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From Local Culture Projects to Deeper Learning: Strengthening Conceptual Understanding and Critical Thinking in Elementary Natural and Social Sciences

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Abstract
Elementary Natural and Social Sciences learning often remains oriented toward recall, leaving students with limited opportunities to explain concepts, justify decisions, and apply knowledge to everyday situations. This classroom action research investigated how deep learning principles—operationalized through mindful engagement, meaningful connections, and joyful contextual tasks—integrated with Project-Based Learning (PjBL) to strengthen fourth-grade students' conceptual understanding and critical thinking. From an initial enrollment of 23 students at SD Negeri 225/IX Kasang Solok, Muaro Jambi, Indonesia, 22 students who completed all assessment components were included in the complete-case analysis (n = 22); one student was excluded due to prolonged non-attendance. Two action cycles, each comprising planning, action, observation, and reflection across two 70-minute meetings, used a coherent, progressively structured sequence of contextual projects: a local-culture mind map, a pop-up book, a "rule tree" poster, and a rules-classification game. Data were collected through observation rubrics, concept-understanding tasks, critical-thinking assessments, field notes, interviews, and documentation. Tasks were independently scored and discussed by the teacher and a collaborator, while interviews were analyzed using thematic coding. Reported percentage-of-maximum scores were higher at the second meeting of each cycle. Conceptual-understanding scores increased from 65.3 to 74.2 in Cycle I and from 67.6 to 80.0 in Cycle II. Critical-thinking scores increased from 66.8 to 73.3 in Cycle I and from 67.4 to 79.6 in Cycle II. Classroom observations suggested that higher performance coincided with scaffolded questioning, structured group roles, and game-based classification. The findings suggest that culturally situated projects can operationalize deep learning by connecting conceptual representation, reasoning, application, and reflection. Nevertheless, the single-class action design and non-equivalent tasks limit causal claims, score comparability, and broader generalization.

Keywords: Conceptual Understanding; Critical Thinking; Deep Learning; Project-Based Learning

INTRODUCTION

Elementary Natural and Social Sciences is intended to help students interpret natural and social phenomena as connected parts of everyday life. This purpose requires more than recalling facts: students must be able to restate concepts, classify examples, represent relationships, apply procedures, justify conclusions, and reconsider their answers. These abilities are particularly important in the elementary years because early experiences with inquiry and explanation shape later scientific literacy (Desstya et al., 2024; Hanum et al., 2024; Palupi et al., 2025; Setiyadi, 2025). Indonesian process standards similarly emphasize interactive, inspiring, challenging, and learning that actively engages students (Amiruddin et al., 2023; Zulaiha, 2025).

To evaluate these capabilities rigorously and distinctly, conceptual understanding was operationalized as the organization and representation of knowledge about customs and rules, including classification and explanation. Critical thinking was operationalized as the evaluation

of that knowledge through focus, reason, inference, situation, clarity, and overview (FRISCO). The two rubrics therefore assessed related but distinct outcomes.

The classroom context motivating this study showed a mismatch between those aspirations and students' learning experiences. Initial documentation in Grade IV at SD Negeri 225/IX Kasang Solok—based on the baseline formative assessment administered on August 12, 2024, using standard school diagnostic tasks—indicated that only 9 of 23 students (39%) met the school's minimum learning-objective mastery criterion (*Kriteria Ketercapaian Tujuan Pembelajaran* / KKTP) of 75. Students had difficulty explaining concepts in their own words, classifying examples, transferring knowledge to new cases, giving reasons, drawing conclusions, and checking the adequacy of their answers. While this school-level baseline criterion served to identify initial learning deficits, subsequent cycles evaluated student growth using mean percentage scores derived from continuous rubric assessments to describe meeting-specific changes in conceptual understanding and critical thinking rather than relying on binary mastery thresholds. These difficulties called for an instructional design that combined conceptual depth with active participation and explicit reasoning.

Deep learning in this article refers to an educational approach centered on mindful engagement, meaningful connections, and the transfer of knowledge to authentic contexts (Alawiyah et al., 2026; Silviani et al., 2025; Zahrudin & Bahij, 2025); it does not refer to artificial-intelligence algorithms. It is compatible with constructivist accounts of learning, in which learners actively reorganize knowledge through experience, interaction, and reflection (Do et al., 2023; Mensah, 2015; Tegegne et al., 2025). Project-Based Learning (PjBL) offers an operational structure for these principles through a driving question, collaborative planning, sustained project work, monitoring, product evaluation, presentation, and reflection (Sánchez-García & Reyes-de-Cózar, 2025; Zhang & Ma, 2023). When projects are linked to learners' social and cultural surroundings, abstract content can be represented in tangible products and examined from multiple perspectives.

Cultural familiarity and authenticity were established through pre-intervention community mapping and student interviews in Muaro Jambi, which identified local customs (*adat*), community norms, and family rules as meaningful contexts familiar to all participating children. Rather than treating project tasks as isolated crafts, the intervention implemented a coherent, progressively structured sequence: starting with identifying and mapping local norms (Mind Map), advancing to multi-representational explanation (Pop-Up Book), progressing to the categorization of rules and their consequences ("Rule Tree" Poster), and culminating in interactive transfer and evaluation (Classification Game).

Previous research has associated PjBL with participation, higher-order thinking, and science learning outcomes (Murniawaty et al., 2025; Susanto & Hidayat, 2026). Other studies have discussed deep-learning-oriented instruction as a means of developing meaningful learning and critical thought (Liesdiana & Syaifuddin, 2026; Salsabilla et al., 2026; Sudarmono et al., 2025; Wicaksono & Khalifah, 2026). Research in elementary Natural and Social Sciences has also reported benefits of project activities for engagement and critical thinking (Melindawati et al., 2025; Priyatno et al., 2025; Rediani & Widiani, 2026; Sabekti et al., 2026). Collectively, these studies support active and contextual learning, yet three gaps in the literature remain:

1. Instructional Integration Gap: PjBL and deep-learning principles are frequently treated as separate, parallel frameworks rather than as a deliberately aligned instructional system where project phases explicitly operationalize deep learning dimensions (*mindful, meaningful, and joyful*).
2. Dual-Outcome Assessment Gap: Prior research typically evaluates either general science achievement or isolated critical thinking. Simultaneous assessment of both conceptual understanding and critical thinking is essential because these constructs are non-interchangeable—conceptual understanding provides the necessary domain-knowledge foundation (e.g., representation and classification), while critical thinking evaluates and applies that knowledge (e.g., FRISCO reasoning pathways).

3. Interdisciplinary scope: The intervention addressed the social dimension of Natural and Social Sciences (Ilmu Pengetahuan Alam dan Sosial; IPAS) through local customs and everyday rules. Classification, explanation, consideration of evidence, and revision of conclusions are reasoning practices relevant to interdisciplinary learning (Hanum et al., 2024). However, the assessed tasks concerned social situations; they did not measure natural-science content knowledge or scientific literacy. The contribution to science education is consequently a contextual account of instructional practices potentially adaptable to science topics, whose effectiveness in those topics remains to be tested.

This study explored how iterative implementation of deep-learning-oriented PjBL was accompanied by changes in fourth-grade students' conceptual understanding and critical thinking in a social-context IPAS unit. It aimed to describe instructional implementation, report meeting-specific performance, and identify reflective teaching revisions. The classroom action design was descriptive and did not isolate causal effects.

The study offers three contributions. Theoretically, it clarifies deep learning as a set of observable learning processes—connection, explanation, application, and reflection—within PjBL. Practically, it provides elementary teachers with a sequence of low-cost contextual projects grounded in local culture and familiar social situations. Methodologically, it demonstrates how two complementary outcome rubrics and cycle-by-cycle reflection can be used to document both conceptual and reasoning development, while maintaining appropriately modest claims for classroom action research.

METHODS

Research Design and Context

7 The study used collaborative classroom action research following the recurring stages of planning, action, observation, and reflection (Defianty & Wilson, 2024; Garcés & Granada, 2016). It was conducted in Grade IV at SD Negeri 225/IX Kasang Solok, Muaro Jambi, Indonesia, across four 70-minute sessions held on May 6, 8, 13, and 15, 2026. The class comprised 23 registered students; however, complete observation and assessment data were available for 22 students who attended and completed all assessment components across all four meetings. One student was excluded prior to final analysis due to prolonged non-attendance across both cycles, resulting in a complete-case analytical sample (n = 22). The earlier school-level diagnostic result retained its original denominator of 23 students (9/23, 39.1%); all intervention summaries used the 22 complete cases. The diagnostic result was contextual information rather than a paired baseline for the intervention. Restricting the analysis to complete cases maintained a consistent analytical sample, but did not eliminate possible attendance-related selection bias.

The classroom teacher delivered the instructional activities, while an independent observer (a collaborator) conducted real-time classroom observations. Assessments were administered by the teacher, and student work was independently scored by both the teacher and the collaborator using pre-defined rubric criteria to minimize expectancy effects. Any 8 scoring discrepancies were resolved through joint review to agree on final ratings. Semi-structured interviews were conducted by the collaborator to reduce social desirability bias. Because the study was designed to improve learning within this specific context, the unit of inference was the participating classroom rather than a broader population. Initial rating differences and an independent agreement coefficient were not available in the supplied reporting records; consensus ratings should therefore not be interpreted as demonstrated inter-rater reliability. Blinding to session or student identity could not be established from those records.

Instructional Action

Two cycles were executed, consisting of two 70-minute meetings per cycle (Cycle I: Meetings 1–2; Cycle II: Meetings 3–4). The planned structure for each meeting followed the complete six-phase PjBL sequence within the allocated session times and small-group arrangements (4–5 students per group):

1. *Defining an essential question* (10 mins): Presenting driving questions focused on local phenomena.
2. *Planning the project* (10 mins): Establishing project boundaries, output criteria, and group roles.
3. *Arranging the schedule* (5 mins): Mapping step-by-step group tasks.
4. *Developing and monitoring the project* (25 mins): Sustained project creation completed entirely in class under teacher monitoring.
5. *Assessing or presenting the product* (15 mins): Group presentations, peer review, and rubric-based evaluation.
6. *Evaluating the learning experience* (5 mins): Guided individual written reflection.

The collaborator observed implementation of the six PjBL phases during the four sessions. These phases provide the reported procedural framework, but item-level fidelity records, scoring anchors, and the numerator and denominator underlying the previously stated 95% were not available for verification. That percentage is therefore not retained as a supported finding. Deep-learning principles were embedded through activation of prior knowledge, collaborative inquiry, representations, reasoning prompts, application, feedback, and reflection (Table 1).

Table 1. Instructional focus and reflective revisions across the two action cycles

Cycle/meeting	Context, Project, & Driving Question	Targeted Learning Process & Criteria	Observed Evidence / Reflection Threshold	Reflective Revision Applied
I/1	Context: Norms and Muaro Jambi customs (*Makan Bebiduk*, *Seloko*). Project: Local-culture mind map. Driving Question: *"Why do local customs exist in Muaro Jambi, and how do they guide daily actions?"*	Target: Activate experience, classify ideas, and connect concepts. Criteria: Identify local customs and explain their social functions.	Reported observation: 8/22 students (36.4%) relied on teacher direction. The passive-participation count and a predetermined intervention threshold were not documented sufficiently to verify.	Revisions: Assigned explicit roles (Leader, Timekeeper, Presenter, Note-taker) using role-check cards. Prompt Added: *"What would happen to community harmony if this custom were ignored?"*

Cycle/meeting	Context, Project, & Driving Question	Targeted Learning Process & Criteria	Observed Evidence / Reflection Threshold	Reflective Revision Applied
I/2	Context: Local culture & social etiquette. Project: Pop-up book. Driving Question: *"How can we explain the consequences of breaking cultural norms to younger peers?"*	Target: Represent concepts, collaborate, explain a product. Criteria: Interactive pop-up pages linking cultural norms to consequences	Evidence: Students struggled to transfer concepts to novel contexts during oral presentation.	Revisions: Shifted to closer-to-home daily rules (home/school) and direct scaffolding. Scaffold Added: Fill-in reasoning templates (*"If [rule] is broken, then [consequence] occurs because..."*).
II/1	Context: Written vs. unwritten rules (Home, School). Project: "Rule tree" poster. Driving Question: *"How do unwritten rules protect our class environment even when not posted on walls?"*	Target: Distinguish examples, justify importance and consequences. Criteria: Categorize rules into written/unwritten with consequence pathways	Evidence: Improved participation; minor difficulty in justifying complex edge cases	Revisions: Provided structured peer-feedback checklists and direct teacher scaffolding. Prompt Added: *"Is this rule fair for everyone? Give evidence from daily class situations."* .
II/2	Context: Rules across home, school, and community. Project: Classification game & poster. Driving Question: *"How do rules in different settings share the same goal of protecting fairness?"*	Target: Transfer concepts, decide, present, and reflect. Criteria: Sort unfamiliar rule scenarios in game format and justify placements.	Observation narrative described more balanced contributions. A final active/passive count and a separate transfer criterion were not supplied.	Revisions: Maintained structured scaffolding framework for future instructional units.

Note on the curricular sequence: Cycle I addressed broader socio-cultural customs (adat), whereas Cycle II addressed everyday rules at home, school, and in the community. This progression offered opportunities to apply reasoning in another context, but did not constitute an equated test of transfer.

Reflection after Cycle I was documented in joint teacher–collaborator logs after Meeting 2. Passive participation was described as fewer than two meaningful contributions during a session. The reported observation of 8 of 22 students (36.4%) relying on teacher direction indicated uneven participation; reliance on assistance is not necessarily identical to the passive-participation criterion. Because the original numerical decision threshold was missing, no predetermined percentage threshold is asserted. The reflection informed clearer roles and reasoning scaffolds.

Instruments and Indicators

Conceptual understanding was assessed using a five-point analytic rubric (scores 1–5; maximum attainable raw score = 35) covering seven indicators: restating a concept, classifying objects or cases, producing examples and non-examples, representing a concept in different forms, developing necessary or sufficient conceptual conditions, selecting and applying a procedure, and applying concepts to problem solving. To make the advanced indicator *"developing necessary or sufficient conceptual conditions"* age-appropriate for Grade IV, it was operationalized as identifying mandatory elements of a rule or norm (e.g., specifying that a classroom rule requires both an expected behavior and an explicit boundary to be valid).

Critical thinking was assessed using a five-point analytic rubric (scores 1–5; maximum attainable raw score = 30) based on six FRISCO-oriented indicators (Ennis, 2011) adapted for elementary rule-based reasoning:

1. **Focus:** Identifying the core rule or problem in a given scenario.
2. **Reason:** Providing evidence-based justifications for why a rule is necessary, distinguishing objective impact from personal dislike (moral judgment vs. evidence-based thinking).
3. **Inference:** Predicting logical consequences if a rule is removed or violated.
4. **Situation:** Evaluating how environmental context (home vs. school vs. community) changes rule application.
5. **Clarity:** Explaining reasoning using clear, unambiguous vocabulary.
6. **Overview:** Reviewing one's own argument or adjusting conclusions after receiving peer feedback.

Observational data were collected using structured teacher and student activity observation sheets (recording frequency of student contributions every 10 minutes), field notes, and semi-structured interviews (4 students selected per cycle based on high/medium/low performance, lasting 10–15 minutes each). Student learning products were archived digitally and evaluated using the same standardized analytic rubrics. All instruments were subjected to expert judgment content validation by two educational experts prior to implementation, resulting in minor wording revisions. The two-expert review and minor wording revisions constitute the reported validation evidence. Separate criteria, item-level judgments, and validation indices for the two rubrics were not supplied, so their content validity cannot be quantified. Projects were produced collaboratively, while individual explanations and responses were the intended basis of learner-level interpretation. The available manuscript does not establish how every group-product rating was separated from individual ratings; group performance must therefore not be treated as independent evidence of each child's attainment.

Data Analysis and Trustworthiness

Percentage-of-maximum scoring is expressed as $P_{ij} = 100 \times R_{ij} / M$, where R_{ij} is the sum of indicator ratings for student i in meeting j and M is the maximum possible sum. For conceptual understanding, M = 35; for critical thinking, M = 30. The mean score for each meeting is $\bar{P}_j = (\Sigma_{i=1}^{22} P_{ij})/22$. All indicators were equally weighted. This is a percentage-of-maximum convention, not a minimum–maximum adjustment: its attainable lower bound is 20 because each indicator is scored from 1 to 5.

The reported ranges in Table 3 are consistent with raw-score/max-score conversion: for example, 18/35 × 100 = 51.4 and 16/30 × 100 = 53.3 after rounding. A min–max transformation, 100 × (R − Rmin)/(M − Rmin), would produce different values and is not used in the stated convention. Because student-level records were not supplied for this revision, the reported means and SDs are retained from the manuscript rather than recalculated independently. All summaries use one decimal place; SDs refer to percentage-score points. The formula and

summary statistics require confirmation against the original scoring sheet before submission.

Qualitative records (field notes, observation sheets, interview transcripts) were analyzed using thematic coding centered on participation, reasoning, conceptual transfer, collaboration, presentation, and reflection. To avoid purely interpretive narrative and provide transparent evidentiary traces, qualitative categories were continuously tested against contrary cases (discrepant evidence). For example, when high group product scores occurred alongside individual student silence, observer notes flagged the instance as a contrary case, prompting targeted interviews to examine whether understanding was genuine or merely copied from peers.

Table 2 compares the reported score summaries, observations, and interview descriptions. Convergence is interpreted cautiously because dated observation extracts and linked interview excerpts were not supplied for every claim. A change in a class mean cannot by itself establish an improvement in individual participation.

No inferential statistical tests or control groups were employed. Common indicators and rating scales provided a consistent assessment framework, but tasks and topics were not psychometrically equated. Meeting-specific scores therefore describe performance on contextualized tasks; their differences cannot establish treatment effects, equal-difficulty learning gains, or transfer to unassessed domains.

Table 2. Triangulation matrix across data sources

Major Claim / Finding	Quantitative Rubric Scores	Observation Sheets & Field Notes	Student & Teacher Interviews	Triangulation Status
Improvement in Conceptual Understanding	Table 3 reports higher second-meeting means and lower SDs within each cycle; tasks were not equated.	Students correctly identified and categorized local norms in mind maps and posters with reduced teacher prompts	Students articulated reasons for classifying rules using their own words during post-cycle interviews.	Partial convergence of reported summaries and narrative evidence; individual source links require verification.
Shift to Active Participation	No separate participation or collaboration subscale is reported in Table 3.	Initial observations described 8/22 students (36.4%) relying on teacher direction. Later observations described more balanced contributions; no verified final passive-participation percentage is available.	Evidence: Students reported feeling clearer about their assigned roles (e.g., presenter, recorder) during group tasks.	The discrepancy between group-product performance and individual participation motivated role allocation. Its resolution was not quantitatively demonstrated.

RESULT AND DISCUSSION

Implementation and Outcome Development

The instructional activities shifted learning from teacher explanation toward the production, defense, and revision of representations. In Cycle I, students mapped local norms and customs and transformed their ideas into a pop-up book. These products required selection and organization of information, but observations showed that 8 out of 22 students (36.4%) still relied on teacher direction, especially when explaining underlying reasons or transferring ideas to novel scenarios.

To illustrate changes in conceptual reasoning, consider an anonymized student explanation from Student S-04:

1. Early intervention example (Cycle I; local-culture task): When explaining why a local custom (Makan Bebiduk) is practiced, Student S-04 was reported as explaining: "Because

that's what people in the village do during events," relying on passive recall without structural justification (reported rubric level 2).

2. Later intervention example (Cycle II, Meeting 2 – Classification Game): When evaluating an unwritten household rule, Student S-04 stated: "If we don't clean up after eating, it breaks the unwritten family agreement because it adds an unfair workload on mom, which causes disharmony at home," demonstrating explicit causal reasoning and rule-context transfer (reported rubric level 5).

Consequently, Cycle II narrowed the conceptual focus to rules encountered at home, school, and community, while increasing direct scaffolding and reasoning prompts.

Table 3. Reported meeting-specific percentage scores, standard deviations, and ranges for conceptual understanding and critical thinking (n = 22)

Outcome	Cycle I meeting 1	Cycle I meeting 2	Cycle II meeting 1	Cycle II meeting 2	Change: first to final
Conceptual understanding	65.3 (SD = 8.2; range 51.4–80.0)	74.2 (SD = 6.9; range 62.9–88.6)	67.6 (SD = 7.5; range 54.3–82.9)	80.0 (SD = 5.8; range 68.6–94.3)	+14.7
Critical thinking	66.8 (SD = 8.0; range 53.3–80.0)	73.3 (SD = 6.5; range 60.0–86.7)	67.4 (SD = 7.1; range 53.3–83.3)	79.6 (SD = 5.4; range 70.0–93.3)	+12.8

Note: Values are reported to one decimal place. The original individual-level dataset was not supplied for this revision; means, SDs, and ranges remain reported summaries. The obvious typographical value 7474.2 has been corrected to 74.2, consistently with the abstract and narrative. Differences are calculated from displayed means and represent percentage-score point differences across non-equated tasks.

Within-cycle differences in displayed means were +8.9 and +12.4 points for conceptual understanding and +6.5 and +12.2 points for critical thinking in Cycles I and II, respectively. First-to-final differences were +14.7 and +12.8 points. These are arithmetic summaries of task-specific scores, not estimates of a common-scale treatment effect.

Conceptual understanding scores were lower at the start of Cycle II than at the end of Cycle I (67.6 versus 74.2). This pattern is compatible with changes in topic, task demand, or student performance; the descriptive design cannot distinguish these explanations.

1. The introduction of a new topic (written vs. unwritten rules) and a more demanding classification task required students to reconstruct rather than merely repeat prior learning.
2. The cognitive demands of the Cycle II tasks may have differed, but relative task difficulty was not independently measured.

The higher second-meeting scores in each cycle coincided with repeated project work, feedback, and reflection. These associations cannot identify which instructional component accounted for the pattern.

The final Cycle II meeting produced the highest scores for both outcomes: 80.0 for conceptual understanding and 79.6 for critical thinking. Students did not simply name rules; they identified the environment in which each rule applied, differentiated written and unwritten rules, considered consequences, composed moral messages, presented group decisions, and responded to peers. However, because assessment tasks were embedded within specific classroom activities, high final scores demonstrate contextualized competence within the unit rather than universal, transferable critical thinking across unstudied domains.

Why Contextual Projects Supported Conceptual Understanding

The observed pattern is consistent with a constructivist interpretation of conceptual learning. Mind maps and pop-up books externalized relationships among norms, customs, and local cultural practices, while the rule-tree poster required students to sort examples according to defining attributes. Such external representations make misconceptions discussable and allow learners to reorganize ideas through peer explanation. This interpretation is compatible with studies linking project learning to active participation and improved elementary learning outcomes (Nilkotina, 2025; Zhang & Ma, 2023). A plausible interpretation grounded in concrete product analysis—rather than a controlled comparison between decorative and reasoning-rich tasks—is that conceptual gains were strongest when project products explicitly required classification, justification, and application rather than decorative assembling alone (Darling-Hammond et al., 2020; Zhang & Ma, 2023).

Local culture also played a role in knowledge construction. Locally credible practices in Muaro Jambi—such as *rewang* (mutual aid during community gatherings), *kumpul sanak* (family clan meetings), and customary expressions of respect—were already familiar to many students in their social environment. However, because cultural background varies across households, these practices were introduced as contextual entry points rather than assumed to be homogeneously experienced by every child. Connecting these lived experiences to the formal concepts of norms, customs, and civic responsibilities reduced the distance between school knowledge and everyday life.

Within IPAS, these activities linked social contexts with classification, representation, and reasoned explanation (Hanum et al., 2024). They provide evidence about learning in a social-context unit rather than direct evidence of natural-science attainment or scientific literacy. Testing the same instructional sequence with natural phenomena would be needed to establish its contribution to science-content learning.

Why Critical Thinking Improved

Critical thinking became visible when prompts moved beyond simple recall or moral preferences (*"Is this rule good?"*) toward evaluative evidence-based reasoning (*"Why is this rule necessary, and what are its concrete social consequences?"*). Questions demanding evidence forced students to move from identifying an example to evaluating its function. To illustrate how critical thinking scoring was justified against competing reasons, consider Student S-12's evaluation of a classroom rule regarding taking turns during discussions:

"*If we don't have a turn-taking rule, loud students will talk all the time. But some peers say rules limit freedom. I disagree because without turns, quiet students cannot share their evidence, so freedom for everyone is actually lost*."

The excerpt illustrates consideration of competing positions, predicted consequences, and justification. It supports interpretation of these reasoning features in that response, but does not independently establish a level 5 rating on all six FRISCO indicators. The original item ratings would be needed to verify that broader scoring claim.

The observed improvement also coincided with reflective revisions by the teacher. Cycle I revealed that open group work could conceal unequal participation. In Cycle II, clearer group roles, targeted FRISCO prompts, and direct scaffolding distributed cognitive responsibility more deliberately. While theory suggests that PjBL fosters higher-order thinking, classroom data suggest that a project creates an opportunity structure that becomes intellectually productive only when teacher scaffolding aligns questions, monitoring, and assessment criteria with intended reasoning processes.

Theoretical, Practical, and Methodological Implications

Theoretically, the results support a process-based view of deep learning within PjBL. In this classroom, cognitive depth was produced through the systematic alignment of authentic socio-cultural context, representation, reason-giving, transfer, and reflection. While conceptual understanding and critical thinking scores improved in parallel across cycles, no reciprocal or mutually reinforcing correlation was statistically modeled. Thus, their relation is presented as a theoretical possibility and an observed qualitative pattern where conceptual knowledge supplied the necessary domain content, while evaluative tasks refined conceptual clarity.

Practically, elementary teachers can begin with culturally familiar phenomena and design a sequence in which each project product requires progressively richer intellectual work. One possible progression is: identify and map → represent and explain → classify and justify → apply and reflect. Low-cost materials are sufficient, but explicit rubrics and equitable group roles must be prepared in advance. When transferring this framework to other regions or schools, educators must consider local cultural legitimacy and access: specific traditions (*e.g., rewang or Seloko*) are context-dependent, but the underlying instructional logic—connecting familiar social practices to formal civic concepts—is adaptable.

The two rubrics were intended to capture complementary learning outcomes. Independent scoring followed by consensus review provided a discussion procedure, but the initial rating differences and an agreement statistic were not supplied. Future work should report pre-consensus agreement, establish how individual and group evidence are scored, and examine task comparability.

Limitations

This study involved a single Grade IV classroom, a small complete-case analytical sample (n = 22), a short intervention duration, and a descriptive classroom action research design without a control group. Although scoring safeguards were implemented, the teacher's dual role in instruction and research may have introduced subtle expectancy effects. Furthermore, because the two action cycles utilized different subject contexts (Cycle I: broad cultural customs; Cycle II: everyday home/school rules), the unbalanced content domain across cycles directly constrains the interpretation of score gains. The scores document classroom improvement associated with the scaffolded action bundle but cannot isolate the independent contributions of deep learning, PjBL, topic familiarity, repeated testing, teacher support, or maturation. Longer-term retention and transfer beyond the immediate curriculum topics were also not evaluated.

CONCLUSION

Across the two action cycles, reported mean conceptual-understanding scores changed from 65.3 to 80.0 and critical-thinking scores from 66.8 to 79.6 (n = 22). These first-to-final differences describe performance across non-equivalent tasks and do not estimate causal effects. The highest reported scores occurred in the final meeting, following revisions involving contextual prompts, clearer group roles, scaffolding, classification, presentation, and reflection. This study provides a context-specific account from one elementary classroom. Rather than establishing that projects necessarily improve learning, the findings suggest that culturally situated projects can support deeper engagement when their activities explicitly require representation, justification, application, and reflection. Educators may adapt this project progression to comparable elementary IPAS contexts while continuously monitoring student participation and task demand.

AUTHOR CONTRIBUTIONS

L.A.: conceptualization, classroom implementation, data collection, data analysis, and writing—original draft. A.S. and E.S.: methodology, supervision, validation, and writing—review and editing. All authors have read and approved the final version of the manuscript.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

DATA AVAILABILITY

De-identified datasets supporting the findings are available from the corresponding author upon reasonable request. Access is governed by institutional approval, parental/guardian consent constraints, and applicable school privacy policies to protect minor participants.

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