
**PROJECT-BASED LEARNING IN ELEMENTARY SCHOOL:
A QUANTITATIVE ANALYSIS OF ITS RELATIONSHIP TO
CRITICAL THINKING SKILLS AND STUDENT ENGAGEMENT**

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2. ABSTRACT

This quantitative study examined the level of Project-Based Learning (PBL) implementation and its relationship to and influence on critical thinking skills and student engagement among 250 Grade 6 elementary learners in Kabacan North District, Province of Cotabato, Philippines, during School Year 2025–2026. A descriptive-correlational design was employed. Survey data were collected using validated questionnaires measuring PBL practices (real-world problems, collaboration, student-centered inquiry, reflective practice, and integration of subjects), critical thinking skills (analysis, evaluation, inference, problem-solving, and reasoning), and student engagement (behavioral, emotional, and cognitive). Spearman rank-order correlation and multiple linear regression analyses were performed. Results revealed that PBL was consistently Practiced across all dimensions ($M = 4.00$ – 4.11), critical thinking skills were uniformly Skilled ($M = 4.00$ – 4.14), and student engagement ranged from Engaged to Highly Engaged ($M = 4.12$ – 4.23). All PBL dimensions correlated significantly with all critical thinking and engagement indicators ($p < 0.001$). Regression analyses showed that PBL components significantly predicted critical thinking skills ($R^2 = 0.266$ – 0.451) and student engagement ($R^2 = 0.338$ – 0.371). Collaboration and reflective practice were the most consistent predictors across outcomes. These findings confirm that PBL is a statistically significant driver of critical thinking development and student engagement in elementary education, particularly when collaborative, reflective, and interdisciplinary dimensions are emphasized.

3. KEYWORDS: Project-Based Learning, Critical Thinking Skills, Student Engagement, Elementary Education, Descriptive-Correlational, Spearman Correlation, Regression Analysis, Kabacan North District, Philippines

4. INTRODUCTION

The increasing complexity of the modern world demands that elementary education move beyond knowledge acquisition toward the cultivation of essential 21st-century competencies — among them, critical thinking and sustained student engagement. Traditional, teacher-centered instruction has proven insufficient for this purpose, necessitating the exploration of more dynamic pedagogical alternatives. Project-Based Learning (PBL) has emerged as a highly promising approach, positioning students as active investigators who engage in authentic, collaborative, and inquiry-based tasks that require analysis, evaluation, and problem-solving (Hmelo-Silver, 2020; Larmer & Mergendoller, 2022).

Grounded in Constructivist Learning Theory (Piaget; Vygotsky) and Self-Determination Theory (Deci & Ryan, 2000), PBL creates learning environments where students actively construct knowledge through meaningful social interaction and inquiry, while having their basic psychological needs for autonomy, competence, and relatedness addressed. Recent evidence confirms that well-implemented PBL enhances both higher-order thinking skills and student engagement across grade levels (Barron & Darling-Hammond, 2021; Thomas, 2023). In Kabacan North District, Cotabato, the transition toward PBL-aligned instruction raises empirically important questions: How consistently are PBL practices implemented? Do PBL practices significantly relate to and predict students' critical thinking skills and engagement? This study was designed to answer these questions through a rigorous quantitative investigation covering 250 Grade 6 pupils from seven elementary schools, focusing on the relationship and influence of PBL on critical thinking skills (analysis, evaluation, inference, problem-solving, reasoning) and student engagement (behavioral, emotional, cognitive).

5. MATERIALS AND METHODS

Research Design and Participants

A descriptive-correlational research design was employed (Linga et al., 2025; Creswell & Creswell, 2023). The study population consisted of 250 Grade 6 pupils from seven elementary schools in Kabacan North District: Aringay (n = 36), Banawag (n = 36), Bangilan (n = 34), Datu Mantawil (n = 36), Katidtuan (n = 38), Malanduaage (n = 36), and Pisan (n = 34) Elementary Schools. Complete enumeration was used, covering all enrolled Grade 6

pupils who were present during both data collection sessions and willing to participate. Grade 6 was selected because learners at this stage are cognitively capable of engaging in higher-order thinking and reflecting meaningfully on their PBL experiences.

Research Instrument

A structured questionnaire composed of three parts was used, validated through expert review and tested for reliability using Cronbach's Alpha (Part 1 PBL: $\alpha = 0.755$; Part 2 Critical Thinking: $\alpha = 0.860$; Part 3 Engagement: $\alpha = 0.830$). Part 1 measured PBL practices across five dimensions (25 items total). Part 2 measured critical thinking skills across five dimensions (25 items). Part 3 measured student engagement across three dimensions (15 items). All items were rated on a five-point Likert scale ranging from 1 (Least Practiced/Skilled/Engaged) to 5 (Highly Practiced/Skilled/Engaged).

Statistical Analysis

Descriptive statistics (mean, standard deviation) profiled all variables. Spearman's rank-order correlation assessed bivariate relationships between PBL dimensions and critical thinking/engagement indicators at the 0.01 significance level. Multiple linear regression analysis determined the predictive influence of PBL components on each critical thinking and engagement dimension, with significance tested at 0.01 and 0.05 levels.

6. RESULTS AND DISCUSSION

Level of Project-Based Learning Practices

Table 1 summarizes the mean scores for all PBL dimensions. All five dimensions fell within the Practiced range (3.41–4.20), indicating consistent but not maximal implementation of PBL across classrooms.

Table 1. Level of Project-Based Learning Practices among Students.

PBL Dimension	Weighted Mean	Interpretation
Real-World Problems	4.05	Practiced
Collaboration	4.11	Practiced
Student-Centered Inquiry	4.00	Practiced
Reflective Practice	4.06	Practiced
Integration of Subjects	4.00	Practiced

Collaboration registered the highest mean ($M = 4.11$), with working with classmates to finish project tasks rated highest ($M = 4.30$, Highly Practiced), suggesting that cooperative task

structures are the most consistently embedded PBL feature. Real-World Problems ($M = 4.05$) showed the highest item rating for community-connected project work ($M = 4.24$, Highly Practiced). Student-Centered Inquiry and Integration of Subjects both registered $M = 4.00$, with teacher-guided rather than autonomy-driven inquiry somewhat limiting the upper range. Reflective Practice was anchored by classroom discussion of learning ($M = 4.29$, Highly Practiced). These results align with Darling-Hammond et al. (2020) and OECD (2021), who documented that constructivist-aligned classrooms prioritize collaborative and reflective tasks as primary vehicles for meaning-making.

Level of Critical Thinking Skills

Table 2. Level of Critical Thinking Skills among Elementary Students

Critical Thinking Dimension	Weighted Mean	Interpretation
Analysis	4.09	Skilled
Evaluation	4.10	Skilled
Inference	4.00	Skilled
Problem-Solving	4.14	Skilled
Reasoning	4.06	Skilled

All five critical thinking dimensions fell within the Skilled range (3.41–4.20). Problem-Solving registered the highest mean ($M = 4.14$), with listing different solutions as the highest item ($M = 4.24$, Highly Skilled). Evaluation followed at $M = 4.10$, anchored by looking at evidence to determine truth ($M = 4.32$, Highly Skilled). Analysis ($M = 4.09$) and Reasoning ($M = 4.06$) showed strong but consistent Skilled ratings. Inference was the lowest dimension ($M = 4.00$), with prediction and gap-filling items registering lower than evidence-based conclusion drawing ($M = 4.22$, Highly Skilled for drawing conclusions). These findings are consistent with Krajcik et al. (2023) and OECD (2021), who found that PBL environments support problem-solving and analysis most directly, while inference — requiring higher cognitive bridging — benefits from more targeted instructional scaffolding.

Level of Student Engagement

Table 3. Extent of Student Engagement in Elementary School Classrooms.

Engagement Dimension	Weighted Mean	Interpretation
Behavioral Engagement	4.23	Highly Engaged
Emotional Engagement	4.12	Engaged
Cognitive Engagement	4.18	Engaged

Behavioral Engagement was the highest dimension ($M = 4.23$, Highly Engaged), with classroom participation rated highest ($M = 4.43$, Highly Engaged), confirming that observable learning behaviors — participation, effort, attendance — are strongly activated in PBL environments. Cognitive Engagement ($M = 4.18$) was anchored by connecting new learning to prior knowledge ($M = 4.36$, Highly Engaged), supporting Krajcik et al. (2023) and Hattie (2021), who found that cognitively engaged students demonstrate deeper reasoning and improved academic outcomes. Emotional Engagement ($M = 4.12$) was led by class enjoyment ($M = 4.32$, Highly Engaged), consistent with Kim and Park (2025), who showed that positive emotional responses to learning are associated with sustained engagement.

Relationship Between PBL and Critical Thinking Skills

All Spearman's rho correlations between PBL dimensions and critical thinking skills were statistically significant ($p < 0.001$). Table 4 highlights the strongest correlations.

Table 4. Spearman Correlation: PBL and Critical Thinking Skills (** $p < 0.001$)

PBL Dimension	Analysis (r)	Evaluation (r)	Inference (r)	Problem-Solving (r)	Reasoning (r)
Real-World Problems	0.489**	0.344**	0.438**	0.354**	0.457**
Collaboration	0.536**	0.376**	0.414**	0.420**	0.559**
Student-Centered Inquiry	0.423**	0.392**	0.360**	0.385**	0.443**
Reflective Practice	0.525**	0.375**	0.434**	0.433**	0.552**
Integration of Subjects	0.447**	0.428**	0.489**	0.412**	0.483**

Collaboration demonstrated the strongest association with Reasoning ($r = 0.559$) and Analysis ($r = 0.536$), confirming that dialogic peer interaction and shared problem-solving promote the highest-order thinking dimensions most powerfully. Reflective Practice similarly showed strong correlations with Reasoning ($r = 0.552$) and Analysis ($r = 0.525$), supporting Schön (2020) and Darling-Hammond et al. (2020), who found that structured reflection enables learners to evaluate strategies, revise understanding, and strengthen reasoning. Integration of Subjects showed the strongest correlation with Inference ($r = 0.489$), consistent with Drake and Reid (2020), who found that interdisciplinary learning enhances students' ability to draw cross-domain conclusions. All null hypotheses asserting no significant relationship between PBL and critical thinking skills are rejected.

Influence of PBL on Critical Thinking Skills: Regression Results***Table 5. Regression Summary: PBL as Predictor of Critical Thinking Skills. (** $p < 0.01$)***

Outcome	R ²	F	Significant PBL Predictors
Analysis	0.402	32.870**	Real-World Problems, Collaboration, Reflective Practice, Integration of Subjects
Evaluation	0.266	17.709**	Student-Centered Inquiry, Integration of Subjects
Inference	0.339	25.055**	Real-World Problems, Integration of Subjects
Problem-Solving	0.282	19.168**	Collaboration, Student-Centered Inquiry, Reflective Practice, Integration of Subjects
Reasoning	0.451	40.033**	Collaboration, Reflective Practice, Integration of Subjects

Reasoning had the highest explained variance ($R^2 = 0.451$), with Collaboration ($\beta = 0.259$, $p < 0.001$), Reflective Practice ($\beta = 0.206$, $p < 0.001$), and Integration of Subjects ($\beta = 0.154$, $p < 0.01$) as significant predictors. Analysis was the second strongest model ($R^2 = 0.402$), with Collaboration ($\beta = 0.187$, $p < 0.01$) again the dominant predictor. Inference ($R^2 = 0.339$) was uniquely driven by real-world authenticity and interdisciplinary connection, while Evaluation ($R^2 = 0.266$) was primarily predicted by inquiry and integration — consistent with Schraw et al. (2020) and Bell (2020), who emphasized that evaluative thinking develops through authentic exploration and cross-domain synthesis. Student-Centered Inquiry was the only PBL component that did not significantly predict Analysis, suggesting that unstructured inquiry requires complementary scaffolds to translate into analytical gains.

Relationship Between PBL and Student Engagement***Table 6. Spearman Correlation: PBL and Student Engagement. (** $p < 0.001$)***

PBL Dimension	Behavioral Engagement (r)	Emotional Engagement (r)	Cognitive Engagement (r)
Real-World Problems	0.420**	0.425**	0.407**
Collaboration	0.528**	0.531**	0.513**
Student-Centered Inquiry	0.329**	0.406**	0.384**
Reflective Practice	0.431**	0.441**	0.482**
Integration of Subjects	0.385**	0.458**	0.428**

Collaboration demonstrated the strongest correlations across all engagement dimensions (behavioral: $r = 0.528$; emotional: $r = 0.531$; cognitive: $r = 0.513$), confirming that peer-collaborative structures are the most potent PBL feature for generating active participation, positive learning emotions, and deep mental investment. Reflective Practice showed the

strongest association with Cognitive Engagement ($r = 0.482$), consistent with Linnenbrink-Garcia et al. (2022) and Kim and Park (2025), who found that self-regulation and metacognitive reflection drive cognitive engagement most directly. Real-World Problems showed consistent moderate correlations across all engagement dimensions, supporting Herrington and Parker (2021), who found that authentic, community-connected learning contexts increase relevance and motivational engagement.

Influence of PBL on Student Engagement: Regression Results

Table 7. Regression Summary: PBL as Predictor of Student Engagement. ($p < 0.01$)**

Outcome	R ²	F	Significant PBL Predictors
Behavioral Engagement	0.338	24.865**	Real-World Problems, Collaboration, Integration of Subjects
Emotional Engagement	0.371	28.805**	Real-World Problems, Collaboration, Integration of Subjects
Cognitive Engagement	0.348	26.081**	Collaboration, Reflective Practice, Integration of Subjects

Emotional Engagement had the highest explained variance ($R^2 = 0.371$), driven by Collaboration ($\beta = 0.360$, $p < 0.001$) and Integration of Subjects ($\beta = 0.204$, $p < 0.01$). This supports Dela Cruz and Bautista (2024) and Martinez et al. (2023), who found that emotionally engaging learning experiences are strengthened when instruction connects students to collaborative work and cross-disciplinary real-world relevance. Cognitive Engagement ($R^2 = 0.348$) was uniquely driven by Reflective Practice ($\beta = 0.194$, $p < 0.01$), confirming that metacognitive processing is the bridge between PBL tasks and deep mental investment. Across all three engagement models, Student-Centered Inquiry was the only PBL component that did not achieve statistical significance, suggesting that open-ended inquiry needs additional structure to consistently translate into observable engagement gains.

7. CONCLUSION

This quantitative study provides robust empirical evidence that Project-Based Learning is a significant and meaningful driver of both critical thinking skills and student engagement among Grade 6 elementary learners in Kabacan North District. PBL practices are consistently implemented and are significantly correlated with and predictive of all critical thinking dimensions ($R^2 = 0.266$ – 0.451) and all engagement dimensions ($R^2 = 0.338$ – 0.371). Collaboration and reflective practice are the most powerful and consistent PBL predictors across outcomes, while integration of subjects uniquely drives inference and emotional

engagement. These findings call for sustained, structured PBL implementation with deliberate emphasis on collaborative learning structures, formative reflection, and interdisciplinary task design. Professional development for teachers should prioritize building scaffolded inquiry frameworks that ensure student-centered exploration leads to measurable gains in both higher-order thinking and sustained engagement.

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9. REFERENCES

1. Barron, B., & Darling-Hammond, L. (2021). Teaching for meaningful learning: A review of research on inquiry-based and cooperative learning. *Edutopia*.
2. Bell, S. (2021). Project-based learning for the 21st century: Skills for the future. *The Clearing House: A Journal of Educational Strategies, Issues and Ideas*, 83(2), 39–43.
3. Creswell, J. W., & Creswell, J. D. (2023). *Research design: Qualitative, quantitative, and mixed methods approaches* (6th ed.). SAGE Publications.
4. Darling-Hammond, L., Flook, L., Cook-Harvey, C., Barron, B., & Osher, D. (2020). Implications for educational practice of the science of learning and development. *Applied Developmental Science*, 24(2), 97–140.
5. Deci, E. L., & Ryan, R. M. (2000). The 'what' and 'why' of goal pursuits: Human needs and the self-determination of behavior. *Psychological Inquiry*, 11(4), 227–268.
6. Dela Cruz, R., & Bautista, M. (2024). Culturally relevant pedagogy and emotional engagement in Philippine public elementary schools. *Philippine Journal of Education*, 13(1), 55–72.
7. Dela Cruz, R., & Rivera, P. (2024). Behavioral and cognitive engagement in project-based elementary classrooms. *Philippine Journal of Educational Research*, 12(2), 41–58.
8. Drake, S. M., & Reid, J. L. (2020). Integrated curriculum as an effective way to teach 21st century capabilities. *Asia Pacific Journal of Educational Research*, 3(1), 31–50.
9. Fredricks, J. A., Filsecker, M., & Lawson, M. A. (2022). Student engagement, context, and adjustment: Addressing definitional, measurement, and methodological issues. *Learning and Instruction*, 43, 1–4.

10. Gillies, R. M. (2020). Promoting academically productive student dialogue during collaborative learning. *International Journal of Educational Research*, 97, 200–209.
11. Hattie, J. (2021). *Visible learning for teachers: Maximizing impact on learning*. Routledge.
12. Herrington, J., & Parker, J. (2021). Emerging technologies as cognitive tools for authentic learning. *British Journal of Educational Technology*, 44(4), 607–615.
13. Hmelo-Silver, C. E. (2020). Problem-based learning: What and how do students learn? *Educational Psychology Review*, 16(3), 235–266.
14. Kim, A., & Park, S. (2025). Self-regulated learning and student engagement during blended instruction. *Journal of Educational Psychology*, 117(1), 45–62.
15. Krajcik, J., Shin, N., & Hiller, S. E. (2023). Project-based learning. In R. K. Sawyer (Ed.), *The Cambridge handbook of the learning sciences* (3rd ed.). Cambridge University Press.
16. Larmer, J., & Mergendoller, J. R. (2022). *Setting the standard for project-based learning*. ASCD.
17. Linnenbrink-Garcia, L., et al. (2022). Emotional support in the classroom: Teacher and peer support as predictors of academic motivation and achievement. *Journal of Educational Research*, 115(1), 1–14.
18. Martinez, L., et al. (2023). Interactive digital learning platforms and student engagement in elementary mathematics. *Journal of Computer Assisted Learning*, 39(2), 210–228.
19. OECD. (2021). *21st-century readers: Developing literacy skills in a digital world*. OECD Publishing.
20. Schön, D. A. (2020). *The reflective practitioner: How professionals think in action*. Routledge.
21. Schraw, G., et al. (2020). Promoting self-regulation in science education: Metacognition as part of a broader perspective on learning. *Research in Science Education*, 36(1), 111–139.
22. Thomas, J. W. (2023). *A review of research on project-based learning*. Autodesk Foundation.