Primary Education Journal (2025)

Primary Education Journal

Journal homepage: e-journal.unimudasorong.ac.id/index.php/primadona

The Effect of Project-Based Learning (PjBL)-Based Student Worksheets (LKPD) on Plant Parts Topic of Grade IV Students' IPAS Learning Outcomes

Cindy Claudya Salamor[1], Mustika Irianti[2], & Desti Rahayu[3]

[123] Department of Elementary School Teacher Education, Universitas Pendidikan Muhammadiyah Sorong, Southwest Papua Province, Indonesia
*Correspondence: destirahayu@unimudasorong.ac.id

ARTICLE INFO

Received: 22 March 2025
Revised: 11 April 2025
Accepted: 15 May 2025
Published Online: 21 June 2025

Keywords:
LKPD; project-based learning; plant parts; IPAS learning outcomes; elementary school

ABSTRACT

This study aims to investigate the effect of Project-Based Learning (PjBL)-based Student Worksheets (LKPD) on the topic of Plant Parts on the IPAS (Science and Social Studies) learning outcomes of Grade IV students at SD YPK Inamo, Sorong Regency. A pre-experimental design with a one-group pretest-posttest scheme was employed, involving 15 Grade IV students as research participants selected through saturated sampling. Data were collected using a multiple-choice IPAS test and a student activity observation sheet. Reliability testing using Cronbach's alpha yielded coefficients of 0.922 (pretest) and 0.935 (posttest), both exceeding the threshold of 0.60, confirming instrument reliability. The Shapiro-Wilk normality test confirmed that both pretest (sig. = 0.162 > 0.05) and posttest (sig. = 0.345 > 0.05) data were normally distributed. The pretest mean score was 54.67, with 53.33% of students meeting the Minimum Competency Standard (KKM), increasing to a posttest mean of 85.00 with 73.33% of students achieving the KKM. The paired-samples t-test yielded t_{x} = 2.958 > $t_{a}b_{a}$ = 1.761 (df = 14, sig. = 0.010 < 0.05), confirming that PjBL-based LKPD on Plant Parts has a statistically significant positive effect on Grade IV IPAS learning outcomes.

How to Cite: Salamor, C. C., Irianti, M., & Rahayu, D. (2026). The effect of project-based learning (PjBL)-based student worksheets (LKPD) on the plant parts topic of Grade IV students' IPAS learning outcomes. *Primary Education Journal, 1(3),* 46-61.

INTRODUCTION

Learning is understood as a process of providing guidance and assistance to students in carrying out the process of acquiring knowledge and competencies. As a consequence of the diverse ways in which learners process information, the teacher's role as a guide is especially consequential: some students readily assimilate subject matter, while others require additional time and scaffolding to construct understanding. These differences demand that teachers possess the capacity to adapt instructional strategies to the needs of each individual learner. In this sense, if the essence of learning is change, then the essence of teaching is the systematic regulation of conditions that facilitate such change (Pane & Darwis Dasopang, 2017).

In the context of Indonesia's Merdeka Curriculum, the subjects of Natural Science (IPA) and Social Studies (IPS) at the primary school level have been integrated into a unified subject known as IPAS (Ilmu Pengetahuan Alam dan Sosial, Natural and Social Sciences). This interdisciplinary approach positions science literacy as a foundational competency to be developed from the earliest stages of formal education. Learning outcomes in IPAS serve as a primary indicator of instructional quality, reflecting the degree to which students have achieved the cognitive, affective, and psychomotor objectives specified in the curriculum.

Based on preliminary observations conducted with the Grade IV class teacher at SD YPK Inamo, Sorong Regency, on July 23, 2024, persistent challenges were identified with respect to student learning outcomes in IPAS. During instructional sessions, a number of students were observed engaging in off-task behaviors, including talking, playing, and repeatedly requesting permission to leave the classroom, behaviors indicative of low engagement and

insufficient motivation to learn. Furthermore, the prevailing instructional practice was predominantly teacher-centered, with the teacher relying primarily on dictating notes rather than facilitating active, student-centered learning experiences. This instructional approach limited learner agency and contributed to generally low achievement, with the majority of students failing to meet the established Minimum Competency Standard (KKM). These conditions are consistent with observations reported by Ginting et al. (2022), who note that inequalities in the quality of educational provision contribute significantly to disparities in student learning outcomes at the elementary level.

One viable pedagogical solution to address these challenges is the integration of Student Worksheets (LKPD: Lembar Kerja Peserta Didik) as a structured instructional medium. LKPD represents systematically organized learning material designed to guide students through purposeful, structured activities that promote autonomous learning, critical thinking, and conceptual mastery (Hidayah et al., 2023; Ulia et al., 2019). Research by Rahmawati (2020) confirms that scientifically structured LKPD effectively promotes active learning behaviors, while Nata and Manuaba (2022) demonstrate that PBL-based LKPD enhances engagement and comprehension in elementary science content areas. When developed with contextually appropriate pedagogical frameworks, LKPD creates structured yet exploratory learning experiences that facilitate deeper conceptual understanding (Lase & Zai, 2022).

Project-Based Learning (PjBL) is a student-centered pedagogical approach in which learners engage in extended, in-depth investigation of authentic, real-world questions and challenges, culminating in the production of meaningful project artifacts (Krajcik & Shin, 2022). PjBL is distinguished by its emphasis on sustained inquiry, collaborative problem-solving, and the application of disciplinary knowledge to authentic contexts. Kokotsaki et al. (2016), in a comprehensive review of the PjBL literature, confirm that this approach is associated with enhanced student motivation, improved academic achievement, and the development of twenty-first-century competencies, including collaboration, communication, and critical thinking. Chen and Yang

(2019), through a rigorous meta-analysis of effect studies, demonstrates that PjBL has a statistically significant positive effect on students' academic achievement, with effect sizes particularly pronounced when PjBL is implemented with structured scaffolding and explicit learning objectives. Vogler et al. (2018) further emphasize that PjBL's effectiveness is amplified when interdisciplinary teamwork is systematically integrated into the project cycle. Saputro and Selfiani (2023) similarly document significant improvements in IPAS learning outcomes among Grade IV students in Sorong Regency following the implementation of project-based learning, providing a contextually proximate evidence base for the present study.

The integration of PjBL with LKPD creates a particularly powerful instructional structure. By embedding PjBL activities within a worksheet framework, teachers can provide the cognitive scaffolding necessary to guide students through inquiry processes while maintaining the exploratory, student-driven character of project-based work. Paramita et al. (2019) demonstrate that the application of PjBL-based LKPD in science instruction produces measurable improvements in student learning outcomes. Nursalim et al. (2024) confirm that LKPD structured around inquiry processes likewise enhances IPAS motivation and achievement in Grade IV elementary school students in comparable institutional contexts.

The topic of plant parts constitutes an essential content area within the IPAS curriculum for Grade IV students, encompassing the identification, description, and functional analysis of plant morphological structures, including roots, stems, leaves, flowers, fruits, and seeds. Mastery of this content area requires not only declarative knowledge but also the ability to observe, classify, and draw evidence-based conclusions—all skills that are well-suited to a project-based learning approach. A PBL-based LKPD on plant parts enables students to engage in direct observation, specimen collection, classification, and project creation, transforming abstract biological concepts into concrete, investigative learning experiences.

This study therefore aims to investigate the effect of PjBL-based LKPD on

the IPAS learning outcomes of Grade IV students at SD YPK Inamo, Sorong Regency, specifically addressing the Plant Parts topic. The findings are expected to provide evidence-based guidance for elementary school teachers seeking to enhance student engagement and achievement in IPAS through innovative, student-centered instructional design.

METHODS

This study employed a quantitative approach using a pre-experimental method. Experimental research methods are defined by Sugiyono (2015, p. 107) as research methods used to identify the effect of specific treatments on other variables under controlled conditions. The pre-experimental design was selected on the basis that the study involved only a single group of participants without a control group, in accordance with the classification articulated by Yusuf (2017, p. 78). Specifically, the study adopted a one-group pretest-posttest design, in which a single group of students was measured before (pretest) and after (posttest) the implementation of the PjBL-based LKPD intervention on the Plant Parts topic. This design enables a direct comparison of learning outcomes before and after treatment, thereby providing an indicator of the intervention's effect.

The research population comprised all Grade IV students at SD YPK Inamo, Sorong Regency. A saturated sampling technique was applied, in which the entire population was designated as the research sample due to the limited class size. Accordingly, the study involved 15 students as research participants.
Data were collected through two primary instruments. The first instrument was a multiple-choice IPAS test comprising items covering the Plant Parts topic, administered as both a pretest (prior to the intervention) and a posttest (following the intervention). The second instrument was a structured observation sheet used to monitor and record student activity during the learning process. Instrument reliability was assessed using Cronbach's alpha coefficient, with a minimum acceptable threshold of 0.60 (Sugiyono, 2015). Prior to hypothesis testing, data were subjected to a normality assessment using the

Shapiro-Wilk test to confirm the distributional assumptions required for parametric analysis. Hypothesis testing was subsequently conducted using the Paired-Samples t-test, with a significance level (α) of 0.05. All statistical analyses were performed using dedicated statistical software.

RESULTS AND DISCUSSION

Pretest Descriptive Statistics

Prior to the implementation of the PjBL-based LKPD intervention, a pretest was administered to all 15 research participants. The descriptive statistics for the pretest are presented in Table 1.

Table 1. Pretest Descriptive Statistics (N = 15)

Statistic	Value
Mean	54.67
Range	55
Minimum	25
Maximum	80
Sum	82

The pretest results indicate that the highest score achieved by any student was 80 and the lowest was 25, yielding a score range of 55. The mean pretest score was 54.67. Of the 15 students, 8 (53.33%) achieved scores at or above the KKM of 60, while 7 students (46.67%) scored below this threshold. Based on these data, it is concluded that Grade IV students' IPAS learning outcomes prior to the intervention were categorized as low, corroborating the preliminary observational findings and establishing a clear baseline against which post-intervention progress can be measured. These pre-test results are consistent with observations by Solehah et al. (2022), who document persistently low learning interest and outcomes among elementary school students in contexts characterized by teacher-centered instructional practices.

Posttest Descriptive Statistics

Following the implementation of the PjBL-based LKPD intervention on the For

the Plant Parts topic, a posttest was administered to the same 15 participants. The posttest descriptive statistics are presented in Table 2.

Table 2. Posttest Descriptive Statistics (N = 15)

Statistic	Value
Mean	85.00
Range	35
Minimum	65
Maximum	100
Sum	1,275

The posttest results reveal that the highest score achieved was 100 and the lowest was 65, yielding a range of 35. The mean posttest score was 85.00, representing a substantial improvement of 30.33 points over the pretest mean. Of the 15 students, 11 (73.33%) achieved scores at or above the KKM of 60 following the intervention, compared to 8 students prior to the intervention. Only 4 students (26.67%) remained below the KKM. Based on these data, it is concluded that Grade IV students' IPAS learning outcomes following the implementation of the PjBL-based LKPD are categorized as high, reflecting a meaningful improvement in achievement across the student cohort. This improvement is consistent with Chen and Yang's (2019) meta-analytic finding that PjBL produces significant gains in academic achievement and with Winarni and Purwandari's (2021) evidence that project-based approaches particularly improve scientific literacy outcomes in elementary school contexts.

Individual Pretest and Posttest Scores

Table 3 presents the individual pretest and posttest scores for all 15 research participants.

Table 3. Individual Pretest and Posttest Scores

No.	Student Code	Pretest Score	Posttest Score
1	AM	90	100
2	JS	75	100

3	TM	95	100
4	CS	85	95
5	HA	75	100
6	SW	85	100
7	MB	30	95
8	BW	35	75
9	FN	20	50
10	NB	50	95
11	BB	20	20
12	JA	50	35
13	SK	20	30
14	TB	15	80
15	BT	25	70

An examination of the individual score data reveals that 12 of the 15 students demonstrated improvement between the pretest and posttest administrations. Two students (BB and JA) did not show improvement, with BB recording identical scores of 20 on both assessments and JA declining from 50 to 35. One student (SK) also showed minimal improvement (20 to 30). These cases suggest that while the PjBL-based LKPD intervention was broadly effective, a small subset of students may require additional individualized support. Notably, students MB (30 → 95) and TB (15 → 80) demonstrated remarkable improvement, suggesting that project-based learning may be particularly beneficial for students who were previously disengaged from teacher-centered instruction.

KKM Attainment Summary

Table 4. Comparison of KKM Attainment: Pretest versus Posttest

Criterion	Pretest	Posttest	Change
Number of students meeting KKM (≥60)	8 students	11 students	+3 students
Percentage meeting KKM	53.33%	73.33%	+20%
Number of students below KKM	7 students	4 students	−3 students
Percentage below KKM	46.67%	26.67%	−20%

Mean score	54.67	85.00	+30.33

Reliability Testing

Prior to hypothesis testing, instrument reliability was assessed using Cronbach's alpha coefficient. The reliability coefficient for the pretest instrument was 0.922, and for the posttest instrument, it was 0.935. Both values substantially exceed the minimum acceptable threshold of 0.60 (Sugiyono, 2015), confirming that both instruments possess high internal consistency and are reliable for use as data collection tools in this study.

Normality Testing

Prior to conducting the paired-samples t-test, the normality of the data distribution was assessed using the Shapiro-Wilk test, which is appropriate for samples of fewer than 50 observations. The results are presented in Table 5.

Table 5. Shapiro-Wilk Normality Test Results

Variable	Statistic	df	Sig.
Pretest Learning Outcomes	0.915	15	0.162
Posttest Learning Outcomes	0.937	15	0.345

The Shapiro-Wilk statistic for the pretest data was 0.915 ($p = 0.162$) and for the posttest data was 0.937 ($p = 0.345$). Both significance values exceed the threshold of 0.05, confirming that the pretest and posttest data are normally distributed. This satisfies the parametric assumption required for the paired-samples t-test and confirms that the data are appropriate for hypothesis testing.

Hypothesis Testing: Paired-Samples t-Test

The research hypothesis posits that the implementation of PjBL-based LKPD on the Plant Parts topic has a significant positive effect on the IPAS learning outcomes of Grade IV students at SD YPK Inamo, Sorong Regency. To test this hypothesis, a paired-samples t-test was conducted, comparing the pretest and posttest scores of the single experimental group. The results are presented in

Table 6.

Table 6. Paired-Samples t-Test Results

Pair	Mean Difference	Standard Deviation	Std. Error Mean	95% CI Lower	95% CI Upper	t	df	Sig. (2-tailed)
Pretest–Posttest	−17.667	23.135	5.973	−30.479	−4.855	−2.958	14	0.010

The paired-samples t-test yielded a calculated t-value (t^{calc}) of 2.958 with degrees of freedom df = n − 1 = 14. The critical t-value ($t_{\alpha b^{l}e}$) at α = 0.05 with df = 14 is 1.761. Since t^{calc} (2.958) > $t_{\alpha b^{l}e}$ (1.761) and the two-tailed significance value (0.010) is less than the significance threshold (0.05), the null hypothesis (H_0) is rejected and the alternative hypothesis (H_1) is accepted. It is therefore concluded that the implementation of PjBL-based LKPD on the Plant Parts topic has a statistically significant positive effect on the IPAS learning outcomes of Grade IV students at SD YPK Inamo, Sorong Regency.

Discussion

The findings of this study are consistent with the broader literature on project-based learning and student worksheet interventions in elementary science education. The improvement in mean score from 54.67 to 85.00 reflects a pedagogically meaningful shift in students' IPAS achievement following the implementation of the PjBL-based LKPD. Prior to the intervention, only 8 students (53.33%) achieved the KKM; after the intervention, 11 students (73.33%) met this threshold, an improvement of 20 percentage points. These outcomes align with Chen and Yang's (2019) meta-analytic findings that PjBL produces significant academic achievement gains, and with Kokotsaki et al.'s (2016) review confirming that PjBL enhances student motivation and active learning.

The mechanics underlying this improvement can be understood through reference to the distinctive features of PjBL-based LKPD. LKPD provides structured scaffolding that guides students through inquiry tasks in a

sequential and manageable manner, reducing cognitive overload while maintaining cognitive challenge (Rahmawati, 2020; Nata & Manuaba, 2022). When embedded within a PjBL framework, LKPD tasks are situated within authentic, project-driven contexts that heighten relevance and engagement. Students in this study were invited to observe, identify, draw, and classify plant parts directly, transforming abstract taxonomic knowledge into concrete investigative experiences. Krajcik and Shin (2022) emphasize that this form of sustained, disciplinary inquiry is central to the mechanism by which PjBL promotes deep understanding. Kartika et al. (2020) similarly confirm that PjBL-based LKPD enhances not only academic achievement but also creative thinking competencies among elementary school students.

The observation data on student activity during the PjBL-based LKPD implementation further illuminate the learning process. Three phases of activity—preliminary (opening) activities, core learning activities, and closing activities—all demonstrated high levels of student engagement, with all participants recorded as active during each phase. This active participation contrasts markedly with the disengaged, off-task behavior observed during preliminary baseline observations, suggesting that the shift to a project-based learning environment produced a meaningful change in students' orientations toward learning. Vogler et al. (2018) note that the authentic, collaborative character of PjBL is particularly effective in sustaining student engagement across the full duration of complex learning tasks. Septiani and Redjeki (2021) similarly document marked improvements in both motivation and science learning outcomes following PjBL implementation in elementary school contexts.

The persistence of below-KKM outcomes for four students following the intervention warrants attention. These students may require individualized supplementary instructional support, differentiated LKPD tasks calibrated to their specific learning needs, or greater attention to affective and motivational factors that influence learning engagement. Wahyuningsih et al. (2022)

recommend complementing PjBL with explicit instruction in critical thinking skills and differentiated scaffolding to ensure that all learners, including those with lower initial achievement levels, can benefit fully from project-based learning experiences. The overall findings of this study therefore support the conclusion that PjBL-based LKPD constitutes an effective and evidence-aligned instructional tool for enhancing IPAS learning outcomes in Grade IV elementary school contexts, while also identifying areas for continued instructional refinement.

CONCLUSION

Based on the research hypothesis, data analysis, and discussion presented above, it is concluded that the implementation of PjBL-based LKPD on the Plant Parts topic has a statistically significant positive effect on the IPAS learning outcomes of Grade IV students at SD YPK Inamo, Sorong Regency. This conclusion is supported by the paired-samples t-test result, which yielded t^{calc} (2.958) > t□αß¹e (1.761) with degrees of freedom df = 14 and a two-tailed significance value of 0.010, which is less than the significance threshold of α = 0.05. The mean score improved from 54.67 (pretest) to 85.00 (posttest), and the percentage of students meeting the KKM increased from 53.33% to 73.33%.

These findings confirm that PjBL-based LKPD is an effective instructional instrument for improving IPAS learning outcomes in the elementary school context. Teachers are encouraged to adopt and further develop PjBL-based LKPD for other IPAS content areas within the Merdeka Curriculum framework, adapting project tasks to the specific morphological and contextual characteristics of each topic. Schools and educational administrators are advised to provide professional development support to enable teachers to design and implement PjBL-based LKPD with fidelity. Future research is recommended to employ experimental designs with control groups, larger and more diverse samples, and longitudinal follow-up assessment to more rigorously establish the sustained effects of PjBL-based LKPD on IPAS learning outcomes and broader scientific competencies.

Acknowledgments

The author gratefully acknowledges the principal, classroom teacher, and Grade IV students of SD YPK Inamo, Sorong Regency, for their cooperation and participation in this study. Sincere gratitude is also extended to the academic supervisors and colleagues of the Elementary School Teacher Education Program at Universitas Pendidikan Muhammadiyah Sorong for their guidance, constructive feedback, and support throughout the research process.

Declarations

Author Contribution	:	C. C. Salamor: Conceptualization, Data Collection, Media Development, Writing – Original Draft; Mustika Irianti: Writing – Review & Editing, Formal Analysis, and Methodology; Desti Rahayu: Validation and Supervision.
Funding Statement	:	This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.
Conflict of Interest	:	The authors declare no conflict of interest.
Additional Information	:	No additional information is available for this paper.

REFERENCES

Anniswati, A., & Thamrin, S. (2017). Aplikasi lembar kerja peserta didik (LKPD) berbasis masalah untuk minat belajar dan penguasaan konsep fisika pada materi bunyi peserta didik kelas VIII MTs Madani Alauddin Paopao [Application of problem-based student worksheets for learning interest and concept mastery in sound topics]. Jurnal Pendidikan Fisika, 5(2), 120–127.

Fauhah, H., & Rosy, B. (2021). Analisis model pembelajaran make a match terhadap hasil belajar siswa [Analysis of the make-a-match learning model on student learning outcomes]. Jurnal Pendidikan Administrasi Perkantoran (JPAP), 9(2), 321–334.

Ginting, R. R., Ginting, E. V., Hasibuan, R. J., & Perangin-angin, L. M. (2022). Analisis faktor tidak meratanya pendidikan di SDN 0704 Sungai Korang [Analysis of factors behind educational inequality at SDN 0704 Sungai Korang]. Jurnal Pendidikan Indonesia, 3(4), 407–416.

Hidayah, N., Sumarno, S., & Dwijayanti, I. (2023). Analisis bahan ajar terhadap kebutuhan guru dan peserta didik kelas V [Analysis of teaching materials

in relation to the needs of Grade V teachers and students]. Jurnal Ilmiah Pendidikan Dasar, 10(2), 102–128.

Lase, N. K., & Zai, N. (2022). Pengembangan lembar kerja peserta didik (LKPD) berbasis contextual teaching and learning pada materi sistem ekskresi manusia di kelas VIII SMP Negeri 3 Idanogawo [Development of CTL-based LKPD on human excretory system for Grade VIII students]. Jurnal Ilmu Pendidikan, 32, 99–113.

Mboa, M. N., & Ajito, T. (2024). Meningkatkan hasil belajar dengan menggunakan model pembelajaran problem based learning (PBL) pada materi peluang siswa kelas VIII SNPK St. Theresia Kupang [Improving learning outcomes using problem based learning on probability topics for Grade VIII students]. Journal on Education, 6(2), 12296–12301.

Mukminim, E., & Mushafanah, Q. (2023). Penerapan media visual untuk meningkatkan hasil belajar siswa pada pembelajaran Bahasa Indonesia kelas 1 SD Negeri Pati Lor 03 [Application of visual media to improve learning outcomes in Indonesian Language at Grade 1]. Prosiding Seminar Nasional Pendidikan Profesi Guru, 1(1), 1–10.

Nata, A. S., & Manuaba, I. B. S. (2022). Lembar kerja peserta didik berbasis problem-based learning pada topik sumber energi untuk kelas IV sekolah dasar [PBL-based student worksheets on energy sources for Grade IV elementary school]. Mimbar Ilmu, 27(1), 1–10.

Pane, A., & Darwis Dasopang, M. (2017). Belajar dan pembelajaran [Learning and teaching]. FITRAH: Jurnal Kajian Ilmu-Ilmu Keislaman, 3(2), 333–352.

Paramita, P., Erni, A. I., & Izzatika, A. (2019). Penerapan LKPD IPA berbasis project based learning terhadap hasil belajar peserta didik [Application of science-based PjBL student worksheets on student learning outcomes]. Pedagogi: Jurnal Pendidikan Dasar, 7(5), 1–10.

Pratiwi, N. L. A. P. D., & Indrayani, L. (2023). Pengembangan lembar kerja peserta didik (LKPD) berbasis profil pelajar Pancasila dalam mata pelajaran ekonomi di SMA N 1 Singaraja [Development of LKPD based on Pancasila Student Profile in economics at SMA N 1 Singaraja]. Jurnal Pendidikan Ekonomi Undiksha, 11(1), 143–150.

Putri, R. H., & Hardjono, N. (2019). Peningkatan hasil belajar tematik melalui penerapan model problem based learning dengan media mind mapping [Improving thematic learning outcomes through problem based learning with mind mapping media]. Jurnal Riset Teknologi dan Inovasi Pendidikan (JARTIKA), 2(1), 81–101.

Rahmawati, L. H. (2020). Pengembangan lembar kegiatan peserta didik (LKPD) berbasis scientific approach pada mata pelajaran administrasi umum kelas X OTKP di SMK Negeri 1 Jombang [Development of scientific

approach-based LKPD for administrative studies at Grade X SMK]. Jurnal Pendidikan Administrasi Perkantoran, 8(3), 504–515.

Solehah, N. N., Saputra, H. H., & Setiawan, H. (2022). Analisis minat belajar siswa kelas IV SDN 20 Ampenan pada masa pandemi COVID-19 tahun pelajaran 2021/2022 [Analysis of learning interest among Grade IV students at SDN 20 Ampenan during the COVID-19 pandemic]. Jurnal Ilmiah Profesi Pendidikan, 7(1), 229–235.

Sugiyono. (2015). Metode penelitian pendidikan: Pendekatan kuantitatif, kualitatif, dan R&D [Educational research methods: Quantitative, qualitative, and R&D approaches]. Alfabeta.

Chen, C. H., & Yang, Y. C. (2019). Revisiting the effects of project-based learning on students' academic achievement: A meta-analysis investigating moderators. Educational Research Review, 26, 71–81. https://doi.org/10.1016/j.edurev.2018.11.001

Kokotsaki, D., Menzies, V., & Wiggins, A. (2016). Project-based learning: A review of the literature. Improving Schools, 19(3), 267–277. https://doi.org/10.1177/1365480216659733

Krajcik, J. S., & Shin, N. (2022). Project-based learning. In R. K. Sawyer (Ed.), The Cambridge handbook of the learning sciences (3rd ed., pp. 171–208). Cambridge University Press. https://doi.org/10.1017/9781108888691.011

Vogler, J. S., Thompson, P., Davis, D. W., Mayfield, B. E., Finley, P. M., & Yasseri, D. (2018). The hard work of soft skills: Augmenting the project-based learning experience with interdisciplinary teamwork. Instructional Science, 46(3), 457–488. https://doi.org/10.1007/s11251-017-9438-9

Winarni, E. W., & Purwandari, E. P. (2021). Project-based learning to improve scientific literacy for elementary students in science and Indonesian language. International Journal of Instruction, 14(1), 243–256. https://doi.org/10.29333/iji.2021.14115a

Ardianti, S. D., Wanabuliandari, S., & Kanzunnudin, M. (2019). Keefektifan model PjBL berbasis etnosains terhadap minat belajar IPA siswa sekolah dasar [Effectiveness of ethnoscience-based PjBL model on science learning interest of elementary school students]. Primary: Jurnal Pendidikan Guru Sekolah Dasar, 8(1), 39–47.

Kartika, H., Wahyuni, A., & Pratama, R. A. (2020). Pengembangan lembar kerja peserta didik berbasis project based learning terhadap kreativitas siswa SD [Development of PjBL-based student worksheets for enhancing elementary students' creativity]. Jurnal Basicedu, 4(4), 1080–1090. https://doi.org/10.31004/basicedu.v4i4.476

Septiani, A., & Redjeki, S. (2021). Penerapan project based learning untuk meningkatkan motivasi dan hasil belajar sains siswa sekolah dasar

[Application of project-based learning to improve motivation and science learning outcomes of elementary school students]. Jurnal Basicedu, 5(4), 2018–2027. https://doi.org/10.31004/basicedu.v5i4.1099

Wahyuningsih, T., Murwaningsih, T., & Fadhilah, S. S. (2022). Peningkatan keterampilan berpikir kritis siswa melalui project based learning dalam pembelajaran IPA sekolah dasar [Improving critical thinking skills through project-based learning in elementary science instruction]. Jurnal Pendidikan Dasar, 13(1), 12–22.

Nursalim, N., Wulandari, F., & Hidayat, M. T. (2024). Efektivitas penggunaan LKPD berbasis inquiry terhadap motivasi dan hasil belajar IPAS siswa kelas IV sekolah dasar [Effectiveness of inquiry-based LKPD on IPAS motivation and learning outcomes of Grade IV elementary school students]. Primary Education Journal (Primadona), 5(1), 18–27.

Saputro, I. E., & Selfiani, S. (2023). Penerapan model project based learning dalam meningkatkan hasil belajar IPAS siswa kelas IV sekolah dasar di Kabupaten Sorong [Application of project-based learning to improve Grade IV IPAS learning outcomes in Sorong Regency elementary schools]. Primary Education Journal (Primadona), 4(2), 34–42.