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Scramble Cooperative Learning and Fourth-Grade IPAS Achievement: A Classroom Action Study with Student-Level Reanalysis

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ABSTRACT

Integrated natural and social science (IPAS) learning requires conceptual understanding, active inquiry, and sustained participation, yet conventional explanation and note-taking can produce disengagement. This classroom action study examined the progression of 31 fourth-grade students at SD Negeri 09 Tilamuta, Indonesia, during Scramble cooperative learning. The design included a baseline assessment, two meetings in Cycle I, and one meeting in Cycle II. Students worked in five groups to match question cards with scrambled answer cards, explain their reasoning, present group results, and receive feedback and reinforcement. Student-level scores were reanalysed using descriptive statistics, the Friedman test, planned Wilcoxon signed-rank tests with Holm correction, Kendall's W, Cochran's Q, and exact McNemar tests. Mean scores increased from 63.23 at baseline to 71.13, 79.13, and 87.48 across the three action meetings. The repeated change was significant, chi-square(3) = 93.00, p < .001, Kendall W = 1.000. Every student improved at every measurement. Mastery at the school criterion of 75 increased from 54.8% to 64.5%, 71.0%, and 80.6%, Cochran Q(3) = 15.69, p = .001. The baseline-to-final mastery transition was significant after Holm correction, exact p = .031. Scramble learning was associated with substantial and increasingly consistent achievement. However, the perfectly monotonic score pattern, uncertain equivalence of the teacher-developed assessments, repeated exposure, and the absence of a comparison class require cautious interpretation.

Keywords: *classroom action research; cooperative learning; IPAS; learning achievement; Scramble model; student participation*

1. INTRODUCTION

Integrated natural and social science, known in the Indonesian curriculum as IPAS, introduces elementary students to living systems, matter, energy, environments, technology, geography, history, and social interaction. Effective IPAS instruction therefore requires more than the memorisation of facts. Students need to observe, classify, compare, explain relationships, communicate evidence, and apply concepts to familiar situations (Ihsanudin et al., 2024; Sulistianingrum et al., 2024).

The instructional problem in this study emerged in Grade IV at SD Negeri 09 Tilamuta. Initial observation and discussion with the classroom teacher indicated low attention, limited motivation, weak conceptual understanding, and continued reliance on explanation and written notes. Daily assessment records also indicated that a substantial group had not reached the school mastery standard. These conditions supported the need for a structured model that would increase student responsibility while retaining clear academic direction.

Scramble is a cooperative model organised around the reconstruction or matching of information that has been deliberately disordered. Students receive questions, words, statements, or text segments and work together to identify the correct arrangement or corresponding answer within a time limit. The task can combine retrieval, comparison, peer explanation, and rapid feedback. Prior studies have associated Scramble learning with higher participation and achievement in science, social science, citizenship, and reading comprehension (Fitri & Arwin, 2025; Pujasari & Samsudin, 2022; Sipayung et al., 2024; Utami et al., 2025).

The model also has limitations. When answers are already supplied, students may rely on recognition rather than explanation. Competition and time pressure can privilege faster students, increase classroom noise, or allow some group members to remain dependent on peers. The teacher must therefore design distractors carefully, distribute responsibility, ask students to justify matches, and verify learning through individual assessment rather than group performance alone (Afifah, 2020; Yati et al., 2021).

Classroom action research often evaluates success through aggregate mastery percentages. This approach is useful for deciding whether another cycle is required, but it can conceal data inconsistencies and individual trajectories. The source thesis contained four student-level score occasions, while its aggregate baseline total and abstract did not fully align with the individual matrix. The present article therefore prioritises student-level records and asks four questions: How did the score distribution change across occasions? Were the repeated changes statistically reliable? How did mastery status change? What implementation refinements accompanied the progression?

2. CONCEPTUAL FRAMEWORK

2.1 Cooperative Reconstruction in Scramble Learning

Scramble learning combines cooperative problem solving with a constrained reconstruction task. The teacher first establishes the conceptual content, then distributes question cards and disordered answer alternatives. Group members compare cues, discuss possible relationships, agree on a match, and present the result. The value of the model depends on the quality of discussion that occurs between the initial cue and the final answer. A correct card match without explanation provides weak evidence of conceptual learning.

The model can support IPAS learning through four linked mechanisms. First, the visible cards reduce the amount of information that must be held in memory. Second, matching requires students to discriminate between related concepts. Third, peer discussion exposes students to alternative explanations. Fourth, the time-bound game format can sustain attention. These mechanisms are consistent with reports that cooperative Scramble activities can increase both activity and achievement (Sipayung et al., 2024; Waruwu & Tafonao, 2023; Sabela & Zannah, 2023).

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2.2 Reflection as an Instructional Component

In classroom action research, a cycle is not merely a repeated lesson. Observation and reflection are intended to identify barriers and redesign the next implementation. The first meeting in this study revealed incomplete delivery of objectives and prompting questions, uneven participation, and limited student creativity. The second meeting used more varied Scramble activity. The final meeting added stronger classroom management, familiar examples, clearer motivation, and more consistent completion of the planned teaching sequence.

This iterative design supports local improvement but complicates causal interpretation. Gains may reflect the Scramble structure, better teacher delivery, greater familiarity with the content and assessment, repeated practice, or the combined effect of all changes. The analysis therefore treats the intervention as an evolving instructional package rather than an isolated treatment.

3. METHOD

3.1 Design, Setting, and Participants

The study used collaborative classroom action research based on planning, action, observation, and reflection. It was conducted from November to December 2025 at SD Negeri 09 Tilamuta, Boalemo Regency, Gorontalo Province, Indonesia. The intact Grade IV class included 31 students, comprising 12 boys and 19 girls. The research sequence consisted of a baseline assessment, Cycle I Meeting 1 on 21 November 2025, Cycle I Meeting 2 on 5 December 2025, and Cycle II Meeting 1 on 16 December 2025. The study stopped when the class mastery percentage exceeded the stated success criterion of 75%.

3.2 Instructional Intervention

The learning content addressed plants, plant parts and functions, and photosynthesis. At each action meeting, the teacher opened the lesson, reviewed prior knowledge, provided an ice-breaking activity, communicated the learning objective, and introduced a contextual question. Students were divided into five groups. Each group received question cards and answer cards presented in a scrambled arrangement.

Students worked cooperatively to identify the answer corresponding to each question. The teacher imposed a time limit, monitored group work, checked responses, and required groups to submit their work when time expired. Group representatives then presented their decisions. The lesson ended with an individual worksheet or formative assessment, a class conclusion, reinforcement, motivation, prayer, and closing.

Reflection after the first meeting identified missing instructional steps and insufficient engagement. The second meeting strengthened the explanation, prompting, and variety of the game. The Cycle II meeting used familiar examples, more active facilitation, clearer group guidance, and more complete implementation. Rewards and verbal reinforcement were used to maintain participation.

3.3 Measures and Data Quality

Achievement was represented by teacher-developed formative scores on a 0-100 scale. The thesis displayed five sample multiple-choice pre-test items and referred to pre-tests,

post-tests, worksheets, and formative tests, but did not provide a complete scoring rubric, item analysis, internal-consistency estimate, or evidence that the forms were equivalent across occasions. The school mastery criterion was 75.

Observation instruments covered teacher implementation, student activity, and cognitive, affective, and psychomotor indicators. The teacher checklist documented whether planned steps were implemented. The source did not report inter-rater reliability, observer independence, or a stable quantitative denominator for all observation summaries. These records were therefore used as supportive process evidence rather than as an independently validated outcome.

A data-integrity audit was conducted before analysis. The baseline aggregate row reported 18 mastered students, but recounting the 31 individual scores at the criterion of at least 75 yielded 17. The thesis abstract described an increase from 64.5% to 80.6%, which corresponds to the first action meeting and the final meeting rather than the true baseline. All results in this article use the individual-level score matrix as the primary record.

3.4 Statistical Analysis

Scores were summarised using the mean, standard deviation, median, interquartile range, range, and mastery frequency. The Friedman test evaluated change across four related occasions. Kendall's W was calculated as the Friedman chi-square divided by n(k - 1). Planned pairwise comparisons included each adjacent occasion and baseline versus the final meeting. Two-sided Wilcoxon signed-rank tests were adjusted using the Holm procedure, and matched-pairs rank-biserial correlation described effect magnitude. Mastery was analysed with Cochran's Q and exact McNemar tests, also Holm-adjusted. No missing scores were present. Statistical significance was set at .05. Because the study was not randomised and lacked a comparison class, inferential tests describe within-class temporal change rather than causal treatment effects.

3.5 Ethical and Reporting Considerations

The thesis documented school-based implementation and included research permission materials in its appendices. It did not report an institutional ethics-committee approval number or detailed parental consent and child assent procedures. The present article contains only de-identified records. The author and institution should retain the original permission and consent documentation required by the target journal and applicable local regulations.

4. RESULTS

4.1 Achievement Distribution

Scores increased at every measurement and became less dispersed. The mean rose by 24.26 points from baseline to the final meeting, while the standard deviation declined from 20.06 to 9.58. The lower quartile moved from 40 to 77.5, indicating that improvement was not restricted to students who had initially performed well. Six students nevertheless remained below mastery at the final meeting, with scores clustered from 71 to 74.

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Table 1

Achievement Scores and Mastery Across Four Measurement Occasions

Occasion	M	SD	Median	IQR	Range	Mastery, n (%)
Baseline	63.23	20.06	80.0	40-80	20-80	17 (54.8)
Cycle I, Meeting 1	71.13	17.78	85.0	50-85	40-85	20 (64.5)
Cycle I, Meeting 2	79.13	14.23	90.0	71.5-90	50-90	22 (71.0)
Cycle II, Meeting 1	87.48	9.58	95.0	77.5-95	71-95	25 (80.6)

Note. n = 31. Mastery was defined as a score of at least 75. The baseline mastery total was recalculated from the individual matrix and differs from the aggregate row in the source thesis.

4.2 Repeated-Measures Change

The Friedman statistic reached its theoretical maximum for 31 participants and four occasions because every student recorded a higher score at each successive measurement. The pairwise rank-biserial correlations were therefore 1.000. This is a strong longitudinal pattern, but its uniformity also raises a measurement question. Perfectly monotonic improvement is unusual in classroom data and may partly reflect progressive scoring, repeated exposure, non-equivalent tasks, or teacher calibration across meetings.

Table 2

Repeated-Measures and Planned Pairwise Analyses

Analysis	Statistic	p	Holm p	Effect size	Pattern
Friedman test	chi-square(3) = 93.00	< .001	Not applicable	Kendall W = 1.000	Perfect temporal ordering
Baseline vs C1-M1	Wilcoxon W = 0.00	< .001	< .001	r_rb = 1.000	31 higher, 0 lower
C1-M1 vs C1-M2	Wilcoxon W = 0.00	< .001	< .001	r_rb = 1.000	31 higher, 0 lower
C1-M2 vs C2-M1	Wilcoxon W = 0.00	< .001	< .001	r_rb = 1.000	31 higher, 0 lower
Baseline vs C2-M1	Wilcoxon W = 0.00	< .001	< .001	r_rb = 1.000	31 higher, 0 lower

Note. Pairwise tests were two-sided Wilcoxon signed-rank tests with Holm adjustment. r_rb = matched-pairs rank-biserial correlation. The exact numerical p values are all below .001; tied absolute differences required an asymptotic Wilcoxon calculation.

4.3 Mastery Transitions

Mastery increased more gradually than the continuous scores because only students crossing the threshold changed status. Three students newly mastered after the first meeting, two after the second, and three after the final meeting. No student lost mastery. Adjacent McNemar tests were not significant after correction because each transition involved only two or three students. Across the full study, eight students newly mastered and the baseline-to-final transition remained significant after Holm correction.

Table 3

Transitions in Mastery Status

Comparison	Newly mastered	Lost mastery	Unchanged	Exact p	Holm p
Baseline to C1-M1	3	0	28	.250	.750
C1-M1 to C1-M2	2	0	29	.500	.750
C1-M2 to C2-M1	3	0	28	.250	.750
Baseline to C2-M1	8	0	23	.008	.031

Note. Cochran Q across the four occasions was 15.69, df = 3, p = .001. Exact McNemar p values were calculated from discordant pairs and adjusted across the four planned comparisons.

4.4 Implementation Refinement

The implementation records show a progressive reduction in omitted teaching steps. In the first Cycle I meeting, six checklist entries were marked as not implemented. The reflection specifically identified incomplete communication of objectives and prompting questions, weak creativity, and low participation. In the second Cycle I meeting, only one entry was marked as not implemented, although nine students remained below mastery. In Cycle II, no planned teacher-checklist entry was marked as omitted. Reflection attributed the final improvement to stronger classroom management, more varied Scramble activity, familiar examples, and more sustained engagement. Because the checklist was not independently validated, this pattern should be interpreted as implementation evidence rather than a precise fidelity estimate.

Table 4

Documented Instructional Refinement Across Action Meetings

Meeting	Checklist record	Main reflection	Instructional response
Cycle I, Meeting 1	6 entries marked not implemented	Objectives and prompts incomplete; participation uneven	Clarify sequence and increase active guidance
Cycle I, Meeting 2	1 entry marked not implemented	Improvement, but 9 students remained below mastery	Vary the Scramble game and strengthen involvement
Cycle II, Meeting 1	No entry marked not implemented	Stronger engagement and class management	Use familiar examples, reinforcement, and complete sequence

Note. The table summarises the teacher implementation checklist and written reflections. The source did not report inter-rater reliability or a validated fidelity scale.

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5. DISCUSSION

5.1 Magnitude and Meaning of the Score Progression

The student-level analysis shows a large and systematic increase across the instructional sequence. The final mean was 24.26 points above baseline, and the lower end of the distribution improved substantially. The reduced standard deviation suggests that the class became more homogeneous at a higher achievement level. The final mastery percentage of 80.6% exceeded the action-research criterion and supports the local decision to stop the cycle.

The most striking result is that every student improved at every occasion. This creates the maximum Friedman effect and maximum rank-biserial correlations. Such consistency can reflect effective iterative instruction, especially when low-performing students receive repeated support. It can also indicate that the assessments were progressively easier, that similar items were repeated, or that scoring standards shifted. The result should therefore be read as evidence of a perfectly ordered score matrix, not as proof of a perfectly effective intervention.

The mastery analysis provides a more conservative interpretation. Only eight additional students crossed the threshold from baseline to the final meeting. Adjacent transitions were too small to reach statistical significance after correction, even though continuous scores improved. This distinction shows why both score distributions and mastery status should be reported. A rising mean does not automatically mean that all students have reached the instructional standard.

5.2 Plausible Instructional Mechanisms

The Scramble structure may have supported learning by converting plant concepts into visible, manipulable relationships. Students had to compare a question with several candidate answers, discuss the match, and publicly account for the group decision. This sequence can increase attention and retrieval while exposing misconceptions to peer and teacher feedback. Similar benefits have been reported in elementary IPAS and science contexts (Fitri & Arwin, 2025; Sipayung et al., 2024; Sabela & Zannah, 2023).

The cycle-by-cycle refinement likely contributed to the outcome. The first meeting did not fully implement all planned steps. The later meetings improved objective communication, prompting, variation, modelling, and classroom control. By Cycle II, students were also familiar with the card routine and group expectations. Familiarity may have reduced procedural load and allowed more attention to the plant content.

Scramble should not be reduced to a speed game. The supplied answer cards can encourage guessing or surface recognition. A stronger version requires each group to explain why the selected answer is correct, reject at least one distractor, and complete an individual transfer item without the cards. These additions would better establish conceptual understanding and reduce dependence on high-performing group members.

5.3 Practical Implications

Teachers should align each Scramble set with one clearly defined IPAS concept. Cards should use concise language, plausible distractors, readable print, and examples connected to the students' environment. Group size should permit every student to

handle a card, read a prompt, explain a match, record an answer, or present a result. Rotating responsibilities can prevent dominance and passive participation.

Time limits should create focus without eliminating reasoning. The teacher should pause after selected items and ask groups to state the evidence behind their choice. Feedback should address the concept, not only the game score. Students who remain below mastery need targeted follow-up, especially the six students whose final scores remained between 71 and 74. Brief diagnostic questions can determine whether their difficulty concerns vocabulary, plant structure, photosynthesis, reading comprehension, or test-taking.

Data monitoring should begin with the individual matrix. The discrepancy in the baseline total demonstrates that aggregate rows can contain counting errors. A simple spreadsheet that calculates means, mastery, gains, and student-level transitions would improve the reliability of classroom decisions and journal reporting.

5.4 Limitations and Future Research

The study involved one intact class without randomisation or a comparison condition. The observed progression may include maturation, repeated testing, increased teacher attention, familiarity with the topic, and normal instructional development. The teacher-researcher arrangement also creates expectancy and observer-bias risks.

The main limitation concerns measurement. The source showed only sample items and did not report a complete scoring protocol, validity evidence, reliability, difficulty equivalence, or whether the same items were reused. The perfectly monotonic trajectory and final ceiling concentration make these omissions especially important. Future studies should use parallel validated forms, preserve item-level data, blind or independently verify scoring, and include delayed retention and transfer assessments.

Observation data were not suitable for strong quantitative inference because denominators and category totals were inconsistent and inter-rater reliability was absent. Future research should use a fixed fidelity checklist, two observers, agreement statistics, and direct measures of group participation. A comparison class or staggered introduction across classes would provide stronger evidence that Scramble learning, rather than time or repeated assessment, accounts for the gains.

6. CONCLUSION

Scramble cooperative learning was associated with a strong, orderly increase in fourth-grade IPAS achievement at SD Negeri 09 Tilamuta. Mean scores rose from 63.23 at baseline to 71.13, 79.13, and 87.48, while mastery increased from 54.8% to 80.6%. Every student improved at every measurement, and eight additional students reached mastery by the final meeting. The cycle records indicate that clearer objectives, more varied card activity, stronger facilitation, familiar examples, and complete implementation accompanied the final improvement. The model is a promising classroom-improvement option when matching tasks require explanation and individual verification. The findings do not establish causal effectiveness because the study lacked a comparison group and did not demonstrate assessment equivalence or reliability.

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AUTHOR CONTRIBUTIONS

Ronalis Abdullah: Conceptualisation, methodology, classroom implementation, observation, data curation, formal analysis, writing of the original draft, review, and editing. The author approved the final manuscript and accepts responsibility for its integrity.

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DATA AVAILABILITY

The de-identified student-level achievement records supporting this article may be requested from the corresponding author, subject to school permission and applicable confidentiality requirements.

CONFLICTS OF INTEREST

The author declares no conflicts of interest related to this research, authorship, or publication.

GENERATIVE ARTIFICIAL INTELLIGENCE DISCLOSURE

OpenAI ChatGPT was used to assist English-language editing, manuscript restructuring, data-integrity review, and statistical reanalysis of the original de-identified records. It was not used to create participants, raw scores, references, findings, consent records, or ethical approval information. The author reviewed the manuscript and remains responsible for its accuracy and integrity.

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