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Scaffolded Project-Based Learning for Slow Learners in Inclusive Elementary Mathematics: A Classroom Action Study

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Abstract

Background: Project-Based Learning (PjBL) is widely used to promote active learning, yet its implementation for students who require slower pacing and repeated instructional support remains underdocumented in inclusive elementary mathematics.

Aims: This study describes a scaffolded PjBL implementation in Grade V mathematics and examines the learning and motivational responses of five students identified through school-based assessment as slow learners.

Methods: A qualitative-dominant classroom action research design was conducted in one inclusive class of 30 students at UPT SPF SD Inpres Manggala, Makassar City, Indonesia. Five focal students were identified through classroom tests, observation, and teacher interviews. Across seven meetings, project-oriented learning was combined with guided worksheets, video and concrete media, repetition, individualized assistance, observation, interviews, and individual evaluation.

Results: All five focal students completed the assigned project tasks. Three could summarize the material in their own words, whereas two could restate or explain the main mathematical ideas after guided practice and evaluation. Persistence and interest in completing project work were evident, but verbal participation remained limited: three students expressed an opinion once across six discussion sessions and two did not contribute verbally. Learning devices were reported as receiving average validation ratings of at least 3 and were categorized as good, although item-level validation statistics were unavailable.

Conclusion: The findings support a conditional interpretation of inclusive PjBL: project activity was most workable when paired with competence-oriented scaffolding, repetition, concrete representation, and individualized guidance. Because the study lacked a comparison group and standardized pre-post motivation measures, the evidence should be interpreted as descriptive implementation evidence rather than causal proof of effectiveness.

INTRODUCTION

Project-Based Learning (PjBL) is often promoted as a corrective to passive instruction, but the strength of its evidence is more contested than its classroom popularity suggests. Recent synthesis indicates generally favorable effects on academic achievement, higher-order thinking, and twenty-first-century skills, while also showing substantial heterogeneity in study quality, implementation, and outcome measurement (Farshad & Fortin, 2026). Motivation-focused meta-analysis likewise reports advantages for project-, problem-, and case-based learning, yet the magnitude of improvement differs across motivational constructs and instructional conditions (Wijnia et al., 2024). At the elementary level, a systematic review found promising outcomes but concluded that weak designs and incomplete implementation reporting still restrict confident claims about effectiveness (Ferrero et al., 2021). Experimental work with young learners has nevertheless shown that well-designed PjBL can improve disciplinary learning and motivation when projects are embedded in coherent curriculum and teacher support (Duke et al., 2021). The controversy is therefore not whether projects can be educationally valuable, but whether the conditions that make them valuable are equally accessible to students with different learning profiles. This issue is especially important in inclusive classrooms, where autonomy, collaboration, and complex tasks can create opportunity for some learners while increasing cognitive and communicative demands for others. PjBL must consequently be examined as an instructional system whose effects depend on the interaction between project design, teacher mediation, and learner variability rather than as a universally effective technique.

Learner variability becomes particularly visible among students described in school practice as slow learners, who may require additional processing time, repeated explanation, concrete representations, and carefully sequenced guidance. The label must be used cautiously because it is an educational descriptor and cannot substitute for standardized psychoeducational diagnosis; low achievement can reflect interacting cognitive, motivational, instructional, and contextual influences. Contemporary inclusive pedagogy therefore emphasizes participation in shared learning opportunities while adapting access, pacing, and support so that difference does not become exclusion (Losberg & Zwodziak-Myers, 2024). Research on differentiated instruction similarly shows that mixed-ability classrooms demand purposeful variation in teaching rather than a single uniform route to the same goal (Gaitas et al., 2024). Teachers' capacity to plan such differentiation is shaped by their assumptions about curriculum and by how they interpret learner needs, making responsive planning central to inclusive practice (Maia & Freire, 2025). Broader evidence also associates inclusive teaching environments with students' social and emotional competencies, reinforcing the importance of support that enables meaningful participation rather than mere physical presence in the same classroom (Llorent et al., 2024). In the present Grade V class, five students were identified through school tests, observation, and teacher interviews as having persistent difficulty processing information quickly and understanding abstract material, alongside reduced interest in mathematics. Their classroom profile creates an empirical problem that is pedagogically important: active project work must remain challenging enough to support learning while being structured enough to prevent cognitive difficulty from becoming disengagement.

Motivation provides a second layer of urgency because completing an assigned task does not necessarily mean that a learner feels competent, autonomous, or willing to participate. Self-Determination Theory distinguishes autonomous motivation from controlled participation and proposes that competence, autonomy, and relatedness are central psychological conditions for sustained engagement. Meta-analytic evidence shows that intrinsic motivation and personally valued regulation are positively associated with persistence, achievement, and well-being, whereas amotivation is consistently related to poorer educational outcomes (Howard et al., 2021). A complementary meta-analysis identifies competence satisfaction as a particularly strong antecedent of self-determined motivation and highlights the role of autonomy-supportive teaching in shaping motivational quality (Bureau et al., 2022). Autonomy support is also positively related to engagement, self-beliefs, and other learning outcomes across educational settings (Mammadov & Schroeder, 2023). Classroom research further suggests that need-supportive teaching can strengthen engagement when students experience structure and autonomy support together rather than as competing instructional choices (Olivier et al., 2021). School-based intervention evidence shows that engagement itself can be changed through deliberately designed educational experiences, although different dimensions of engagement do not always move in parallel (Azevedo et al., 2023). For slow learners, these findings imply that additional structure may support rather than suppress autonomy when it reduces confusion, makes competence attainable, and gives students a realistic route into project participation.

Mathematics is a demanding context for this balance because abstract symbols, multistep procedures, and rapid classroom discourse can magnify differences in prior knowledge and processing speed. Student-centered learning can make content more meaningful, but its success depends on whether inquiry, collaboration, and task complexity are accompanied by sufficient instructional support. Research on collaborative learning shows that participation structures shape how children engage with peers and teachers, indicating that active formats do not automatically produce equally active participation for all students (Sun et al., 2022). Video-based evidence from primary and secondary classrooms similarly demonstrates that student-guided participation is associated with learning, while participation itself is conditioned by students' prior knowledge and opportunities to contribute (Decristan et al., 2023). Systematic review of open inquiry concludes that learner-centered approaches are strongest when learners receive adequate guidance and when the demands of inquiry are aligned with their readiness (Dah et al., 2024). In project-oriented computing education, combining PjBL with hands-on and flipped elements has also been linked with stronger learning, illustrating the value of multiple representations and structured access to difficult content (Malik & Zhu, 2023). Meta-analytic evidence from informal STEM PjBL further indicates that learning effects vary according to moderators in the instructional context rather than emerging from project activity alone (Santhosh et al., 2023). These findings rationalize the present focus on repeated explanation, guided worksheets, concrete and video media, and individualized assistance as integral components of PjBL rather than as remedial additions external to the model.

Recent PjBL scholarship increasingly emphasizes implementation quality, and this literature helps explain why the same model may produce different outcomes across classrooms. Experienced practitioners identify disciplinary learning, authentic work, collaboration, feedback, reflection, and revision as core practices that must be deliberately orchestrated rather than left to emerge from a project label (Pupik Dean et al., 2023). Analysis of student-centered PjBL designs likewise shows that curricular features and high-support teaching practices are related but not interchangeable, highlighting a continuing gap between designing projects and enacting them effectively (Farrow et al., 2024). Professional-development research demonstrates that teachers improve complex PjBL inquiry practices when coaching makes instructional moves visible, decomposable, and open to reflection (Kavanagh et al., 2024). Longitudinal evidence on scaling PjBL also shows that teachers sustain project-based practices through adaptation, ownership, and responsiveness to local student needs rather than through rigid replication (Seidel Potvin et al., 2021). Related work on shifts toward student-centered learning indicates that teachers' instructional beliefs and experiences influence how much responsibility can productively be transferred to learners (Dunbar & Yadav, 2022). K-12 STEM evidence further suggests that teacher capacity and efficacy are consequential for implementing student-centered and project-oriented practices at scale (Pozo-Rico et al., 2024). The dominant finding across these studies is therefore conditional rather than absolute: PjBL is strengthened by intentional teacher support, yet most implementation research concentrates on general classrooms, teachers, or older learners rather than slow learners in elementary mathematics, leaving unanswered how high-support PjBL can be operationalized when a small group of students needs substantially more repetition and guidance while remaining within a shared classroom activity.

A second limitation in the literature concerns how learning and motivation are interpreted when PjBL is used with heterogeneous learners. Inclusive PjBL research shows that students can value projects differently depending on whether the curriculum affords meaningful access, collaboration, and recognition of diverse ways of participating (Boardman & Hovland, 2024). At the same time, observation research in special education warns that classroom conclusions are credible only when behavioral indicators and interpretation boundaries are explicitly reported (Rodgers et al., 2022). Teacher-education studies show that PjBL can support agency, confidence, and professional identity, but these outcomes emerge in contexts with sustained reflection and structured pedagogical support that differ markedly from elementary slow-learner settings (Tsybulsky & Muchnik-Rozanov, 2023). The growing global evidence base thus documents average achievement, motivation, inquiry, teacher practice, and participation more extensively than the micro-processes through which slow learners gain access to a mathematics project. It also tends to treat positive engagement as a broad outcome even though persistence, task completion, verbal participation, and autonomous motivation are conceptually distinct. The explicit research gap is the shortage of implementation-focused evidence showing how scaffolded PjBL functions for slow learners in an inclusive elementary mathematics classroom while simultaneously reporting cognitive progress and unresolved motivational barriers. Filling this gap requires conservative interpretation because a classroom action study can illuminate mechanisms and feasibility without establishing a population-level causal effect; a source-grounded analysis that reports both successful project completion and limited classroom talk can therefore contribute a more differentiated account of what inclusive PjBL makes possible and what it does not resolve.

Against this background, the present study aims to describe the implementation of scaffolded PjBL in Grade V mathematics and to examine the learning and motivational responses of five students identified through school-based assessment as slow learners. The study focuses on seven meetings in which project-oriented work was combined with repetition, individualized guidance, worksheets, concrete and video media, and continuing evaluation. Learning is examined through project completion and students' documented ability to summarize, restate, or explain the mathematical material, while motivation is interpreted through persistence, interest, willingness to complete tasks, and verbal participation rather than through an undocumented scale score. Theoretically, the study connects PjBL implementation with competence-oriented support by arguing that learner autonomy in inclusive classrooms may depend on appropriately calibrated structure rather than on minimal teacher direction. It also extends the literature on differentiated and inclusive pedagogy by treating additional support as a route into a common learning activity rather than as a separate curriculum for the focal students. Practically, the study offers teachers a transparent account of how project work, individualized assistance, repetition, and multimodal resources can be combined without overstating the evidence for causal effectiveness. Methodologically, it responds to calls for clearer observation and implementation reporting by distinguishing documented classroom change from outcomes that were not measured with standardized instruments. The contribution is therefore a cautious, context-sensitive model of inclusive PjBL that positions scaffolded participation, rather than project completion alone, as the central unit for understanding slow learners' mathematics learning and engagement.

METHOD

Research Design

This study employed qualitative-dominant Classroom Action Research with an exploratory and implementation-focused orientation. The design was selected because the study sought to improve an existing Grade V mathematics learning process while documenting how a PjBL intervention functioned for students who required additional support, rather than estimating a population-level treatment effect. The source manuscript identifies the work as Classroom Action Research and records the essential action-research functions of planning, classroom implementation, observation, evaluation, and reflection, although it does not document multiple formally separated cycles. Accordingly, the revised report treats the seven-meeting intervention as one documented action sequence and does not invent additional cycles. The design also retains the original use of qualitative evidence from observation and interviews while incorporating descriptive information from classroom tests, task completion, and learning-device validation. Because there was no randomization, comparison group, or standardized pre-test/post-test motivation scale, all claims are framed as observed classroom changes and implementation patterns rather than causal effects.

Research Setting and Time

The study was conducted in a Grade V inclusive classroom at UPT SPF SD Inpres Manggala, Makassar City, South Sulawesi, Indonesia, within regular mathematics instruction. The source manuscript reports that the intervention was organized across seven instructional meetings and that integer operations formed part of the mathematics content, with video-supported PjBL introduced from the third meeting. The first meeting was used for orientation to the mathematics learning activities, the second introduced the relevant integer-operation material, and meetings three through seven combined project-oriented learning, guided practice, repetition, and individualized support. The exact calendar dates and semester were not documented in the source manuscript; therefore, no dates are invented in this revision. This temporal limitation is reported transparently because exact replication would require the authors to add the verified month, semester, and academic year before journal submission.

Population, Participants, and Identification of Slow Learners

The classroom population consisted of 30 Grade V students, of whom five were selected as focal participants using criterion-based purposive identification. The five students were identified from the convergence of classroom test results, direct observation, and interviews with the classroom teacher and mathematics teacher, which indicated persistent difficulty understanding abstract concepts or processing new information at the pace expected in the class. The same school-based records also described reduced learning interest and motivation among the five students. This classification was educational rather than clinical because the source manuscript does not report standardized intelligence testing, formal psychoeducational diagnosis, or disability assessment. The term slow learner is therefore used in this article only to reflect the school's instructional identification and not to imply a medical or psychological diagnosis. No additional exclusion criteria were documented, and the five focal students continued to participate in the same inclusive class as their peers while receiving more intensive guidance.

Research Instruments

Data were collected using a classroom diagnostic/achievement test, an observation record, teacher interview information, project-task and individual-evaluation records, and documentation of the instructional devices used during the intervention. Observation focused on students' participation, persistence in completing assigned work, responses during discussion, use of learning media, and ability to communicate the material after instruction. Learning comprehension was interpreted from project completion, classroom evaluation, the ability to summarize or restate mathematical content, and performance reported in the midterm assessment, while learning motivation was operationalized behaviorally through task persistence, interest in completing project work, classroom participation, and willingness to respond during discussion. The instructional package comprised an elementary lesson plan, an individualized learning program (PPI), teaching materials, student worksheets/media, and an evaluation instrument. The source manuscript also mentions questionnaires as a possible evaluation format but does not provide an administered motivation scale, item list, scores, or psychometric results; consequently, this revision does not treat questionnaire scores as evidence. This decision prevents the Results section from attributing numerical motivation changes that are not supported by the original data.

Table 1. Operationalization of Core Evidence Dimensions

Dimension	Indicators / evidence	Interpretive use
Learning comprehension	Project completion; ability to summarize or restate mathematical content; classroom and midterm evaluation	Descriptive evidence of understanding
Learning motivation	Task persistence; interest in completing projects; classroom participation; willingness to respond	Behavioral/observation al evidence
PjBL implementation	Participation in project-oriented tasks; use of worksheets, media, video, and guidance	Implementation fidelity at the level documented
Individualized support	PPI, repetition, consultation, concrete media, additional explanation	Scaffolding for focal students

Table 1 clarifies how the revised study distinguishes learning comprehension from learning motivation and implementation evidence. The table uses only indicators explicitly supported by the original manuscript and does not convert qualitative observations into invented scale scores. Learning motivation is therefore represented by persistence, interest, participation, and willingness to respond rather than by an undocumented questionnaire total. The PjBL dimension captures the project-oriented learning process and the support media that were actually reported. Individualized support is treated as a distinct analytic dimension because the focal students received additional explanation, repetition, and consultation. This operationalization improves replicability while keeping the claims proportional to the available data.

Validity and Trustworthiness

Instrument quality was addressed at two levels. First, the instructional devices were subjected to the validation procedure reported in the source manuscript, with each device receiving an average rating of at least 3 and being interpreted as good, although the number of validators, item-level means, scale anchors, and a formal content-validity coefficient were not documented. Second, the credibility of the classroom findings was strengthened through source and method triangulation by comparing test information, observation, teacher interviews, project-task records, and individual evaluation. This approach is consistent with the principle that classroom observation evidence should be interpreted through explicit behavioral indicators and multiple sources rather than unsupported global judgments (Rodgers et al., 2022). No Cronbach's alpha, Rasch statistic, or inter-rater coefficient is reported because the source record does not provide a scored psychometric motivation instrument or independent observer ratings. The revision therefore distinguishes validated instructional materials from the descriptive trustworthiness procedures used for the qualitative outcome evidence and avoids manufacturing reliability values.

Data Collection Procedure

Data collection followed a sequential classroom action procedure. During the identification stage, the researchers reviewed test performance, observed classroom learning, and consulted the class and mathematics teachers to identify five students who consistently required more time and support. During planning, the team prepared the lesson plan, PPI, teaching materials, student worksheets/media, video support, and evaluation procedures, with additional scaffolding and repetition built into the learning sequence for the focal students. During action, the class completed seven mathematics meetings, beginning with orientation and conceptual preparation and continuing with project-oriented tasks and guided work from the third meeting onward. During observation, the researchers documented project completion, individual learning responses, discussion participation, and the focal students' ability to summarize or explain the material. The reflection stage compared these observed responses with the initial classroom problem and recorded remaining barriers, particularly limited verbal participation and the continuing need for concrete guidance and repetition. Figure 1 summarizes this source-grounded procedure.

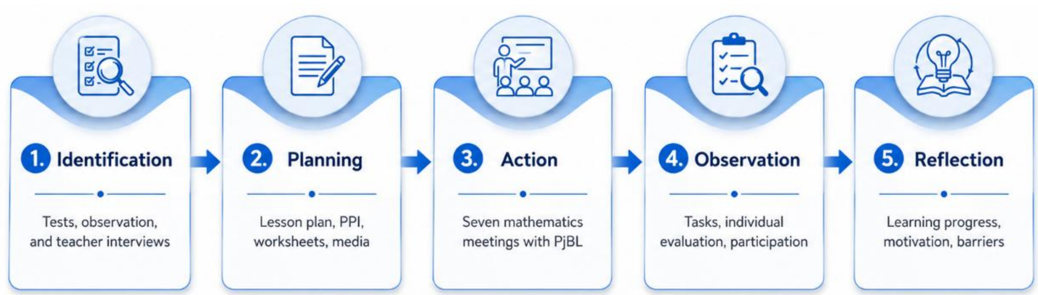

Figure 1. Classroom Action Procedure for Scaffolded Project-Based Learning

Figure 1 presents the five linked stages used to organize the classroom action sequence. Identification combined tests, classroom observation, and teacher interviews to determine the focal learners and the initial instructional problem. Planning translated those needs into a lesson plan, individualized learning program, worksheets, media, and additional scaffolding. Action occurred across seven mathematics meetings, while observation documented task completion, individual evaluation, and participation. Reflection compared student responses with the initial problem and identified both progress and remaining barriers. The figure represents one documented action sequence because the source manuscript does not provide evidence of multiple formally separated cycles.

Data Analysis

The study used descriptive qualitative analysis organized around data reduction, data display, comparison of evidence sources, and conclusion drawing. Observation and interview information was first reduced into four analytic dimensions: PjBL implementation, mathematics comprehension, learning motivation and participation, and the role of scaffolding. Test and task information was then used descriptively to corroborate the qualitative patterns, but no inferential statistics or effect sizes were calculated because the source data did not provide standardized pre-post scores or a comparison group. Within-case attention was given to the five focal students, followed by cross-case synthesis of common patterns such as task completion, ability to summarize or explain content, and discussion participation. The analysis retained convergent as well as negative or mixed evidence, especially the fact that stronger project persistence did not eliminate reluctance to speak during whole-class discussion. Interpretive credibility was supported through triangulation across tests, observations, teacher interviews, task records, and instructional documentation, while claims were deliberately limited to patterns directly documented in the classroom record (Rodgers et al., 2022).

Ethical Considerations

The study involved elementary-school students and was implemented within regular school learning; however, the source manuscript does not report an institutional ethics approval number, written parental consent procedure, or child-assent process. No identifying information about the five focal students is presented in the revised article, and findings are reported only at the group level. Because ethical documentation cannot be reconstructed retrospectively from the manuscript, the authors should verify and insert any school permission, parental/guardian consent, and institutional ethics information that was actually obtained before submission. This statement is intentionally transparent and should not be replaced by invented approval details.

RESULTS AND DISCUSSION

Results

The intervention was implemented in one inclusive Grade V classroom containing 30 students, with five students serving as the focal slow-learner group. Across seven mathematics meetings, the teaching sequence moved from orientation and conceptual preparation toward project-oriented work supported by worksheets, repeated explanation, video media, and individualized guidance. The first meeting introduced the learning expectations, while the second focused on integer operations and related conceptual preparation. Video-supported PjBL was introduced in the third meeting and the project-oriented approach continued through the remaining meetings. The five focal students completed the assigned project tasks within the support structure provided by the teacher and research team. These implementation data show that the project format was feasible for the focal students when additional guidance was embedded rather than provided as a separate curriculum.

Learning evidence showed meaningful but non-quantified progress among the five focal students. All five were able to complete the project tasks in accordance with their individual learning characteristics. Three students could summarize the mathematics material that had been taught, indicating that they could reorganize the content into a simpler verbal form. The other two students were able to restate or explain the core material after guided evaluation and repeated practice. The source record also reports that all five students responded well to the midterm-test questions after receiving regular testing and evaluation, although individual scores were not provided. Because no standardized pre-test/post-test dataset was available, these outcomes are interpreted as descriptive evidence of improved classroom understanding rather than a measured effect size.

Motivational evidence was mixed and therefore requires a more differentiated interpretation than the original manuscript provided. The five students showed persistence in completing project tasks and were reported to have greater interest in carrying the learning activities through to completion. At the same time, verbal participation during peer discussion remained low across six discussion sessions. Three students expressed an opinion only once, whereas two students did not contribute verbally during the recorded discussions. When asked about this pattern, the two non-participating students reported confusion about how to ask questions or explain their ideas and indicated a preference for reading picture-based materials. The results therefore suggest improvement in task-focused engagement without equivalent improvement in spontaneous classroom communication.

The instructional package combined whole-class PjBL with individualized learning support for the focal students. The source record lists a lesson-planning component, an individualized learning program, teaching materials, student worksheets/media, and an evaluation instrument as the main devices. These devices were reported to receive average validation ratings of at least 3 and were categorized as good. The exact rating for each device, number of validators, and scale anchors were not available in the source manuscript. The differentiated element of the intervention was primarily the additional guidance, consultation, repetition, and concrete media provided to the five focal students while they participated in the same classroom activities as their peers. This arrangement allowed the class to maintain a common project-based structure while adjusting the intensity of support to learner needs.

Table 2. Instructional Devices and Source-Reported Validation

Instructional component	Source-grounded specification	Validation status
Lesson plan	Project-oriented mathematics instruction aligned with the classroom sequence	Average rating >= 3; good
Individualized learning program (PPI)	Support adapted to the documented characteristics of the focal slow learners	Average rating >= 3; good
Teaching materials	Conventional teaching material used with additional explanation and repetition	Average rating >= 3; good
Student worksheet / learning media	Guided project steps and concrete support; video introduced from Meeting 3	Average rating >= 3; good
Evaluation instrument	Individual evaluation using formats intended to reduce unnecessary confusion	Average rating >= 3; good

Table 2 summarizes the instructional devices reported in the original study and the level of validation that can be defended from the available record. Every component was described as receiving an average rating of at least 3 and being categorized as good. The table does not assign separate numerical means because those values were not reported. It also uses the elementary-school term lesson plan rather than the higher-education term RPS while retaining the instructional function described in the source. The PPI is presented as the main vehicle for adapting support to the focal students without removing them from the common project activity. These data support feasibility of the instructional package but not a stronger psychometric claim about its validity.

Taken together, the results show a pattern of feasible project participation, improved ability to communicate learned content, and stronger task persistence, alongside persistent difficulty with verbal interaction. The evidence does not support a claim that every dimension of motivation improved to the same degree. Instead, the most visible gains occurred in project completion, willingness to continue working, and the ability to summarize or explain material after scaffolding. Discussion participation remained an unresolved barrier and points to a need for specific communication supports within future PjBL implementation. The learning-device validation and the classroom observations indicate that the intervention was organized systematically, but the absence of exact validation statistics and standardized outcome measures limits quantitative interpretation. The study therefore provides an implementation profile of scaffolded PjBL for slow learners rather than an experimental demonstration of effectiveness.

Table 3. Descriptive Learning and Motivation Evidence for the Five Focal Students

Outcome dimension	Documented evidence	Interpretation boundary
Project completion	All five focal students completed assigned project tasks	Feasible with scaffolding; no control comparison
Content communication	Three summarized the material; two restated/explained the core ideas	Descriptive post-implementation evidence
Midterm response	All five were reported to answer the UTS questions well	Exact scores unavailable
Discussion participation	Three students expressed one opinion; two did not respond across six discussion sessions	Verbal participation remained limited
Task-focused motivation	Greater persistence and interest in completing project work were observed/reported	No standardized motivation scale

Table 3 integrates the learning and motivational evidence without adding numerical values that were not present in the original dataset. The strongest common outcome was successful completion of the assigned project tasks by all five focal students. Content communication improved in differentiated forms, with three students summarizing and two students explaining or restating the material after support. The midterm result is retained only as a qualitative statement because the source provides no individual scores. Motivation is presented as mixed because persistence and interest increased while verbal discussion remained weak. This evidence structure makes the Results section more transparent and prevents task completion from being misrepresented as proof that every aspect of motivation improved.

Discussion

The first major finding is that all five focal students completed the assigned project tasks and could communicate the mathematics content after guided practice, although the form of communication differed across students. Three students summarized the material in their own words, whereas two were able to restate or explain the core ideas after additional support, suggesting that cognitive access emerged through a combination of project activity and scaffolding rather than through independent project work alone. This interpretation is consistent with elementary evidence showing that carefully designed PjBL can improve disciplinary learning (Duke et al., 2021) and with broader syntheses reporting positive but heterogeneous effects that depend strongly on implementation conditions (Ferrero et al., 2021; Farshad & Fortin, 2026). Experienced PjBL practitioners similarly treat disciplinary focus, iterative feedback, and structured collaboration as core teaching practices, which supports the view that teacher mediation is part of high-quality PjBL rather than a departure from it (Pupik Dean et al., 2023). The present study nevertheless cannot isolate the effect of the project from repetition, worksheets, video, concrete media, and individualized explanation because these elements were delivered as one instructional package. Its contribution is therefore conceptual as well as practical: for slow learners, the relevant explanatory unit is scaffolded project participation, and claims about PjBL should specify the supports through which access to the project was achieved.

The second finding is motivationally mixed: students showed persistence and interest in completing project work, but these positive responses did not translate into consistently strong verbal participation. Self-Determination Theory helps explain this pattern because motivation is multidimensional; feeling able to continue a task can improve before a learner becomes confident enough to speak publicly or initiate discussion. Meta-analyses show that competence, autonomy, and relatedness support autonomous motivation and engagement, while different motivational outcomes can respond differently to the same instructional environment (Howard et al., 2021; Bureau et al., 2022; Mammadov & Schroeder, 2023). The PjBL motivation literature likewise reports overall benefits but considerable variation across constructs, cautioning against treating task completion as a proxy for every aspect of motivation (Wijnia et al., 2024). Need-supportive classroom evidence further suggests that structure and autonomy support can work synergistically, which is relevant here because focal students received more guidance while still participating in the same project (Olivier et al., 2021). The result extends this literature by showing that competence-oriented scaffolding may first appear as persistence and willingness to finish work, while communicative agency can remain comparatively fragile and require a different form of support.

The third finding is the persistence of limited discussion participation despite evidence of improved task engagement, and this negative finding is analytically important rather than incidental. Across six discussion sessions, only three focal students expressed an opinion once and two did not contribute verbally, with the latter reporting confusion about how to ask or explain and a preference for picture-based materials. Research on classroom discourse shows that student-guided participation is associated with learning but is itself shaped by prior knowledge and the interactional opportunities created in class (Decristan et al., 2023). Studies of participation structures also demonstrate that children's engagement changes according to whether instructional arrangements invite, distribute, and support contributions rather than simply making collaboration available (Sun et al., 2022). Inclusive PjBL research similarly indicates that students experience projects differently depending on the accessibility of collaboration and the extent to which diverse forms of participation are recognized (Boardman & Hovland, 2024), while inclusive teaching is linked with broader social-emotional competencies that can support classroom interaction (Llorent et al., 2024). The present evidence therefore modifies a simple motivational-success narrative: scaffolded PjBL appeared to support persistence and comprehension more readily than spontaneous public talk, implying that communication scaffolds such as visual response options, rehearsal time, sentence starters, paired discussion, and structured turn-taking should be designed explicitly rather than assumed to emerge from group work.

The fourth finding is that individualized guidance, repetition, and concrete or visual media were central conditions of participation rather than peripheral accommodations. This pattern aligns with inclusive pedagogy, which seeks common participation while varying the support needed to reach shared learning goals (Losberg & Zwodziak-Myers, 2024). Research on differentiated instruction likewise shows that effective mixed-ability teaching involves deliberate adaptation of process, support, and curriculum planning instead of lowering expectations for particular learners (Gaitas et al., 2024; Maia & Freire, 2025). The current classroom extends those principles into PjBL because the five focal students were not assigned a separate mathematics objective; they were given a more accessible pathway through additional explanation, consultation, and repeated opportunities to process the same content. Evidence from student-centered learning and inquiry research reinforces this logic by showing that increased learner responsibility is productive when teachers calibrate guidance to task complexity and readiness (Dunbar & Yadav, 2022; Dah et al., 2024). Theoretically, this finding reframes scaffolding as motivational infrastructure: carefully timed structure can enlarge autonomy by enabling a learner to act competently within a project that would otherwise exceed current processing resources.

The fifth finding concerns implementation quality and the reported validity of the instructional devices, all of which received source-reported average ratings of at least 3 and were categorized as good, although item-level statistics and validator details were unavailable. This evidence supports feasibility of the instructional package but cannot establish psychometric validity, and that distinction is essential when positioning a small classroom action study in the international literature. Observation scholarship emphasizes that validity depends on transparent links among constructs, recorded behaviors, and interpretation rather than on unreported numerical labels (Rodgers et al., 2022). PjBL implementation research similarly shows that curriculum design does not guarantee high-support enactment, making teacher practice, coaching, reflection, and adaptation central to fidelity and quality (Farrow et al., 2024; Kavanagh et al., 2024). Studies of sustained PjBL adoption further indicate that effective implementation involves teacher ownership and contextual modification (Seidel Potvin et al., 2021), while teacher-development research shows that project-oriented pedagogies can influence professional agency when supported by structured reflection (Tsybulsky & Muchnik-Rozanov, 2023; Pozo-Rico et al., 2024). Accordingly, the present study should be read as evidence that a locally developed package of lesson planning, individualized support, worksheets, media, and evaluation can be enacted coherently, not as proof that the package has established measurement properties or that its effects will generalize unchanged to other schools.

The final contribution lies in positioning this study within a global PjBL literature that increasingly favors learner-centered inquiry but still provides limited process evidence for slow learners in elementary mathematics. Hands-on and project-oriented designs can improve learning when difficult content is represented through multiple forms and students are given structured opportunities to apply concepts (Malik & Zhu, 2023), while STEM meta-analysis confirms that context and design moderate project-based effects (Santhosh et al., 2023). The present classroom adds a learner-variability perspective by showing that a common project can coexist with differentiated pacing and support, yet it also demonstrates that successful completion does not erase differences in communicative participation. This nuance complements school-engagement research showing that interventions can alter engagement while different behavioral dimensions remain uneven (Azevedo et al., 2023) and aligns with broader evidence that effective PjBL depends on coherent high-support practices rather than nominal adoption of a model (Farrow et al., 2024). The novelty is therefore not a claim that PjBL universally solves slow learning, but a conditional proposition that project-based mathematics can become more inclusive when competence-oriented scaffolding is treated as part of the pedagogy and when motivation is disaggregated into observable dimensions. Future comparative and longitudinal studies should test this proposition with verified learner-identification criteria, explicit project products, validated age-appropriate motivation measures, repeated achievement assessments, and longer follow-up so that feasibility evidence can be translated into stronger causal knowledge.

Implications

The findings have several implications for inclusive elementary mathematics teaching. Teachers can use a common project structure for the whole class while providing slower-processing learners with smaller task steps, repeated explanation, visual examples, guided worksheets, and additional time to formulate responses. Motivation should be monitored through several indicators rather than inferred from project completion alone, because persistence may improve before students become confident enough to speak in peer discussion. Structured communication supports such as rehearsal with a partner, sentence starters, picture prompts, and predictable turn-taking may help convert task engagement into classroom participation. Schools should also document the instructional adaptations used for focal learners so that future reflection can distinguish the contribution of the project itself from the contribution of scaffolding. In this sense, PjBL is most defensible as an inclusive strategy when it is designed as flexible participation in a shared learning goal rather than as identical independence for every student.

Limitations

Several limitations constrain interpretation of the findings. The study involved one Grade V class and only five focal slow learners, so the results cannot be generalized statistically. The classification of slow learner was based on school tests, observation, and teacher interviews rather than a standardized psychoeducational assessment, and the exact identification thresholds were not documented. The source manuscript did not provide the intervention dates, a comparison group, standardized pre-post achievement scores, a validated motivation scale, item-level validation statistics, or long-term follow-up. Although learning devices were reported as receiving average ratings above 3, the number and expertise of validators and the scale anchors were unavailable. The discussion data also show that verbal participation remained low, which means that the intervention did not resolve all dimensions of engagement. These limitations make the study useful for generating implementation hypotheses but insufficient for making strong causal claims about PjBL effectiveness.

Future Research

Future research should combine the implementation strengths of classroom action research with more explicit measurement. Studies should report verified criteria for identifying slow learners, exact participant characteristics, intervention dates, the project product and task sequence, and the dosage of individualized support. A validated age-appropriate motivation instrument can be combined with structured observation so that changes in interest, persistence, autonomy, competence, and verbal participation are measured separately. Repeated mathematics assessments or a comparison class would allow researchers to estimate change more rigorously without losing the contextual detail of classroom implementation. Longer follow-up is also needed to determine whether task persistence and content understanding are sustained after intensive scaffolding is reduced. Finally, future PjBL designs should test communication scaffolds explicitly because the present study suggests that willingness to complete a project and willingness to speak publicly may follow different developmental pathways.

CONCLUSION

This classroom action study shows that scaffolded Project-Based Learning can be implemented with five students identified by school-based assessment as slow learners within an inclusive Grade V mathematics class. Across seven meetings, all five completed the assigned project tasks, three could summarize the learned material, and two could restate or explain the core ideas after guided practice and evaluation. The strongest motivational evidence concerned task persistence and interest in completing project work, while discussion participation remained limited. These findings indicate that PjBL should not be interpreted as a stand-alone solution for slow learners; its practical value emerged from the combination of project activity, repeated explanation, individualized guidance, worksheets, concrete media, and video support. The study therefore supports a conditional view of inclusive PjBL in which learner autonomy is strengthened by competence-oriented scaffolding rather than by reducing teacher support. Because the evidence is descriptive and lacks standardized pre-post measures and a comparison group, the findings should be treated as implementation evidence rather than causal proof.

The study contributes a more differentiated account of motivation and inclusion than the original manuscript by reporting both improvement and unresolved barriers. It positions slow learners as participants in a shared classroom project rather than as recipients of a separate curriculum, while recognizing that equitable participation may require different levels of instructional support. For teachers, the central implication is to preserve common learning goals but vary pacing, explanation, repetition, media, and response opportunities according to students' needs. For researchers, the study identifies several measurement priorities, including transparent learner-identification criteria, validated motivation measures, detailed project descriptions, and longer follow-up. These additions are necessary before the magnitude and durability of PjBL effects for slow learners can be established. Even with these limitations, the present evidence offers a grounded starting point for designing project-based mathematics instruction that is active, supportive, and more responsive to learner variability.

AUTHOR CONTRIBUTION STATEMENT

Specific CRediT roles were not reported in the source manuscript and therefore are not assigned in this revision. Before submission, the authors should replace this statement with a verified description of each author's contribution to conceptualization, classroom implementation, data collection, analysis, writing, and final approval. This verification is necessary to ensure that the contribution statement accurately reflects the work performed by Riswana, Fatihah Amania Firman, Yustina Jimmy, Nur Afni Aprilia, Yani Labok, and Rian Mansyur.

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