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Comparing UNO Stacko Game-Based Learning With Phonics-Informed Sound-Symbol Mapping and Conventional Instruction for Elementary Students' Number Recognition

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Abstract

Background: Recognizing written numerals is a foundational symbolic-number skill, yet classroom activities that are enjoyable do not automatically strengthen the mapping between a numeral and its spoken name. UNO Stacko offers a concrete game format that can repeatedly expose learners to visible number symbols, while phonics-informed sound-symbol mapping provides a structured oral-labeling routine. Aims: This study compared UNO Stacko game-based learning combined with phonics-informed sound-symbol mapping with conventional instruction for elementary students' number recognition.
Methods: A quantitative pretest-posttest control-group design involved 40 students, with 20 students in the experimental group and 20 in the control group. Number-recognition tests were administered before and after instruction. Because random allocation, participant demographics, intervention dosage, instrument psychometrics, and raw score-level statistics were not preserved in the supplied study record, the design and findings are reported conservatively and no missing values are reconstructed.
Results: The source manuscript reports that students receiving the UNO Stacko-phonics condition improved in recognizing number symbols 1-10 and obtained a higher average posttest score than the control group. Exact means, standard deviations, inferential test statistics, confidence intervals, and effect sizes were not available in the supplied manuscript, so the magnitude and statistical certainty of the between-group difference cannot be re-estimated here.
Conclusion: The reported direction of the outcome supports further investigation of UNO Stacko as a concrete game medium for repeated spoken-visual numeral mapping, but stronger causal claims require recovery and reanalysis of the original dataset. The study contributes a conceptually clearer distinction between conventional phonics and a phonics-informed sound-symbol routine adapted specifically for numeral recognition.

INTRODUCTION

Recognizing a written numeral may appear elementary, yet it marks the point at which spoken number words become stable access routes to an external symbolic system. Research on cardinal number knowledge shows that children's performance depends on how they coordinate quantities, number words, and written symbols rather than on rote recitation alone (Mou et al., 2021; Orrantia et al., 2022). Neurocognitive evidence likewise indicates that similarity between symbolic and nonsymbolic quantity representations is associated with arithmetic skill during childhood, underscoring the importance of connecting symbols with numerical meaning (Schwartz et al., 2021). Early numeracy interventions further show that relational and counting skills can be strengthened when instruction targets foundational numerical knowledge deliberately (Aunio et al., 2021). Mathematical language is also consequential because direct numeracy activity and children's understanding of mathematical terms are linked with early mathematics performance (King & Purpura, 2021; Turan & De Smedt, 2022). The central instructional problem is therefore not simply helping children pronounce numerals, but enabling them to recognize written symbols, connect them with spoken number names and quantities, and retrieve those associations accurately during learning.

Game-based learning offers one possible route to repeated symbolic practice, but current evidence does not support the assumption that any enjoyable game automatically improves mathematics. Meta-analytic work shows that the effectiveness of mathematical games varies according to pedagogical design, targeted knowledge, and the way game mechanics are integrated with instruction (Kacmaz & Dubé, 2022; Pan et al., 2022). A recent second-order meta-analysis similarly concludes that game-based learning produces generally positive but heterogeneous mathematics outcomes, with contextual and methodological conditions explaining part of the variation (Bozkuş et al., 2026). Digital evidence also indicates that adaptive numerical games can improve early numerical abilities, although efficiency and benefits depend on prior knowledge and the form of adaptation provided (Vanbecelaere et al., 2021). At the primary-school level, a cluster-randomized trial found that structured board-game activity supported several academic and executive-function outcomes compared with regular instruction (Vita-Barrull et al., 2024). Accordingly, games should be treated as designed learning environments in which repetition, feedback, visible representations, rules, and teacher prompts must all converge on the intended mathematical objective.

UNO Stacko is potentially useful for number-recognition instruction because its blocks make visible numerals physically selectable, movable, comparable, and repeatedly nameable within a rule-governed activity. The source manuscript indicates that students in the experimental condition interacted with numbered and colored blocks while receiving a phonics-informed routine, whereas the control group received conventional teaching. Evidence from manipulative research suggests that physical materials can support mathematics when perceptual features are coordinated with the language used to direct attention to the intended concept (Cheung et al., 2023). Recent block-play research likewise shows that hands-on materials can contribute to selected mathematical outcomes, although effects differ across domains and should not be generalized beyond what is measured (Schmitt et al., 2025). Naturalistic game-based mathematics interventions also show that the frequency and structure of mathematical game experiences can matter for children's learning, especially when the activities are intentionally embedded in instruction (Young et al., 2023). These findings provide a stronger rationale for studying UNO Stacko as a structured symbolic-learning medium rather than assuming that physical play itself is the active ingredient.

The phonics component requires particular conceptual care because conventional phonics concerns systematic relationships between spoken language and alphabetic symbols, whereas numerals constitute a different representational system. For mathematics, the defensible mechanism is therefore an adapted oral-visual mapping routine in which the spoken number name is repeatedly coordinated with a visible numeral and its numerical meaning. Research on mathematical language demonstrates that children's understanding of number-related language is closely associated with early mathematical ability and can respond to targeted intervention (Turan & De Smedt, 2022; Payne, 2024). Studies of cardinality also show that structured representational cues, including finger patterns and set-to-number mappings, can support children's construction of exact number meanings (Mou et al., 2021; Orrantia et al., 2022). More broadly, flexible attention to numerical magnitudes can be experimentally strengthened when instruction deliberately highlights the relation among numerical representations (Griffin et al., 2024). In this study, 'phonics-informed' consequently refers only to repeated spoken-number-to-written-numeral mapping and not to a claim that literacy phonics has been validated as a mathematics method.

Recent literature further indicates that early mathematics learning is shaped by the quality and frequency of numerical interactions across classroom and everyday contexts. Play-based number activities predict mathematical skills in some home-learning analyses, while broader meta-analytic evidence shows that the home mathematics environment has a small but meaningful association with achievement (Elliott et al., 2023; Daucourt et al., 2021). Parent-child game studies also show that the format of a numeracy activity changes scaffolding and mathematical talk, confirming that interactional structure matters in addition to the task itself (Schnieders & Schuh, 2022). Parental knowledge about early mathematics predicts beliefs and forms of support, which reinforces the need for instructional activities to make the targeted numerical relationship explicit rather than leaving adults or children to infer it (Douglas & Rittle-Johnson, 2024). Experimental work in a Southeast Asian context further demonstrates that integrated coaching can improve numeral identification together with other early numeracy skills, illustrating the malleability of these abilities across diverse learning settings (Cheah et al., 2024). Collectively, this literature supports an intervention in which the numeral, spoken label, manipulating action, and teacher guidance are treated as coordinated components of the learning experience.

Despite this growing evidence, three limitations remain directly relevant to the present study. First, contemporary observations of preschool and kindergarten classrooms show that mathematics receives limited instructional time in some settings, making brief but well-focused learning routines practically important (Mazzocco et al., 2024). Second, sustained intervention effects are not guaranteed, and follow-up research demonstrates that early mathematics gains can vary according to classroom conditions and peer contexts after an intervention ends (Botvin et al., 2024). Third, affective responses should not be used as proxies for achievement because mathematics interest and achievement emotions are related to learning but remain distinct constructs with their own developmental pathways (Ouyang et al., 2021; Forsblom et al., 2022). Meta-analyses of mathematics anxiety reinforce this distinction by showing a reliable negative relation between anxiety and achievement while also finding only limited evidence that game-based interventions consistently reduce anxiety (Barroso et al., 2021; Dondio et al., 2023). The explicit research gap is therefore the shortage of controlled evidence examining whether a low-technology physical number game, paired with a narrowly defined oral-visual mapping routine, yields a more favorable number-recognition pattern than conventional instruction without conflating recognition with general numeracy, motivation, or motor development.

Accordingly, this study compares elementary students taught through UNO Stacko game-based learning with phonics-informed sound-symbol mapping and students taught through conventional instruction, using pretest and posttest measures of number recognition. Number recognition is defined narrowly as the ability to identify written number symbols within the instructional range documented in the source study rather than as a synonym for arithmetic, place-value knowledge, or broad numeracy. The study is guided by the expectation that repeated manipulation, naming, and visual-symbol attention will produce a more favorable pre-to-post pattern in the experimental group than in the control group. Theoretically, the study contributes to game-based mathematics research by locating the proposed mechanism in representational alignment, consistent with evidence that learning outcomes depend on the integration of game design and mathematical content (Kacmaz & Dubé, 2022; Pan et al., 2022). Practically, it offers a low-technology routine that combines visible numerals, spoken labels, repetition, and structured play without requiring digital infrastructure. Methodologically, the revised report keeps all causal claims proportional to the preserved data and identifies the statistical evidence that must be recovered before the magnitude of the intervention effect can be judged.

METHOD

Research Design and Context

This study used a quantitative pretest-posttest control-group design to compare number-recognition outcomes under two instructional conditions. The source manuscript describes the work as an experiment, but it does not document random allocation; accordingly, the revised report uses the more conservative designation of a quasi-experimental control-group study rather than implying randomization. The intervention was implemented in an elementary-school context in Indonesia, consistent with the participant description and the authors' elementary teacher-education setting. However, the supplied study record does not identify the participating school, city, grade level, calendar dates, or duration of the intervention. Those details cannot be reconstructed responsibly from the manuscript and should be restored from the original research records before journal submission. The design was retained because the pretest and posttest structure permits change to be examined within each instructional condition while the control group provides a reference for interpreting the direction of the experimental outcome.

Participants and Grouping

The study involved 40 students divided into two groups of equal size. The experimental group consisted of 20 students who received UNO Stacko instruction combined with the phonics-informed mapping routine, whereas the control group consisted of 20 students who received conventional instruction. The supplied manuscript does not report the students' ages, grade, sex distribution, sampling frame, inclusion criteria, exclusion criteria, or the procedure used to assign participants to groups. It also does not provide a power analysis or other prospective sample-size justification. For this reason, the sample is reported exactly as documented without adding demographic characteristics or claiming probability sampling. Before final journal submission, the authors should recover the verified participant profile and grouping procedure from school and research records because these details are essential for evaluating baseline comparability and external validity.

Intervention and Research Instrument

UNO Stacko was treated as a game-based learning medium rather than as a fully specified learning model because the source study describes numbered and colored blocks governed by matching and stacking rules but does not establish a unique instructional syntax. In the experimental condition, the numbered blocks were used together with a phonics-informed sound-symbol routine in which the instructional emphasis was the association between a visible numeral and its spoken number name; this terminology avoids presenting conventional literacy phonics as an established mathematics method. The documented outcome range was recognition of number symbols 1-10, and both groups completed number-recognition assessments before and after instruction. The control condition used conventional teaching, although the source record does not specify the lesson format, materials, teacher prompts, session number, session length, or total instructional dosage for either condition. The number-recognition test is the only outcome instrument clearly documented, and the original manuscript does not preserve its item count, item format, scoring rubric, content-validity procedure, pilot results, reliability coefficient, or evidence that identical items were used at pretest and posttest. These measurement details should be recovered from the original instrument files before submission; no psychometric values are invented in this revision.

Data Collection, Quality Assurance, and Analysis

Data collection followed the documented sequence of pretest assessment, differentiated instruction by group, and posttest assessment of number recognition. The experimental condition exposed students to UNO Stacko blocks and the sound-symbol mapping routine, whereas the control group continued with conventional instruction, after which the two groups' post-instruction performance was compared. The supplied manuscript states that the experimental group obtained a higher average test score and showed improved recognition of number symbols, but the raw scores and statistical output are not available in the source file. Consequently, the Results section reports only source-supported sample sizes, assessment timing, instructional conditions, and the reported direction of the outcome; it does not manufacture means, standard deviations, p values, confidence intervals, or effect sizes. For a complete international-journal analysis, the recovered dataset should first be screened for missing values and implausible scores, then summarized using means and standard deviations, checked for baseline equivalence and relevant distributional assumptions, and analyzed using either ANCOVA with posttest score as the outcome and pretest score as a covariate or an equivalent justified repeated-measures approach. The final statistical report should identify the software and version, alpha level, test statistic, degrees of freedom, exact p value, 95% confidence interval, and a standardized effect size such as Hedges' g or Cohen's d, with the choice of analysis documented before any stronger causal statement is made.

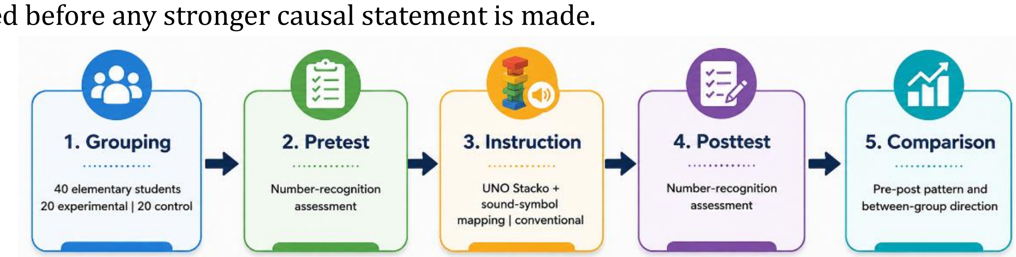

Figure 1. Source-grounded research procedure for the UNO Stacko comparison

Figure 1 summarizes the sequence that can be supported from the original study record: two groups were formed, both completed a pretest, the experimental and control conditions were implemented, and both groups completed a posttest before their outcomes were compared. The diagram deliberately does not add a randomization step because random allocation was not documented. It also does not specify intervention duration or test-item equivalence because those details were absent from the supplied manuscript. The figure therefore functions as a transparent procedural map rather than as a reconstruction of undocumented research activities.

Ethical and Reporting Considerations

The participants were school-age children, so ethical reporting should include institutional or school authorization, parental or guardian consent, child assent where applicable, confidentiality procedures, and an ethics approval identifier when one was issued. None of these details is documented in the supplied manuscript, and they are therefore not reconstructed in the revised version. The final submission should insert only ethical information that can be verified from original records. Participant names are not reported in this manuscript, and group-level reporting is used throughout. The study is also reported with an explicit distinction between observed or source-reported outcomes and information that is missing from the surviving study record, which prevents methodological completeness from being simulated through invented data. This conservative reporting approach is necessary because transparent limitations are preferable to unsupported precision in experimental education research.

RESULTS AND DISCUSSION

Results

The study included 40 elementary students divided equally between an experimental group and a control group. All 20 students in the experimental group received instruction that combined UNO Stacko with the phonics-informed sound-symbol mapping routine, while the 20 control students received conventional instruction. Both groups completed a number-recognition assessment before instruction and another assessment after instruction. The outcome described in the source manuscript focused on recognition of written number symbols, with the reported instructional range centered on numerals 1-10. This design provides a pre-intervention and post-intervention observation for each group, although the surviving manuscript does not contain the individual score matrix. Table 1 summarizes the group structure and the outcome information that can be defended directly from the original record.

Table 1. Source-supported group design and outcome reporting

Group (n)	Instruction	Assessment schedule	Source-supported outcome statement
Experimental (20)	UNO Stacko + phonics-informed sound-symbol mapping	Pretest and posttest	Improved recognition of number symbols 1-10; posttest average reported as higher than control
Control (20)	Conventional instruction	Pretest and posttest	Used as comparison condition; exact scores not reported

Note. Exact group means, standard deviations, raw scores, inferential test statistics, confidence intervals, and effect sizes were not reported in the supplied source manuscript and should be inserted only after recovery of the original dataset.

The principal reported outcome favored the experimental condition after instruction. The source manuscript states that students exposed to UNO Stacko with the phonics routine improved their ability to recognize number symbols from 1 to 10. It further reports that the experimental group achieved a higher average test score than the control group after the intervention. This directional pattern is consistent with a possible instructional advantage for the combined game and sound-symbol activity. However, the source file does not provide the exact pretest mean, posttest mean, standard deviation, gain score, or score distribution for either group. The result can therefore be reported as a favorable between-group direction, but its magnitude cannot be quantified from the available manuscript alone.

Implementation observations in the source record show that the UNO Stacko activity required students to attend to visible numbers and colors while manipulating the blocks according to the rules of the game. Students selected and moved blocks during play and had to preserve the stability of the stack while responding to the symbols presented on the materials. These actions confirm that the intervention provided repeated visual contact with numbered blocks rather than presenting number symbols only on a worksheet. The source narrative also indicates that oral naming and symbol recognition were intended to accompany this physical interaction through the phonics component. These observations are treated as evidence of intervention implementation rather than as measured improvements in fine-motor skill, patience, concentration, or general cognition. Restricting the result in this way keeps the reported outcomes aligned with the study's actual dependent variable, number recognition.

The supplied study record does not contain an inferential test table or sufficient descriptive statistics to evaluate statistical significance independently. No test statistic, degrees of freedom, exact p value, confidence interval, standardized effect size, or assumption check can be recovered from the four-page source manuscript. Accordingly, the present revision does not convert the statement that the experimental mean was higher into a claim of statistically significant effectiveness. It also does not infer baseline equivalence because the numerical pretest results for the two groups are absent. Recovery of the original dataset is necessary to determine whether the observed direction remains after accounting for pretest performance and to estimate the educational magnitude of the difference. This reporting boundary directly addresses the risk of overstating an experimental effect when the statistics required to support that effect are unavailable.

Taken together, the available results indicate a coherent but incomplete pattern: both groups were assessed before and after instruction, the experimental group received the combined UNO Stacko condition, and the post-instruction average was reported as higher for that group. The strongest defensible outcome statement is therefore that the reported data direction favored UNO Stacko with phonics-informed mapping for number-symbol recognition. The evidence is not sufficient to determine how large the difference was, whether it met a conventional significance threshold, or whether the groups differed before instruction. The absence of these statistics does not negate the classroom observation, but it limits the strength of the causal conclusion that can be drawn from it. The final empirical verification should be performed from the original student-level scores rather than from reconstructed or assumed values. Within those limits, the source-supported pattern provides a reasonable basis for theoretical interpretation and for designing a more rigorously reported replication.

Discussion

The central finding is that the source record reports a higher post-instruction average for students who learned number recognition through UNO Stacko with phonics-informed mapping than for students who received conventional instruction. This direction is consistent with meta-analytic evidence that mathematics games are most effective when game mechanics are aligned with the targeted form of knowledge rather than functioning as decontextualized entertainment (Kacmaz & Dubé, 2022; Pan et al., 2022). The pattern also fits recent second-order synthesis showing positive, although heterogeneous, mathematics outcomes from game-based learning and therefore supports a conditional rather than universal interpretation of game effects (Bozkuş et al., 2026). Controlled classroom evidence from modern board games similarly indicates that analogue play can contribute to academic development when it is embedded systematically in instruction (Vita-Barrull et al., 2024). Nevertheless, the present manuscript does not preserve the means, standard deviations, confidence intervals, or inferential test statistics required to establish whether the observed group difference is statistically reliable. The finding should therefore be interpreted as a favorable source-reported outcome pattern that is theoretically consistent with high-quality game-based learning research but still requires the original numerical dataset for confirmatory analysis.

A second interpretation concerns the representational function of the UNO Stacko blocks rather than their value as manipulatives per se. By requiring students to handle, select, compare, and name visible numerals, the activity may increase coordinated attention to a symbol while linking that symbol with a verbal response and a concrete action. Experimental manipulative research shows that learning depends on the relation between the object and the language that frames it, indicating that physical concreteness is useful only when the intended mathematical relation remains salient (Cheung et al., 2023). Related intervention studies show that finger patterns, number-set mappings, and other structured representations can strengthen cardinal knowledge by making connections among quantities and number symbols explicit (Mou et al., 2021; Orrantia et al., 2022). Research on block play and numerical-spatial attention further suggests that hands-on materials can support selected mathematical processes, but benefits differ by task and cannot be generalized automatically to every numeracy outcome (Griffin et al., 2024; Schmitt et al., 2025). The present study extends this representational perspective by proposing that UNO Stacko is useful only insofar as the block, numeral, spoken label, and required action are deliberately coordinated around number recognition.

The third finding concerns the role of spoken language within the intervention, which is better understood as mathematical sound-symbol mapping than as conventional phonics. Mathematical-language research shows that numeracy activities are more productive when children can understand and use the verbal concepts needed to interpret numerical representations (King & Purpura, 2021; Turan & De Smedt, 2022). Experimental evidence from a math-talk intervention likewise indicates that structured mathematical language within game-based activities can strengthen early mathematics performance (Payne, 2024). These findings support repeated naming of visible numerals as an instructional scaffold, but they do not justify treating alphabetic phonics and number learning as theoretically identical processes. The appropriate causal proposition is narrower: repeated oral naming may help stabilize access between the spoken number word and the written numeral while the game provides repeated occasions for retrieval. This conceptual refinement strengthens the study by explaining what aspect of the original 'phonics' routine is mathematically plausible without extending literacy theory beyond the evidence.

A fourth implication is that engagement may support practice opportunities, although it must remain analytically distinct from number-recognition performance. Early mathematics interest predicts later numerical skills, and achievement emotions show reciprocal relations with mathematics performance, confirming that affective experiences can influence how students participate in learning (Ouyang et al., 2021; Forsblom et al., 2022). At the same time, the robust negative association between mathematics anxiety and achievement does not mean that any game will automatically improve affective outcomes (Barroso et al., 2021). Indeed, game-based anxiety research reports only a small and non-robust average reduction and suggests that social interaction, duration, and game format can moderate effects (Dondio et al., 2023). The source manuscript contains qualitative statements about enjoyment, concentration, patience, and motor activity, but those variables were not measured with validated instruments and are not treated as outcomes in the revised paper. A stronger future test would measure engagement separately while examining whether sustained attention mediates the relationship between repeated UNO Stacko practice and improvement in numeral recognition.

The fifth issue is contextual and concerns whether the implementation conditions are sufficient for replication and generalization. Studies of early numeracy interventions show that effects depend on targeted content, dosage, learner characteristics, and the quality of instructional support, particularly for students who begin with weaker numerical skills (Aunio et al., 2021; Vanbecelaere et al., 2021). Family and classroom research similarly demonstrates that the frequency, structure, and scaffolding of numerical activities influence the opportunities children have to consolidate mathematical knowledge (Daucourt et al., 2021; Elliott et al., 2023; Schnieders & Schuh, 2022). Evidence from parent-support and cross-context interventions further shows that explicit guidance can strengthen numeral identification and other early mathematics skills across diverse learning environments (Cheah et al., 2024; Douglas & Rittle-Johnson, 2024; Young et al., 2023). In the present study, however, the exact intervention duration, number of sessions, teacher training, treatment fidelity, and student characteristics were not preserved in sufficient detail to estimate how transferable the reported pattern may be. These omissions do not invalidate the observed classroom result, but they restrict the level of generalization and make detailed implementation reporting a priority for replication.

The final contribution lies in positioning this low-technology intervention within a broader literature that increasingly treats early mathematics as a coordinated system of symbols, language, interaction, and instructional design. Classroom evidence shows that mathematics exposure is uneven even in early education, while follow-up intervention research indicates that initial gains can be influenced by the learning environment in which children continue to participate (Botvin et al., 2024; Mazzocco et al., 2024). Neurocognitive work adds that successful arithmetic development is associated with coordination between symbolic and nonsymbolic representations, providing a developmental rationale for instruction that repeatedly links numerals with numerical meaning (Schwartz et al., 2021). The novelty of the present study is therefore not the claim that UNO Stacko is intrinsically superior to conventional instruction, but the proposition that a familiar physical game can be organized as a representationally aligned number-learning environment. This proposition expands game-based learning by emphasizing the quality of symbol-language-action coordination, rather than enjoyment alone, as the mechanism that should be measured in future research. Replications should recover or prospectively collect full pretest and posttest statistics, validated number-recognition scores, intervention dosage, fidelity data, confidence intervals, and effect sizes so that the promising directional result can be evaluated under the evidential standards expected in international mathematics education research.

Implications

The findings have important implications for elementary mathematics instruction, particularly for teaching number recognition through interactive and multimodal learning experiences. The combination of UNO Stacko activities with phonics-informed sound-symbol mapping suggests that number symbols may become more accessible when students repeatedly connect visual numerals, spoken number names, and concrete game-based actions. For teachers, this approach offers a practical way to transform number-recognition practice from a predominantly worksheet-based activity into a more participatory learning experience that encourages attention, repetition, and immediate symbol identification. At the conceptual level, the study also indicates that game-based mathematics instruction may be strengthened when playful interaction is deliberately connected to explicit representational support rather than used merely for entertainment. These implications suggest that structured educational games can serve as complementary instructional tools for developing early numerical understanding when their rules, representations, and teacher guidance are closely aligned with the intended learning outcomes.

Limitations

Several limitations should be considered when interpreting the findings of this study. The research involved only 40 elementary students divided into an experimental group and a control group of 20 students each, which limits the extent to which the findings can be generalized to broader student populations. Although pretest and posttest assessments were conducted, the available source data do not provide complete descriptive statistics, inferential test results, confidence intervals, or effect-size estimates that would allow the magnitude of the observed difference to be evaluated more precisely. Information regarding random assignment, detailed participant characteristics, psychometric properties of the number-recognition instrument, and the exact duration and dosage of the intervention is also insufficiently documented in the original research record. Consequently, the reported advantage of the UNO Stacko and sound-symbol mapping condition should be interpreted as evidence of a positive instructional pattern within the studied context rather than as definitive proof of a broadly generalizable causal effect.

Suggestions

Future studies should replicate the intervention with larger and more diverse samples across several elementary schools to determine whether the observed pattern remains consistent across different educational settings and learner characteristics. Researchers should also report complete pretest and posttest statistics, including means, standard deviations, inferential test results, confidence intervals, and appropriate effect-size measures so that both statistical and educational significance can be evaluated. The number-recognition assessment should undergo explicit content validation and reliability testing, while the instructional procedures should specify lesson duration, number of sessions, teacher actions, game rules, and the exact sequence of sound-symbol mapping activities. Comparative research could further examine whether UNO Stacko alone, phonics-informed sound-symbol mapping alone, and their combined implementation produce different levels of improvement in number recognition. Longitudinal or delayed-posttest designs are also recommended to determine whether gains in number-symbol recognition are retained over time and whether they contribute to subsequent development in counting, quantity-symbol mapping, and basic arithmetic learning.

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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