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PROJECT-BASED LEARNING AND SCHOOL FACILITIES AS PREDICTORS OF IPAS LEARNING OUTCOMES IN INDONESIAN ELEMENTARY SCHOOLS KALIREJO II

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Abstract

This research aims to determine of Project Based Learning (PjBL) model implementation and school facilities on science learning outcomes of Phase B and C students at SDN Kalirejo II Dringu. The low science learning outcomes were caused by conventional learning approaches and limited school facilities that had not been optimally utilized.The research employed a quantitative approach with an explanatory model. The research population consisted of all Phase B students (grades III and IV) and Phase C students (grades V and VI), totaling 65 students, using saturated sampling technique. Data collection was conducted through questionnaires, observations, interviews, and documentation. Data analysis used multiple linear regression tests with SPSS 27, including normality tests, linearity tests, F-test (simultaneous), and t-test (partial).The research findings indicate: (1) There is a positive and significant influence of PjBL model implementation on science learning outcomes with a coefficient of determination $R^2 = 0.917$ (91.7%) and $F(1,63) = 692.86$, $p < 0.001$; (2) There is a positive and significant influence of school facilities on science learning outcomes with $R^2 = 0.785$ (78.5%) and $F(1,63) = 229.92$, $p < 0.001$; (3) Simultaneously, the implementation of PjBL model and school facilities have a highly significant influence on science learning outcomes with $R^2 = 0.920$ (92%) and $F(2,62) = 355.99$, $p < 0.001$.The conclusion of this research confirms that improvement in science learning outcomes can be achieved through a combination of project-based learning model implementation supported by adequate school facilities. The research recommends that teachers consistently implement PjBL, schools improve the quality of learning facilities, and conduct regular monitoring to ensure the effectiveness of project-based learning.

Keywords: Project-Based Learning, School Facilities, IPAS Learning Outcomes, Elementary Education, Merdeka Curriculum, Quantitative Research, Indonesia

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INTRODUCTION | مقدمة

Learning IPAS (Science and Social Studies) in the Kurikulum Merdeka demands a transition from mere subject mastery toward the development of integrative scientific literacy and social awareness (Kemendikbudristek, 2022). Ghufron (2024) asserts that optimal IPAS achievement requires a balance between cognitive and psychomotor domains. However, at SDN Kalirejo II, a discrepancy was found between curriculum ideals and field reality: 50% of Phase B and C students have not reached the minimum mastery criteria (KKM 70) due to the dominance of lecture-based methods (rote learning) and suboptimal utilization of facilities.

While the effectiveness of Project-Based Learning (PjBL) in improving learning outcomes has been widely discussed, a significant research gap remains. Most previous studies tend to position PjBL as a single variable operating in an instructional vacuum. Conversely, Hutapea et al. (2025) emphasize that the success of investigative models heavily depends on the supporting ecosystem, particularly school facilities. The novelty of this research lies in the integrative analysis testing the synergy between pedagogical strategies (PjBL) and infrastructure availability simultaneously within a primary school context. This study examines not only "what" improves learning outcomes, but "how" the strength of the PjBL method can be maximized through the supporting capacity of school facilities during developmental phases B and C.

The objective of this study is to analyze the partial and simultaneous influence of PjBL and school facilities on IPAS learning outcomes. These findings are expected to provide an empirical basis for educators and policymakers at SDN Kalirejo II to optimize the sustainable implementation of Kurikulum Merdeka through the collaboration of pedagogical aspects and the management of facilities and infrastructure.

METHOD | منهج

This study employs a quantitative approach with an explanatory model to examine the influence of Project-Based Learning (PjBL) implementation (X1) and school facilities (X2) on Science and Social Studies (IPAS) learning outcomes (Y) among Phase B and C students at SDN Kalirejo II. To ensure replicability, PjBL was implemented systematically over six sessions (12 lesson hours) per cycle, adhering to the Kemdikbudristek (Ministry of Education) syntax. The stages commenced with essential questions regarding real-world phenomena, collaborative project planning and scheduling, followed by monitoring, product presentation, and a holistic evaluation of the learning experience.

Data reliability was ensured through instrument testing conducted prior to primary data collection on a pilot group of 20 students outside the main sample. Construct validity was tested using Confirmatory Factor Analysis (CFA) or corrected item-total correlation, while reliability was measured using Cronbach’s Alpha coefficients. The results indicated that all instruments were reliable, exceeding the 0.70 threshold:PjBL Questionnaire: 0.82 School Facilities: 0.79 IPAS Learning Outcomes: 0.84.

The study utilized saturation sampling (total sampling) with a total of 65 respondents to obtain a comprehensive representation of the population.

Ethical aspects were strictly maintained through institutional clearance and informed consent from parents or guardians. Student participation was voluntary, with identity confidentiality guaranteed through respondent coding (R1, R2, etc.) to protect privacy. The researcher also ensured that the data collection process did not disrupt academic activities or the psychological well-being of the students.

Data analysis was performed using multiple linear regression with IBM SPSS version 27. In addition to statistical significance via t-tests and F-tests, this study reported effect size using Cohen’s $f2$ to measure the practical impact of the independent variables.Based on the analysis, the $f2$ value was found to be 5.76, which significantly exceeds the criteria for a large effect ($f2 \geq 0.35$). This indicates that the combination of PjBL implementation and supportive school facilities contributes very significantly and tangibly to the improvement of students' IPAS learning outcomes.

RESULT | نتائج

This study examines the influence of two independent variables on the science learning outcomes (IPAS) of students in grades III–VI at SDN Kalirejo II. The independent variables include Project-Based Learning (X1) and School Facilities (X2), while the dependent variable is Science Learning Outcomes (Y). Data were collected from 65 respondents using a Likert-scale questionnaire (1–5) and analyzed using SPSS 27.

All three variables were measured simultaneously from the same respondents, with all data declared valid (missing = 0). The score distribution of the three variables shows a near-normal pattern, with most scores ranging between 40–42 and a peak at 41.

The following is a summary of descriptive statistics for the three research variables. The mean, median, and mode of all variables are very close, indicating a relatively symmetrical and homogeneous distribution. The low standard deviation (1.8–2.1) shows consistency among respondents' scores.

Tabel 1. Statistik Deskriptif Variabel X1, X2, dan Y

Statistic	X1 (PjBL)	X2 (Facility)	Y (Learning Outcomes)
N (Valid)	65	65	65
Mean	40.20	40.03	39.85
Median	41.00	41.00	40.00
Mode	41	41	41
Std. Deviation	1.864	2.084	1.856
Minimum	36	35	36
Maximum	43	44	43
Sum	2613	2602	2590

Note: X1 = Project-Based Learning; X2 = School Facilities; Y = Science Learning Outcomes. Scores are raw scores from a Likert scale (1–5), not standardized.

Frequency distribution analysis shows that most respondents fall within the high score range. For X1, more than 60% of respondents scored 40–42. For X2, the most frequent score is 41 (33.8% of respondents). For Y, 63.1% of students are within the 40–42 range, indicating moderate to high learning outcomes. This consistent pattern supports the conclusion that the data are approximately normally distributed. Normality was tested visually using a Normal P-P Plot and histogram with a normal curve. The results show that data points follow the diagonal line consistently, and the histogram forms a bell-shaped curve. This indicates that all variables are normally distributed and meet the assumptions for parametric statistical analysis, including linear regression.

Linearity was tested using ANOVA Test for Linearity to confirm that relationships between variables form a linear pattern.

Table 2. Linearity Test Results (X1–Y and X2–Y)

Connection	Componen	Sum of Squares	df	F	Sig.
X1 – Y	Linearity	202.086	1	759.728	0.000 ✓
	Deviation from Linearity	3.213	6	2.013	0.079 ✓
X2 – Y	Linearity	173.045	1	265.537	0.000 ✓
	Deviation from Linearity	11.574	8	2.220	0.040 ⚠️

Notes: SPSS 27, 2025

The X1–Y relationship is fully linear with no significant deviation. The X2–Y relationship is also significant but shows slight deviation from linearity. However, the linear component remains dominant, so regression analysis is still appropriate with careful interpretation.

Regression analysis was conducted in three stages: partial regression of X1 on Y, partial regression of X2 on Y, and simultaneous regression of X1 and X2 on Y.

Table 3. Summary of Linear Regression Results

Model	R	R^2	Adj. R^2	F	Sig.
Parsial: X1 → Y	.957	**.917**	.915	692.86	.000
Parsial: X2 → Y	.886	**.785**	.782	229.92	.000
Simultan: X1, X2 → Y	.959	**.920**	.917	355.99	.000

Notes: All models are statistically significant. SPSS 27 2025

The partial regression of X1 explains 91.7% of the variance in learning outcomes. The partial regression of X2 explains 78.5% of the variance. In the simultaneous model, X1 and X2 together explain 92.0% of the variance. Durbin-Watson values fall within the acceptable range (1.5–2.5), indicating no autocorrelation issues.This section addresses three main issues: high R^2 values, measurement scale, and the need for data visualization.

Table 4. Methodological Notes and Responses

Aspect	Explanation
High R^2 Value	R^2 = 0.920 0.920 is very high for social-educational research. Possible causes include: ((1) simultaneous measurement of variables; (2) homogeneous sample (low SD); (3) no strong multicollinearity detected, but VIF testing is recommended.
Measurement Scale	Scores are raw Likert-scale scores (1–5). The range (35–44) and mean (~40) indicate a tendency toward high responses. Scores have not been standardized (e.g., z-score or T-score).
Linearity Deviation (X2–Y)	A slight deviation exists (Sig. < 0.05), but the linear relationship remains dominant.
Additional Visualization	Recommended to include: (1) scatterplots (X1–Y, X2–Y); (2) residual plots (for homoscedasticity); (3) VIF testing (for multicollinearity)..

DISCUSSION | مناقشة

This study proves that the combination of Project-Based Learning (PjBL) and school facilities exerts a very strong simultaneous influence on science (IPAS) learning outcomes, with the coefficient of determination reaching 92%. This massive synergistic effect did not occur by chance but was driven by several pedagogical and psychological mechanisms:

- Cognitive Psychology (Levels of Processing Theory): PjBL encourages students to engage in active elaboration. The availability of adequate facilities (props, audiovisual media) acts as a physical scaffolding that helps internalize abstract concepts into concrete experiences, thereby reducing students' cognitive load.
- Motivational Psychology (Self-Determination Theory): PjBL inherently fulfills the basic psychological needs for autonomy, competence, and relatedness. Good facility support ensures that the fulfillment of students' competence is not hindered by equipment limitations, keeping intrinsic motivation intact to drive optimal learning outcomes.
- Social Constructivism (Vygotsky): Effective learning occurs within the Zone of Proximal Development (ZPD). PjBL provides a challenging yet manageable task structure, while school facilities expand the reach of the ZPD by providing resources to support exploration.
- Learning Ecology Theory: School facilities form a microsystem that interacts directly with students. The active strategy of PjBL maximizes student interaction with these microsystem elements, creating a mutually reinforcing learning ecosystem.

To maintain academic validity and data credibility, references that initially used contemporary years (such as 2024 and 2025 publications) need to be re-verified or replaced with classic and highly credible literature in the fields of educational technology and project-based learning.

To maintain academic transparency and the integrity of the study's findings, this research acknowledges several fundamental limitations:Sample and Generalization Limitations: This study was conducted exclusively at a single school (SDN Kalirejo II). The homogeneity of the social, cultural, and economic context means that the results cannot be automatically generalized to schools with significantly different characteristics.Potential Measurement Bias: Data regarding the availability and quality of school facilities (X2) was gathered purely based on the subjective perceptions of students rather than an objective physical inventory observation.Correlational Research Design: This study is only capable of identifying the direction of relationships and predictive power, but it cannot prove absolute cause-and-effect (causality) like an experimental method.Uncontrolled Variables: There is 8% of the variance in learning outcomes that is influenced by external factors not examined in this model, such as teachers' pedagogical competence, family economic background, and parental support.Subject Coverage: The focus of this research is limited to the IPAS (Science) subject at the elementary school level, which by its nature is highly responsive to exploration and project-based approaches.

CONCLUSSION | خاتمة

Based on the limitations identified in this study, the following forward-looking strategic recommendations are proposed for future scientific development and practitioners:

For Practitioners and Schools: It is recommended that schools do not merely focus on the passive procurement of physical facilities. This must be balanced with intensive training for teachers to effectively integrate these facilities into a structured project-based learning syntax.

Research Design Development (Causality): Future researchers are advised to shift from a correlational approach to a quasi-experimental or true experimental method. This is crucial to prove a pure cause-and-effect relationship (causality) between PjBL, facilities, and learning outcomes. Objectivity of Measurement Instruments: To minimize the bias of student subjectivity in assessing school facilities, future research is recommended to use standardized physical inventory observation sheets or evaluations from independent observers.

Exploration of Other Variables (The Unexplained 8%): Given that there is still 8% of variance in learning outcomes influenced by other factors, future research could expand the model. This can be done by including moderating or mediating variables such as teachers' digital competence, parental involvement, or students' self-efficacy. Sample Expansion and Generalization: To strengthen external validity, replication of this study needs to be carried out on a broader regional scale. This should include private schools or schools in areas with contrasting facility disparities.

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