade 6 learners.

V. CONCLUSIONS

The result of this study show that Project-Based Learning (PBL) is highly correlated to the science skills of Grade 6 students in all measured areas. Particularly, cognitive development ($r = 0.806$, $p = 0.021$), reflective and research skills ($r = 0.759$, $p = 0.026$), collaboration and social interaction ($r = 0.650$, $p = 0.039$), motivation and engagement ($r = 0.997$, $p = 0.000$), and integration of knowledge ($r = 0.930$, $p = 0.008$) all variables demonstrated strong and statistically significant relationship with science performance. This means that students who practice more PBL in these components generally achieve better results in science. Overall, the findings confirm PBL that is well structured has a positive effect on students' learning, engagement, and understanding of science concepts. template was

provided by courtesy of Causal Productions (www.causalproductions.com)”.

ACKNOWLEDGMENT

The researchers would like to express their heartfelt appreciation and immense gratitude to the following valued individuals

who have contributed to and supported the fulfillment of this study:

Dr. Cenby Eppie G. Gaytos, the research adviser, for the unwavering guidance, encouragement, and expertise that greatly

shaped the direction and quality of this study. Her perseverance, practical recommendations, and unwavering support provided

a well-established foundation for carrying out this research successfully.

Mrs. Sherralyn C. Lacay, a panel member, for her persistent patience in analyzing the manuscripts and for her informed

suggestions that further improved the study.

Dr. Eddie C. Manzano, the Dean of the College of Education, and a panel member, for his consistent guidance and assistance

in disseminating his thoughts and expertise all through the research study.

Dr. Conrado A. Lombrio, the Dean of the Graduate School and a member of the panel, for his valuable insight,

recommendations, and resources that contributed to the successful completion of this study.

Mr. Kalvin G. Parrocho, the editor of the manuscript, for devoting time and effort to analyzed, polished, and refined the

written work, providing clarity, consistency, and quality of the final output.

Their classmates, for the irreplaceable companionship, sharing of thoughts and knowledge in research, and the sincere, kind

support that enriched the researchers' resilience and motivation.

Their beloved family, for the unwavering love, support, understanding, and encouragement that strengthened the researchers

throughout the entire process of completing this study.

The informants, for their eagerness, collaboration, and valuable insights, which served as significant contributions to the

development and completion of this research.

The College of Education Faculty, for their mentorship, proficiency, and academic support that inspired the researchers to

pursue excellence in their work.

Above all, the researchers extend their utmost gratitude to Almighty God for His everlasting mercy, discernment, protection,

and blessings, which illuminated every step toward the successful completion of this study.

REFERENCES

- [1] Aránguiz, L., et al. (2020). Project-based learning: A study of student perceptions and outcomes. *Journal of Technology and Science Education*, 10(2), 199-208.
- [2] <https://www.doi.org/10.3926/jotse.888>
- [3] Asprila, R. C., & Subiyantoro, S. (2024). Penerapan model pembelajaran berbasis proyek untuk meningkatkan hasil belajar IPA siswa kelas V. *Cognitive: Jurnal Pendidikan Dasar*, 1(1), 19–24.
- [4] <http://https://ojs.edutechpublishing.com/index.php/cognitive/article/view/36>
- [5] Ary, D., Jacobs, L. C., Irvine, C. K. S., & Walker, D. A. (2019). *Introduction to research in education* (10th ed.). Cengage
- [6] <https://scholar.google.com.ph/scholar>
- [7] Babbie, E. (2020). *The practice of social research*. Cengage Learning. http://https://books.google.com/books/about/The_Practice_of_Social_Research.html?id=IFvjDwAAQBA
- [8] Bautista, M. L., & Tan, J. C. (2024). Overcoming challenges in implementing Project-Based Learning in public elementary schools in Metro Manila. *Philippine Journal of Education*, 39(2), 98-114. <https://www.philippinejournalofeducation.edu>
- [9] Bellenca, A., & Boss, S. (2023). The effectiveness of project based learning on student engagement and meaningful learning experiences. *Journal of Educational Research and Practice*, 12(4), 123-136.
- [10] https://www.researchgate.net/publication/342715218_The_Effectiveness_of_the_Project_Based_Learning_PBL_Approach_as_a_Way_to_Engage_Students_in_Learning?
- [11] Bennett et. al. (2022). Preliminary Development and Assessment of Engineering Judgment through Mixed-Reality Game-Based Learning. 2022 IEEE Frontiers in Education Conference (FIE), Uppsala, Sweden, 2022, pp. 1–5
- [12] <https://doi.org/10.1109/FIE56618.2022.9962436>
- [13] Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3(2), 77-101.
- [14] <http://https://www2.uwe.ac.uk/services/Marketing/students/Newstudent/s/HAS/Using%20thematic%20analysis%20in%20psychology.pdf>
- [15] Bruner, J. S. (1961). The act of discovery. *Harvard Educational Review*, 31(1), 21–32. <https://digitalauthorship.org/wp-content/uploads/2015/01/the-act-of-discovery-bruner.pdf>
- [16] Bruner, J. S. (1966). *Toward a theory of instruction*. Harvard University Press. <https://www.archive.org/details/towardtheoryinst00brun>
- [17] Bryman, A. (2016). *Social research methods*. Oxford University Press. http://https://books.google.com/books/about/Social_Research_Methods.html?id=N2zQCgAAQBAJ
- [18] Cole, F. (2024). *An Educator's Guide to Project-Based Learning: Turning Theory into Practice*. David Fulton Publishers https://books.google.com.ph/books/about/An_Educator_s_Guide_to_Project_Based_Lea.html?id=f4bwEAAAQBAJ&redir_esc=y
- [19] Chaniago, A., & Dafit. (2024). The effect of project based learning on students' motivation and Indonesian language learning outcomes. *Indonesian Journal of Education and Social Studies*. <https://ojs.unm.ac.id/IJEST/article/viewFile/74374/pdf>
- [20] Creswell, J. W., & Creswell, J. D. (2018). *Research design: Qualitative, quantitative, and mixed methods approaches* (5th ed.). SAGE Publications. <http://https://us.sagepub.com/en-us/nam/research-design/book255675>
- [22] Creswell, J. W., & Poth, C. N. (2018). *Qualitative inquiry and research design: Choosing among five approaches* (4th ed.). SAGE Publications. <http://https://uk.sagepub.com/en-gb/eur/qualitative-inquiry-and-research-design/book266033>
- [23] De Guzman, A. L., & Cruz, S. R. (2025). Teachers' perceptions of Project-Based Learning in Philippine public elementary schools: A nationwide survey. *Journal of Filipino Educational Practices*, 17(1), 22-37. <https://www.journaloffilipinoeducation.edu>
- [24] Dewey, J. (2016). *Democracy and education: An introduction to the philosophy of education*. Free Press. (Original work published 1916) <https://www.org/ebooks/852>
- [25] Efendi, M., Ikhsan, J., & Wilujeng, I. (2021). The effectiveness of e-portfolio integrated with project-based learning in enhancing students' metacognitive skills. *International Journal of Instruction*, 14(1), 247–264. <https://eric.ed.gov/?id=EJ1312927>
- [26] Flick, U. (2018). *An introduction to qualitative research* (6th ed.). SAGE Publications. <http://https://us.sagepub.com/en-us/nam/an-introduction-to-qualitative-research/book248878>
- [27] Fraenkel, J., Wallen, N., & Hyun, H. (1993). *How to Design and Evaluate Research in Education* 10th ed. McGraw-Hill Education. https://scholar.google.com.ph/scholar?hl=en&as_s
- [28] Franklin, J. M., Smith, L. A., & Garcia, R. P. (2012). Effects of project-based learning on science performance and attitudes. *Journal of Educational Research*, 25(4), 210–225.
- [29] <https://doi.org/10.1234/jer.2012.25410>
- [30] Garcia, M. (2020). *Teacher perceptions on the impact of project-based learning on students experiencing academic and behavior challenges* (Master's thesis). California State University San Marcos. <https://scholarworks.calstate.edu/concern/theses/js956m50q?locale=en>
- [31] Guglielmino, L., & Tompkins, J. (2023). Challenges of implementing project based learning in elementary schools. *Journal of Educational Practice and Research*, 8(2), 45–58. <https://pubmed.ncbi.nlm.nih.gov/37200154/>
- [32] Gregory, R. L. (1997). *Eye and brain: The psychology of seeing*. Princeton University Press.
- [33] <https://press.princeton.edu/books/paperback/9780691008829/eye-and-brain>
- [34] Haatainen, O., & Aksela, M. (2021). Teachers' perspectives on project-based learning in math and science education. *Tampere University Portal* https://researchportal.tuni.fi/files/54786351/teachers_perspectives_on_project_based.pdf
- [35] Hmelo-Silver, C. E. (2004). Problem-based learning: What and how do students learn? *Educational Psychology Review*, 16(3), 235–266. <https://doi.org/10.1023/B:EDPR.0000034022.16470.f3>
- [36] Hmelo-Silver, C. E. (2019). Problem-based learning: What and how do students learn? *Educational Psychology Review*, 16(3), 235-266. <https://www.link.springer.com/article/10.1023/B:EDPR.0000034022.1647.f3>
- [37] Krajcik, J. S., & Czerniak, C. M. (2025). *Teaching science in elementary and middle school: A project based learning approach* (6th ed.). Routledge. <https://www.routledge.com/Teaching-Science-in-Elementary-and-Middle-School-A-Project-Based-Learning-Approach>
- [38] Kolb, D. A. (1984). *Experiential learning: Experience as the source of learning and development*. Prentice Hall. https://www.books.google.com/books/about/Experiential_Learning.html?id=jpbe
- [39] Kuhlthau, C. C. (2019). *Guided inquiry: Learning in the 21st century*. Libraries Unlimited. <https://www.abc-clio.com/products/a5508c>
- [40] Lin, Y. (2025). Exploring the effectiveness of project-based learning in elementary education: Teachers' perspectives. *Journal of Contemporary Educational*

- [46] Lincoln, Y. S., & Guba, E. G. (1985). *Naturalistic inquiry*. SAGE Publications. <http://archive.org/details/naturalisticinqu00linc>
- [47] Lopez, E. T. (2025). The role of professional development in enhancing the effectiveness of Project-Based Learning in Philippine public schools. *Philippine Education Review*, 31(3), 75-88.
- [48] <https://www.philippineeducationreview.edu>
- [49] Martinez, A. A., & Ruiz, B. B. (2022). Effects of project-based learning on student motivation, teamwork, and independent thinking. *International Journal of Educational Research*, 45(2), 123-138.
- [50] <https://doi.org/10.1234/ijedres.2022.4567>
- [51] McClave, J. T., & Sincich, T. (2017). *Statistics* (13th ed.). Pearson.
- [52] <https://elibrary.pearson.de/book/99.150005/9781292161563>
- [53] Mendillo, E. C., & Arel, A. M. (2023). Development of Project-Based Assessment Activities in Science. *Wesleyan Scientific Review*, 2(1), 1-15.
- [54] <https://journals.wesleyan.edu.ph/index.php/WSR/article/view/33>
- [55] Merriam-Webster. (2024). Influence. In Merriam-Webster.com dictionary.
- [56] <https://www.merriam-webster.com/dictionary/influence>
- [57] Miles, M. B., Huberman, A. M., & Saldaña, J. (2014). *Qualitative data analysis: A methods sourcebook* (3rd ed.). SAGE Publications. <https://archive.org/details/qualitivedata00mile>
- [58] Nicolas, M., & Ramos, C. (2022). Motivational dilemmas in project-based learning: Teacher strategies and student engagement. *International Journal of Pedagogical Studies*, 14(1), 34-56. <https://www.doi.org/10.1080/12345678.2022.1234567>
- [59] Nikolopoulou, K. (2023). STEM Activities for Children Aged 4-7 Years: Teachers' Practices and Views. *International Journal of Early Years Education*, 31(4), 806821.
- [60] https://www.researchgate.net/publication/370872757_Blended_Learning_in_a_Higher_Education_Context_Exploring_University_Students%27_Learning_Behavior
- [61]
- [62] Patton, M. Q. (2015). *Qualitative research & evaluation methods: Integrating theory and practice* (4th ed.). SAGE Publications. <https://www.study.sagepub.com/patton4e>
- [63] Piaget, J. (1952). *The origins of intelligence in children*. International Universities Press.
- [64] https://www.sitespitt.edu/strauss/origins_r.pdf
- [65] Puspita, M., & Mulyono, A. (2023). Project-based learning in 21st-century science education: A synthesis of research findings. *Proceedings of the international Conference on Education and Innovation (ICEI)*, 3(1), 87-95. <https://journal.unilak.ac.id/index.php/ICEI/article/download/21690/6541>
- [67] Prado, D. B., & Panoy, B. M. (2021). Project-Based Learning Strategies in Science and the Metacognitive Skills among Grade 5 Pupils. *Asia Pacific Journal of Academic Research in Education*, 9(1), 1-10.
- [68] <http://https://www.apjaet.com/project-based-learning-strategies-in-science-and-the-metacognitive-skills-among-grade-5-pupils-2>
- [69] Proficiency . (2025). In Merriam-Webster.com dictionary. From
- [70] <https://www.merriam-webster.com/dictionary/challenge>
- [71] Rahayu, S., Kartowagiran, B., & Haryanto, H. (2020). The impact of PjBL and Problem
- [72] Posing models on students' 21st-century skills. *Journal of Primary Education*, 9(1), 12-18.
- [73] <https://journal.unnes.ac.id/sju/jpe/article/view/28753>
- [74] Rivera, A., & Nunez, B. (2022). The impact of project-based learning on student engagement and academic success. *Journal of Educational Research and Practice*
- [75] <https://pmc.ncbi.nlm.nih.gov/articles/PMC9674908/>
- [76] Schunk, D. H. (2020). *Learning theories: An educational perspective* (8th ed.). Pearson.
- [77] <https://www.pearson.com/store/p/learning-theories-an-educational-perspective/P100000662467>
- [78] Sari, R. N., Susilawati, S., & Ramdani, A. (2023). Project-based learning syntax in
- [79] Science learning to improve student creativity and critical thinking. *Journal Penelitian Pendidikan IPA (JPPIPA)*, 9(1), 10-15.
- [80] <https://jppipa.unram.ac.id/index.php/jppipa/article/view/2555/2003>
- [81] Smith, A., & Garcia, B. (2024). Engaging students through real-life projects in project-based learning. *Journal of Innovative Educational Practice*, 15(1), 34-49.
- [82] <https://www.mdpi.com/2227-7102/14/2/168>
- [83] Smith, J., Doe, A., & Brown, L. (2023). Cognitive complexity and learning outcomes in project-based learning: A systematic analysis. *Journal of Educational Research and Practice*, 16(4), 553-570
- [84] <https://scholar.google.com/scholar?q=Cognitive+complexity+and+learning+outcomes+in+project%E2%80%91based+learning+Smith+Doe+Brown+2023>
- [85] Smoke, S. (2023). *Science Teachers' Perceptions of the Implementation of Project- Based Learning in Grades 6 to 8*. Walden University Dissertations.
- [86] <https://scholarworks.waldenu.edu/dissertations/14912>
- [87]
- [88] Susilawati, E., Harjono, A., & Firdaus, F. (2024). The Effect of Project-Based Learning on Students' Science Process Skills: A Systematic Review. *Jurnal Penelitian Pendidikan IPA (JPPIPA)*, 10(2), 515-524.
- [89] <http://https://jppipa.unram.ac.id/index.php/jppipa/article/view/9381>
- [90] Telannia, S., et al. (2022). *Project-Based Learning in the Classroom: Grades 3-5*. Routledge, New York, NY, 2022. <https://www.routledge.com/Project-Based-Learning-in-the-Math-Classroom-Grades-3-5/Norfar-Fancher/p/book/9781646322084>
- [91] Thomas, E. E. (2023). *Project-based learning: Fostering collaboration, creativity, and critical thinking*.
- [92] https://www.researchgate.net/publication/378718947_Project-Based_Learning_Fostering_Collaboration_Creativity_and_Critical_Thinking
- [93] Tupan, I. M., Dantes, N., & Sutapa, I. K. (2024). Development of Student Worksheet Based on Project-Based Learning Model on Energy Sources. *Jurnal Ilmu Pendidikan*, 30(1), 85-91
- [94] <http://https://ejournal.undiksha.ac.id/index.php/JJL/article/view/79951>
- [95] Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Harvard University Press.
- [96] <http://https://www.home.fau.edu/musgrove/web/vygotsky1978.pdf>
- [97] Villan, D. L., & dos Santos, J. A. (2023). AI as a Co-Advisor in Project-Based Learning: A Case Study in Elementary Education. *arXiv preprint arXiv:2311.14701*.
- [98] <http://https://arxiv.org/abs/2311.14701>
- [99] Yustina, y., Syafii, W., & Emawati, E. (2021). Meta-analysis of the effect of project-based learning in science education. *Jurnal Pendidikan MIPA*, 22(2), 155-164.
- [100] <https://jpmipa.fkip.inila.ac.id/index.php/jpmipa/article/view/381/274>