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The Utilization of the Classroom Mathematics Games in Boosting the Creative Thinking Skills of the Grade 2 Learners in Goa District, Division of Camarines Sur

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ABSTRACT

The study examined the utilization of interactive classroom mathematics games and teacher-reported creative-thinking indicators among Grade 2 learners in Goa District, Division of Camarines Sur, during School Year 2025–2026. A descriptive-evaluative-correlational design involved 61 Grade 2 teachers and a self-made questionnaire. Weighted means, frequency counts, percentages, ranks, Kendall's coefficient of concordance, and corresponding chi-square tests were identified as analytical tools, with significance set at 0.05. Eight game categories were examined: Splash Learn, Round Robin Benefit, Fraction Action, Around the Block, 101 and Out, The Counting Game, Odds and Events, and Sequence Benefit. All reported game-utilization indicators were classified as Very Much Utilized. Reported indicators for divergent, lateral, and convergent thinking, mindfulness, and flexibility were classified as Very Much Evident. Rank agreement was reported as significant for seven game categories, with The Counting Game as the exception. Among the five creative-thinking domains, significant agreement was reported only for convergent thinking ($W = 0.70$, $\chi^2 = 16.80$, $p < 0.05$). The findings support attention to differentiated game facilitation, mathematical explanation, reflection, and teacher professional development. High ratings and rank agreement do not establish gains in learner creativity or a causal effect of games. Unreported sampling and instrument details, unavailable group-specific rankings, and a duplicated convergent-thinking indicator limit reproducibility and interpretation.

1. Introduction

Mathematics games can organize classroom participation around a problem, a set of rules, and opportunities to make decisions. For young learners, these activities may include working with number patterns, comparing possible moves, explaining a strategy, or reconsidering an answer after feedback. Their educational significance depends on the mathematical work required and the way teachers facilitate it. The study examined how Grade 2 teachers in Goa District reported using classroom mathematics games and the extent to which creative-thinking indicators were evident during these activities.

The distinction between participation and thinking is central to this inquiry. Completing a game does not by itself demonstrate that a learner generated alternative approaches, made a useful connection, or evaluated a strategy. Similarly, reaching the correct answer does not describe every aspect of creative thinking. A classroom activity can provide opportunities for more than one kind of reasoning, but those opportunities must be distinguished from evidence that learners actually used the relevant processes.

Hui and Mahmud (2023) reviewed research on game-based mathematics learning and identified cognitive and affective outcomes across a range of educational settings. Their review supports examining more than achievement alone when considering classroom games. The study's attention to reasoning, reflection, and adaptation extends that practical concern to a local teacher-reported profile, rather than replicating an intervention or estimating an effect synthesized in the review.

The study considered both a digital platform, Splash Learn, and classroom routines involving participation, number work, fractions, and sequencing. This breadth is relevant because a game-based approach need not depend on a screen. Russo et al. (2024), in a systematic review of non-digital games in primary mathematics, identified a diverse range of activities and generally favorable findings across mathematical and dispositional outcomes. Their review provides a reason to examine non-digital practices alongside app-based activities without assuming that all games have the same instructional value.

Games also need to be distinguished from the wider practice of adding game elements to learning activities. Sailer and Homner (2020) synthesized research on gamification across cognitive, motivational, and behavioral outcomes. Their work concerns a broader educational category than the specific games assessed in the study. It nevertheless underscores the need to specify the outcome of interest rather than treating engagement, game participation, and learning as interchangeable results.

Five domains organized the study's creative-thinking indicators: divergent thinking, lateral thinking, convergent thinking, mindfulness, and flexibility. Divergent indicators concerned alternatives, experimentation, and multiple approaches. Lateral indicators concerned reframing, unusual connections, and unexpected but mathematically defensible solutions. Convergent indicators concerned selecting and checking a correct or efficient response. Mindfulness indicators concerned attention, reflection, emotional composure, and deliberate action. Flexibility indicators concerned adapting approaches and representations when circumstances changed.

These domains describe the operational content of the questionnaire rather than a standardized diagnostic model of creativity. Some statements overlap conceptually. For example, switching strategies appears in both divergent thinking and flexibility, while

reflection and error correction appear across several domains. Such overlap does not invalidate the practical concerns, but it means that a favorable rating in one domain should not automatically be interpreted as an independent psychological capability.

The local contribution of the study is a structured account of teachers' reported use of eight game categories and their ratings of learner behaviors during game-based work. It also examines agreement on the ordering of indicators among respondent groups. These are useful descriptive questions because extensive use can coexist with differences in how teachers prioritize or recognize particular practices. The study does not supply direct pretest and posttest evidence of a change in learner creativity.

1.1 Purpose and research questions

The study sought to determine the utilization of interactive classroom mathematics games in boosting the creative thinking skills of Grade 2 learners in Goa District, Division of Camarines Sur, during School Year 2025–2026. Its questions addressed the extent of utilization of Splash Learn, Round Robin Benefit, Fraction Action, Around the Block, 101 and Out, The Counting Game, Odds and Events, and Sequence Benefit; significant agreement on the rank orders of their utilization indicators; the extent of divergent, lateral, and convergent thinking, mindfulness, and flexibility; significant agreement on the rank orders of these indicators among respondent groups; and policy recommendations based on the findings.

The term boosting expresses the study's instructional purpose. The reported evidence concerns teachers' ratings and concordance in indicator rankings. A high mean describes the rated extent of a practice or behavior, whereas concordance describes similarity in its relative ordering. Neither statistic estimates a before-and-after gain or a causal contribution of games. This distinction governs the interpretation of the study's results and recommendations.

2. Methods

2.1 Research design and setting

The study used descriptive-evaluative-correlational methods in Goa District, Division of Camarines Sur, during School Year 2025–2026. The descriptive and evaluative components concerned the extent of game utilization and creative-thinking indicators. Reported inferential results consisted of Kendall's coefficient of concordance, W, with corresponding chi-square tests. A separate association analysis linking game-utilization scores to creative-thinking scores was not reported.

The design was not described as a randomized experiment or as a pretest–posttest intervention. No control group, assignment procedure, intervention duration, or repeated assessment of learner creativity was reported. Consequently, the study's design designation is preserved without attributing experimental procedures or individual learning gains to it. The empirical unit represented by the participant count is the teacher, while the creative-thinking statements refer to learner behavior as rated through the questionnaire.

2.2 Participants

The respondents were 61 Grade 2 teachers in Goa District. The sampling method, eligible population size, recruitment process, response rate, school count, and demographic distribution were not reported. References to big, medium, and small schools appear in the policy and further-research recommendations, but group-specific participant counts and operational school-size definitions were not supplied. These categories therefore cannot be treated as a documented sampling breakdown.

No number of Grade 2 learners was reported as a directly assessed sample. The study's title concerns learners, but the stated respondents were teachers. The findings should therefore be interpreted as teacher-reported evidence about classroom practice and learner indicators. No assumption is made that individual learners completed a questionnaire, took a standardized creativity test, or were linked to particular teacher responses.

2.3 Questionnaire and operational measures

A self-made questionnaire was the principal data-gathering instrument. Its reported content covered eight game categories and five creative-thinking domains. Game-utilization indicators described curriculum integration, differentiated tasks, participation, formative assessment, feedback, and reflection, with specific emphases varying by game. Creative-thinking indicators described alternative strategies, reframing, accurate reasoning, deliberate reflection, and adaptation during gameplay.

The complete questionnaire, response anchors, score intervals, validation procedures, pilot sample, reliability coefficients, and administration instructions were not reported. The classifications Very Much Utilized and Very Much Evident are retained as reported. Numerical response anchors or interpretive cutoffs are not reconstructed from those labels. The item means are presented to the same two-decimal precision as the reported findings.

The available findings enumerate different numbers of statements by category. The convergent-thinking list contains the same mathematical-justification statement twice, both with a mean of 4.61. Both entries are retained in Table 12 and identified as duplicated. The study does not establish whether the repetition occurred in the administered questionnaire, in the summary of results, or during transcription. It is therefore not silently removed or replaced.

2.4 Data collection and ethical reporting

The reported account identifies a questionnaire-based study but does not specify the dates or mode of administration, instructions given to teachers, collection and retrieval procedures, handling of incomplete responses, or arrangements for confidentiality. Ethics approval, administrative permissions, individual informed consent, and data-retention procedures were not reported. These procedures are not presumed to have occurred, and missing details are identified separately for author confirmation.

The study reports aggregate findings without adding individual teacher or learner information. No new data collection, reanalysis of participant responses, or reconstruction of missing group-level ratings was undertaken. The absence of those records limits the methodological detail that can be provided and the ability to independently reproduce the reported statistics.

2.5 Statistical analysis

Weighted means, frequency counts, percentages, ranks, Kendall's coefficient of concordance, and corresponding chi-square tests were identified as statistical tools. The significance level was set at 0.05. The reported numerical findings consist of indicator means, W coefficients, chi-square values, probability inequalities, and null-hypothesis decisions. No frequency tables, percentage distributions, group-specific rank matrices, or participant-level scores were reported.

Kendall's W concerns agreement in rankings. A significant result indicates that the reported procedure detected concordance; it does not measure the causal effectiveness of a game or the size of improvement in creativity. Nonsignificance does not show that a game was unused or that an indicator was absent. Means and concordance address different aspects of the findings and are interpreted separately.

The tables reproduce the probability inequalities as reported, rather than converting them to exact p values. Degrees of freedom, the number of ranking groups, tie corrections, and calculation details were not supplied. The reported significance classifications and decisions are retained without recalculation. No domain averages, overall composite scores, effect sizes, confidence intervals, or unreported rankings have been added.

3. Results

3.1 Splash Learn utilization

Splash Learn indicators were all rated Very Much Utilized (Table 1). Regular integration aligned with curriculum concepts had the highest mean, 4.67, while guided discussion linking gameplay with conceptual understanding had the lowest, 4.55. The ratings also addressed differentiation, progress monitoring, independent problem-solving, and continuity across teaching settings.

Table 1. Splash Learn utilization

Indicator	Weighted mean
The teacher integrates Splash Learn activities regularly to reinforce specific math concepts aligned with the curriculum	4.67
The teacher selects Splash Learn games that match learners' ability levels and provides differentiated tasks accordingly	4.66
The teacher monitors learners progress using Splash Learn's analytics and uses the data to inform instruction	4.63
The teacher encourages learners to complete Splash Learn challenges as part of their formative or enrichment tasks	4.62
The teacher uses Splash Learn as a tool for promoting learner autonomy and independent problem-solving in mathematics	4.61
The teacher incorporates Splash Learn in both face-to-face and online class settings to provide continuous learning opportunities	4.60
The teacher facilitates guided discussions before or after Splash Learn activities to link gameplay with conceptual understanding	4.55

The comparatively lower discussion rating is relevant because app participation and mathematical understanding are different outcomes. Reviewing how learners explain their moves could complement reported use of analytics and differentiated tasks. The table does not independently confirm platform access, usage logs, the validity of platform analytics, or learning gains. It describes teachers' reported instructional use of the platform.

3.2 Round Robin Benefit utilization

Round Robin Benefit was rated Very Much Utilized across the listed statements (Table 2). Peer-to-peer explanation and collaborative reasoning had the highest mean, 4.73. Encouraging learners to build on others' responses had the lowest, 4.62. Inclusive prompts, structured participation, verbal explanation, feedback, and formative assessment were also represented.

Table 2. Round Robin Benefit utilization

Indicator	Weighted mean
The teacher integrates Round Robin tasks to promote peer-to-peer explanation and collaborative reasoning	4.73
The teacher ensures that Round Robin sessions are inclusive by assigning roles or prompts tailored to diverse learner abilities	4.72
The teacher incorporates Round Robin in both small-group and whole-class settings to foster active engagement	4.72
The teacher uses Round Robin activities to encourage learners to verbalize their problem-solving strategies	4.71
The teacher provides feedback during or after Round Robin sessions to reinforce correct reasoning and clarify misconceptions	4.71
The teacher uses Round Robin as a formative assessment tool to gauge learners' understanding of mathematical concepts	4.70
The teacher facilitates structured turn-taking during math discussions to ensure all learners contribute their ideas	4.66
The teacher encourages learners to build on each other's responses during Round Robin to develop deeper conceptual connections	4.62

The profile distinguishes participation from the development of connections across contributions. Giving each learner a turn can make ideas visible, while asking learners to compare or extend those ideas requires additional facilitation. The lower relative rating for building on responses suggests an instructional focus for reflection. It does not show that collaborative reasoning was absent or that every learner participated equally.

3.3 Fraction Action utilization

All Fraction Action indicators were classified as Very Much Utilized (Table 3). Modeling fractions with visual aids had the highest mean, 4.91, while reflective discussion connecting strategies to mathematical principles had the lowest, 4.66. Real-life scenarios

and multiple representations each received 4.83. The findings therefore placed representational and contextual activity prominently within the reported practice profile.

Table 3. Fraction Action utilization

Indicator	Weighted mean
The teacher uses Fraction Action activities to help learners model fractions using visual aids such as number lines, area models, or manipulatives	4.91
The teacher integrates real-life scenarios (e.g., food sharing, measurement, or games) to contextualize fraction concepts during Fraction Action sessions	4.83
The teacher encourages learners to represent fractions in multiple forms—visual, symbolic, and verbal—during Fraction Action activities	4.83
The teacher facilitates group-based Fraction Action tasks that require learners to collaborate in solving fraction-related challenges	4.81
The teacher uses Fraction Action to differentiate instruction by assigning tasks that match learners' readiness levels and learning styles	4.72
The teacher uses Fraction Action as a formative assessment tool to gauge learners' conceptual understanding and misconceptions	4.70
The teacher guides learners in comparing, ordering, and simplifying fractions through structured Fraction Action exercises	4.70
The teacher incorporates movement-based or digital games in Fraction Action to promote kinesthetic and interactive learning of fractions	4.70
the teacher facilitates reflective discussions after Fraction Action tasks to help learners articulate their reasoning and connect strategies to mathematical principles	4.66

The lower relative reflection rating points to the importance of discussing what a model represents and why a strategy works. Manipulating materials can provide a basis for explanation, but the table does not establish conceptual mastery or transfer to unfamiliar fraction problems. The developmental suitability of the specific comparing, ordering, and simplifying tasks also depends on the actual materials and competencies used, which were not reported.

3.4 Around the Block utilization

Around the Block statements were all rated Very Much Utilized (Table 4). Rapid-response review and equitable turn-taking each had a mean of 4.77. Formative assessment of retention and understanding was lowest at 4.70. The other statements concerned vocabulary, procedural fluency, group format, differentiation, and immediate feedback.

Table 4. Around the Block utilization

Indicator	Weighted mean
The teacher uses Around the Block to review key math concepts through rapid-response questioning	4.77
The teacher ensures all learners participate by structuring turn-taking and rotating prompts equitably	4.77
The teacher uses Around the Block to reinforce math vocabulary and procedural fluency in an engaging format	4.73
The teacher facilitates Around the Block in both small-group and whole-class settings to maximize participation	4.72
The teacher adapts the difficulty of questions during Around the Block to match learners' readiness levels	4.72
The teacher provides immediate feedback during the activity to correct misconceptions and affirm correct responses	4.71
the teacher uses Around the Block as a formative assessment tool to gauge learners' retention and understanding	4.70

The pattern describes a routine in which participation and quick review were prominent. Speed and turn-taking may make an activity lively, but the rating does not determine the quality of learners' reasoning. The comparatively lower assessment rating suggests reviewing how teachers interpret responses beyond whether they are correct. Such a review would extend the findings rather than represent an assessed feature of the study.

3.5 101 and Out utilization

All listed 101 and Out practices were classified as Very Much Utilized (Table 5). Reflection on strategies and outcomes was highest at 4.67. Use as a warm-up or review of number operations was lowest at 4.60. The statements also covered constrained decision-making, readiness-based adjustment, number sense, mental addition, estimation, and place value.

Table 5. 101 and Out utilization

Indicator	Weighted mean
The teacher facilitates reflective discussions after the game to help learners evaluate their strategies and outcomes	4.67
The teacher uses 101 and Out to promote mathematical reasoning and decision-making under constraints	4.66
The teacher differentiates the game by adjusting the number of dice rolls or target totals to match learners' readiness levels	4.65
The teacher uses 101 and Out as a formative assessment tool to observe learners' number sense and computational fluency	4.62
The teacher facilitates 101 and Out to develop learners' mental addition and estimation skills	4.62
The teacher uses 101 and Out to reinforce learners' understanding of place value through strategic digit placement	4.61
The teacher encourages learners to explain their strategies for placing digits in the tens or one's column during gameplay	4.61

Indicator	Weighted mean
the teacher integrates 101 and Out as a warm-up or review activity to activate prior knowledge in number operations	4.60

This ordering differs from the relatively lower reflection entries for some other games. It suggests that teachers reported different facilitation emphases across activities rather than a uniform pattern for every game. The place-value and digit-placement statements make the mathematical focus explicit. Nevertheless, the ratings provide no direct evidence of whether learners' estimates became more accurate or whether particular strategic choices improved over time.

3.6 The Counting Game utilization

The Counting Game indicators were all classified as Very Much Utilized (Table 6). Their means occupied a narrow range from 4.60 to 4.62. Forward counting, turn-taking, and differentiated starting points or patterns each received 4.62. Movement, skip counting, and assessment of order and accuracy each received 4.60.

Table 6. The Counting Game utilization

Indicator	Weighted mean
The teacher uses The Counting Game to reinforce forward counting sequences through whole-class or small-group participation	4.62
The teacher encourages learners to take turns counting aloud, promoting oral fluency and active listening	4.62
The teacher differentiates The Counting Game by varying starting points, counting patterns, or groupings to match learners' readiness levels	4.62
The teacher uses The Counting Game to develop learners' ability to count backward from a given number	4.61
The teacher integrates The Counting Game as a warm-up or transition activity to activate prior knowledge and focus attention	4.61
The teacher facilitates reflective discussion after the game to help learners identify patterns, strategies, or errors in their counting	4.61
The teacher facilitates The Counting Game using physical movement (e.g., clapping, hopping, or passing objects) to support kinesthetic learning	4.60
The teacher adapts The Counting Game to practice skip counting (e.g., by 2s, 5s, or 10s) in alignment with learners' developmental levels	4.60
the teacher uses The Counting Game to assess learners' understanding of number order, sequencing, and counting accuracy	4.60

The near-uniform means suggest broadly favorable ratings without a large descriptive separation among the listed practices. They do not imply identical use by every teacher. The statements encompass both procedural counting and opportunities to notice patterns and errors. Their instructional interpretation depends on the actual counting ranges and task difficulty, which are not established by the mean ratings.

3.7 Odds and Events utilization

Odds and Events indicators were classified as Very Much Utilized (Table 7). Introducing odds through favorable and unfavorable outcomes had the highest mean, 4.69; providing varied contexts had the lowest, 4.61. The other statements concerned calculations, fairness and likelihood, distinguishing probability from odds, verbal and ratio expressions, and formative assessment.

Table 7. Odds and Events utilization

Indicator	Weighted mean
The teacher introduces the concept of odds as a ratio of favorable to unfavorable outcomes using real-life examples	4.69
The teacher facilitates tasks where learners calculate odds in favor and odds against specific events using spinners, dice, or cards	4.68
The teacher uses Odds and Events to promote reasoning about fairness, risk, and likelihood in games or decision-making scenarios	4.68
The teacher guides learners in distinguishing between probability and odds through hands-on activities or simulations	4.67
The teacher encourages learners to express odds both as ratios and in verbal form (e.g., "three to one in favor")	4.65
The teacher uses Odds and Events as a formative assessment tool to evaluate learners' understanding of outcome comparison and probabilistic thinking	4.63
the teacher differentiates instruction by providing varied contexts (e.g., sports, weather, games) to explore odds and probability	4.61

The findings preserve the game name and the specific ratio and probability language as reported. They do not establish that these tasks matched Grade 2 curriculum expectations or learners' developmental readiness. Actual prompts and adaptations would be needed to judge that alignment. The lower relative contextualization rating suggests reviewing the accessibility of examples before recommending a common set of tasks across classrooms.

3.8 Sequence Benefit utilization

All Sequence Benefit statements were rated Very Much Utilized (Table 8). Differentiation and reasoning under constraints each had a mean of 4.69. Estimating and comparing values when arranging numbers was lowest at 4.59. Explaining placements, activating prior knowledge, formative assessment, and reflective evaluation were also represented.

Table 8. Sequence Benefit utilization

Indicator	Weighted mean
The teacher differentiates the game by adjusting the number range, sequence direction (ascending/descending), or scoring rules to match learners' readiness levels	4.69
The teacher uses Sequence Benefit to promote mathematical reasoning and decision-making under time or resource constraints	4.69
The teacher encourages learners to explain their sequencing strategies and justify their number placements during or after the activity	4.68
The teacher integrates Sequence Benefit as a warm-up or review activity to activate prior knowledge in number patterns and operations	4.67
The teacher uses Sequence Benefit as a formative assessment tool to observe learners' number sense, sequencing accuracy, and strategic thinking	4.64
The teacher facilitates reflective discussions after the game to help learners evaluate their strategies and identify more efficient sequencing approaches	4.63
The teacher uses Sequence Benefit to reinforce learners' understanding of number order and sequencing through structured gameplay	4.61
the teacher facilitates Sequence Benefit to develop learners' ability to estimate and compare values when arranging numbers	4.59

The ordering suggests that adapting game conditions and requiring decisions were comparatively prominent, while explicit estimation and comparison were less prominent within the favorable profile. Sequencing accuracy and strategic explanation can serve different instructional purposes. The table does not establish that a correct arrangement was produced through estimation, comparison, memorization, or peer assistance; those processes would require closer observation.

3.9 Agreement on game-utilization rankings

Table 9. Reported concordance in game-utilization indicator rankings

Game category	W	χ^2	Reported p	H_0 decision
Splash Learn	0.97	17.46	$p<0.01$	Rejected
Round Robin Benefit	0.98	20.58	$p<0.005$	Rejected
Fraction Action	0.96	23.04	$p<0.005$	Rejected
Around the Block	0.83	14.94	$p<0.05$	Rejected
101 and Out	0.74	15.54	$p<0.05$	Rejected
The Counting Game	0.64	15.36	$p>0.05$	Not rejected
Odds and Events	0.93	16.74	$p<0.025$	Rejected
Sequence Benefit	0.89	18.69	$p<0.01$	Rejected

Table 9 reports significant concordance for seven game categories. Round Robin Benefit had the largest W, 0.98, followed by Splash Learn at 0.97 and Fraction Action at 0.96. The Counting Game had $W = 0.64$ and $\chi^2 = 15.36$ but was reported as not significant. Its favorable utilization ratings therefore coexisted with an absence of statistically significant rank agreement under the reported test. These findings concern the relative ordering of indicators across respondent groups. They do not rank the games by instructional effectiveness. The chi-square values and probability thresholds also cannot be compared as though each test necessarily had the same item count or degrees of freedom. Their calculation requires the group-specific rankings and treatment of ties, which were not reported.

3.10 Divergent thinking

Divergent-thinking indicators were classified as Very Much Evident (Table 10). Proposing what-if scenarios was highest at 4.76, followed by inventing or modifying rules at 4.73. Generating multiple approaches and considering peers' perspectives each received 4.61. The reported ordering distinguished experimentation with game conditions from the explicit production and comparison of alternative solutions.

Table 10. Divergent thinking indicators

Indicator	Weighted mean
The learner proposes "what-if" scenarios (e.g., "What if I place this number here instead?") that reflect experimentation and willingness to take intellectual risks	4.76
The learner invents or modifies game rules to create alternative challenges or patterns, showing initiative and imaginative extension of the game format	4.73
The learner explores non-routine strategies to achieve a goal or maximize outcomes in math games, even when a more common or expected method is available	4.70
The learner demonstrates flexibility in thought by switching strategies mid-game when faced with unexpected outcomes or new constraints	4.66
The learner generates multiple possible solutions or approaches to a single mathematical task during game-based activities, reflecting idea fluency and originality	4.61
the learner shifts perspectives by considering how peers might approach the task differently, acknowledging diverse methods of solving or playing	4.61

This pattern suggests attention to how exploratory play becomes mathematical explanation. A learner may propose a variation without explaining why it is useful or identifying several defensible approaches. The ratings do not provide counts of ideas, originality scores, or independently assessed work. They therefore describe perceived behaviors rather than measured growth in divergent-thinking performance.

3.11 Lateral thinking

Lateral-thinking indicators were all rated Very Much Evident (Table 11). Humor, analogy, or storytelling had the highest mean, 4.76. Reinterpreting an objective and generating unexpected but mathematically accurate solutions each had 4.61. The other statements concerned questioning assumptions, connections, task reversal, real-life comparisons, and changes to game mechanics.

Table 11. Lateral thinking indicators

Indicator	Weighted mean
The learner uses humor, analogy, or storytelling during gameplay to express or understand mathematical ideas in a unique manner	4.76
The learner challenges standard assumptions about rules, quantities, or patterns embedded in the game, proposing alternate interpretations	4.73
The learner draws connections between seemingly unrelated mathematical concepts or games to form innovative problem-solving strategies	4.70
The learner poses questions that reframe the original task, such as "What if we reverse the goal?" or "Can we play this game backward and still reach a pattern?"	4.66
The learner offers metaphors or comparisons from real-life contexts to creatively explain game strategies or number relationships	4.66
The learner manipulates game mechanics (e.g., timing, scoring, sequencing) to explore new possibilities without compromising the integrity of the mathematical objective	4.63
The learner reinterprets the objective of a math game in a new or creative way that differs from the default strategy, offering alternative routes to success	4.61
the learner generates unexpected or counterintuitive solutions that still demonstrate mathematical accuracy or logic	4.61

The ordering differentiates expressive novelty from the reframing of a mathematical problem. Storytelling can make an idea accessible, while a counterintuitive solution must still satisfy the mathematical conditions of the task. The study did not evaluate learner products against an originality or validity rubric. Its results support discussing these distinctions in teacher development without asserting that unconventional reasoning was independently demonstrated.

3.12 Convergent thinking

Convergent-thinking statements were classified as Very Much Evident (Table 12). Identifying a correct answer was highest at 4.76, while mathematical justification appeared twice at 4.61. Elimination of incorrect choices, strategy selection, accuracy, ordered procedures, feedback-based correction, and checking were also listed. The repeated entry remains visible pending clarification.

Table 12. Convergent thinking indicators

Indicator	Weighted mean
The learner accurately identifies a single correct answer when the game prompt requires computation or pattern recognition	4.76
The learner systematically eliminates incorrect choices during gameplay, demonstrating deductive reasoning and process-of-elimination skills	4.73
The learner selects the most efficient strategy from several options available in a game scenario to solve a problem or reach a goal	4.70
The learner prioritizes solution accuracy over speed or novelty in tasks requiring exact answers	4.66
The learner follows multi-step procedures in correct order during gameplay when solving complex problems	4.66
The learner uses feedback from the game or peers to self-correct errors and refine their solution process for improved accuracy	4.66
The learner cross-checks numerical outcomes or procedural steps during or after the game to ensure correctness	4.63
The learner justifies a solution using formal math language or symbolic representation, confirming the validity of their approach	4.61
the learner justifies a solution using formal math language or symbolic representation, confirming the validity of their approach	4.61

The relatively higher ratings for identifying answers and eliminating choices place correctness prominently in the profile. The lower mathematical-justification rating suggests reviewing opportunities for learners to explain why an answer is valid. Convergent reasoning can complement creative exploration by checking possibilities, but correctness alone does not establish creativity. The duplicate also prevents treating the listed statements as a confirmed set of unique questionnaire items.

3.13 Mindfulness

Mindfulness indicators were all classified as Very Much Evident (Table 13). Monitoring strategy effectiveness and adjusting deliberately had the highest mean, 4.76. Intentional pauses and deliberate pacing each received 4.61. The other statements addressed composure, attention, awareness of insight or confusion, and calm acknowledgment of mistakes.

Table 13. Mindfulness indicators

Indicator	Weighted mean
The learner monitors their own strategy use, noticing when a tactic is or isn't effective and adjusting their approach mindfully	4.76
The learner remains composed and focused, even when encountering setbacks or losing a round, showing emotional regulation and cognitive steadiness	4.73
The learner attends closely to game instructions, peer input, and mathematical cues, demonstrating sustained focus and clarity in processing information	4.70
The learner articulates moments of insight or confusion, signaling self-awareness and the ability to observe one's own cognitive states during gameplay	4.66
The learner acknowledges mistakes calmly, treating them as learning opportunities and reflecting on how to improve future decisions	4.63
The learner pauses intentionally before making a move, reflecting on possible outcomes and consequences rather than acting on impulse	4.61
the learner demonstrates deliberate pacing, resisting the urge to rush and instead ensuring accuracy and thoughtfulness in task execution	4.61

Note. All listed indicators were classified as Very Much Evident. Entries follow the reported descending order; no numerical ranks or category average have been inferred.

The pattern suggests that reflective monitoring was more evident in the ratings than deliberate slowing before action. These behaviors may be related but are not identical: recognizing an ineffective strategy does not necessarily mean a learner paused before choosing it. The study did not use a validated mindfulness measure or report direct observations of emotional regulation. Its mindfulness findings remain specific to the listed teacher-rated classroom behaviors.

3.14 Flexibility

Flexibility indicators were classified as Very Much Evident (Table 14). Adjusting decisions to new information or changing constraints was highest at 4.76. Shifting an ineffective strategy and reorganizing steps or tools each received 4.61. Incorporating peer suggestions, using multiple techniques and representations, tolerating ambiguity, and transferring strategies were also represented.

Table 14. Flexibility indicators

Indicator	Weighted mean
The learner adjusts their decisions in real time in response to new information, game twists, or changing constraints	4.76
The learner incorporates peer suggestions or alternative viewpoints to modify their approach and improve outcomes	4.73
The learner applies different problem-solving techniques across similar tasks or rounds within a game, avoiding reliance on a single routine	4.70
The learner switches between visual, verbal, or symbolic representations depending on what best supports task completion	4.66
The learner shows comfort with ambiguity or multiple possible strategies, and is willing to shift among them without hesitation or frustration	4.66
The learner successfully transfers strategies used in one game to a different context or task, showing adaptive use of knowledge	4.63
The learner shifts strategies when an initial approach proves ineffective, showing an openness to try new methods based on game conditions	4.61
the learner reorders steps or reconfigures tools (e.g., number blocks, symbols, patterns) to suit the problem at hand	4.61

Note. All listed indicators were classified as Very Much Evident. Entries follow the reported descending order; no numerical ranks or category average have been inferred.

The distinction between responding to an external change and initiating a new approach is useful for interpreting the ordering. A learner may adapt when a rule changes while still needing support to abandon an ineffective routine. The ratings suggest questions for facilitation and observation rather than evidence that flexibility increased. Transfer to an unfamiliar task was rated but not independently tested through a separate assessment.

3.15 Agreement on creative-thinking indicator rankings

Table 15. Reported concordance in creative-thinking indicator rankings

Domain	W	χ^2	Reported p	H_0 decision
Divergent	0.18	3.24	p>0.05	Accepted
Lateral	0.47	9.87	p>0.05	Accepted
Convergent	0.70	16.80	p<0.05	Rejected
Mindfulness	0.34	6.12	p>0.05	Accepted
Flexibility	0.64	13.44	p>0.05	Accepted

Note. Significance criterion: 0.05. Values and accepted/rejected decisions are retained as reported. "Accepted" is the reported decision wording; nonsignificance does not demonstrate an absence of agreement or equivalent perceptions. Group counts, degrees of freedom, and ranking details were not supplied.

Table 15 shows significant agreement only for convergent thinking, with W = 0.70 and $\chi^2 = 16.80$. Divergent thinking had the lowest coefficient, 0.18. Lateral thinking, mindfulness, and flexibility were also reported as not significant. Thus, uniformly favorable extent ratings across these domains did not translate into uniformly significant agreement on their internal ordering.

The result does not show that convergent thinking was the only skill present or the only domain supported by games. It indicates that its reported ordering met the study's concordance criterion. Similarly, the not-significant flexibility result does not mean flexibility was absent. These distinctions matter when converting the findings into policy because rank agreement is not a measure of individual mastery or instructional gain.

4. Discussion

4.1 Interpreting extensive utilization

Across Tables 1–8, teachers reported Very Much Utilized practices for all listed game indicators. The findings portray games as integrated with curriculum work, differentiation, feedback, participation, and assessment. The reported utilization is therefore broader than simply allowing learners to play. However, the favorable classifications cannot establish implementation fidelity without details about game materials, lesson duration, opportunities to participate, and the conditions under which teachers completed the questionnaire.

The digital and non-digital activities should be interpreted within their distinct instructional functions. Splash Learn involves reported use of a platform and analytics; other routines emphasize explanation, counting, representations, or strategic number placement. Russo et al. (2024) provide a relevant comparison by documenting the diversity of non-digital mathematics games in primary education. The study's profile similarly suggests that decisions about game use should consider the mathematical activity required rather than the presence of technology alone.

The item patterns also suggest different opportunities for instructional refinement. In Tables 1 and 3, discussion linking play with concepts was comparatively lower than regular integration or visual modeling. In Table 5, strategy reflection was comparatively highest. These differences support examining facilitation at the level of particular activities. They do not justify assuming that reflection was consistently weak or strong across all game formats.

4.2 Thinking processes and assessment

Tables 10–14 describe learner behaviors that extend beyond speed and correct answers. They include experimenting with conditions, considering alternative perspectives, checking solutions, reflecting on mistakes, and adapting approaches. These distinctions are useful for planning observation because a successful game outcome may arise through several different processes. A teacher would need evidence about the process, rather than the final answer alone, to identify which indicator was demonstrated.

Hui and Mahmud (2023) distinguish multiple cognitive and affective concerns in game-based mathematics learning. That broader perspective is relevant to the study's inclusion of reasoning and self-regulatory behaviors. It does not validate the five-domain questionnaire or show that favorable teacher ratings are equivalent to independently assessed learner outcomes. The measurement of creativity remains a separate issue requiring clear indicators and evidence of scoring quality.

The convergent profile emphasizes accuracy and checking, whereas the divergent and lateral profiles emphasize alternatives and reframing. These processes can be complementary: learners may generate possibilities and then evaluate them against mathematical constraints. The study's recommendations concerning multiple approaches and precise reasoning can therefore be considered together. They should not be interpreted as a requirement to prioritize novelty in every task or to treat a single correct answer as the only worthwhile outcome.

Mindfulness and flexibility require additional caution because the reported behaviors overlap with metacognition, attention, emotional regulation, and adaptation. These labels describe the questionnaire's practical groupings. Without validation evidence, the study cannot determine whether the domains represent distinguishable dimensions. The recurring pattern of means across the five creative-thinking lists also warrants verification against the full results before making detailed comparisons among domains.

4.3 Concordance and its policy meaning

The difference between Tables 9 and 15 is substantive. Seven game categories had significant reported rank agreement, whereas only one creative-thinking domain did. This suggests that the reported ordering of utilization practices was more consistently concordant under the study's tests than the ordering of most learner-thinking indicators. The comparison remains descriptive because item counts and statistical details differed or were unavailable.

The Counting Game is particularly informative. Its utilization means were tightly clustered and favorably classified, while its concordance result was reported as not significant. High extent ratings therefore should not be used as a substitute for agreement evidence. Conversely, nonsignificant concordance does not justify discontinuing the game or presuming that teachers lacked shared goals. Group-specific ratings would be needed to examine which practices were ordered differently.

Convergent thinking was the sole significant creative-thinking result, but it should not become the sole policy priority on that basis. The test concerns consistency in rankings, not which skill matters most or which skill improved most. The not-significant domains may warrant clearer observation criteria and discussion among teachers, while the convergent domain still requires careful measurement and resolution of the duplicated indicator.

Sailer and Homner (2020) distinguish several outcomes when synthesizing gamification research. Their work reinforces the value of specifying the intended result of an instructional approach. For the study, the relevant distinction is between reported use, perceived learner behavior, agreement in rankings, and demonstrated learning change. The first three were addressed through the reported questionnaire findings; the fourth was not established.

4.4 Instructional and policy implications

The study proposed embedding game-based approaches in lesson planning, developing a shared repository with implementation guidance, and providing professional development on creative-thinking domains. It also recommended observation tools, reflective questions, communities of practice, and collaboration between curriculum units and researchers. These are proposed responses to the findings, rather than implemented policies or evaluated interventions.

Several practical priorities follow from the item patterns. Teacher development could examine how to connect gameplay with explanations, prompt learners to compare methods, and make reasoning visible through representations. Shared materials could include differentiated variants and post-activity discussion prompts. Decisions about these resources should consider actual learner readiness and curriculum expectations, especially where the listed tasks involve formal odds ratios or fraction simplification.

Digital access recommendations included reviewing hardware and connectivity, supporting offline-capable materials, and providing hands-on guidance for platform use. These proposals acknowledge possible implementation concerns but are not evidence that the study measured device shortages or connection quality. No infrastructure audit results were reported. Resource decisions would therefore require an assessment of local conditions before attributing differences in practice to technology access.

The study also proposed mindfulness prompts, guided pauses, tools for reflecting on decisions, transfer tasks, and opportunities to use peers' approaches. These suggestions align with the lower relative ratings for deliberate pacing, alternative approaches, and strategy changes. Their appropriateness can be explored through classroom implementation, but the study does not show that any one recommendation would produce a specific increase in creativity.

4.5 Limitations and further research

The evidence is limited by its reliance on a self-made questionnaire completed by teachers. Direct learner assessments, classroom observations, usage records, or longitudinal outcomes were not reported. Sampling, participant grouping, response anchors, validation, reliability, and data-collection procedures remain insufficiently specified. The absence of group-specific rankings and degrees of freedom prevents independent reproduction of the concordance tests. All statistics are therefore retained as reported rather than presented as independently verified calculations.

The duplicated convergent statement and the different numbers of indicators across domains require clarification. The reported divergent-thinking summary enumerates six statements, but the information needed to connect that list to the test calculation is missing. No omitted statement is reconstructed. Group-specific raw rankings, complete instrument pages, and the full statistical output are needed to resolve the relationship between the descriptive and inferential findings.

The descriptive-evaluative-correlational designation does not supply evidence of causation. No reported analysis estimates a relationship between game-utilization scores and learner-thinking scores, and no baseline measure establishes improvement. Favorable ratings could reflect perceived practice, teacher expectations, or other classroom conditions. The study cannot distinguish these explanations from an effect of games.

Further research could examine sustained game use over an academic year, compare digital and non-digital formats, and investigate the role of facilitation strategies. It could also examine classroom context, cultural expectations, and access for learners with different needs. Stronger evaluation would require clearly specified outcomes, appropriate learner-level assessments, documented implementation, and an analytical design aligned with the claim being tested. These are proposed directions, not procedures attributed to the study.

5. Conclusion

The 61 participating Grade 2 teachers reported that the listed classroom mathematics-game practices were Very Much Utilized and that the five sets of creative-thinking indicators were Very Much Evident. Significant rank agreement was reported for seven of the eight game categories, with The Counting Game as the exception. Among creative-thinking domains, significant agreement was reported only for convergent thinking.

The findings support consideration of differentiated game facilitation, mathematical explanation, reflective discussion, and professional development focused on recognizing thinking processes. They describe teacher-reported practices and perceptions rather than verified gains in learner creativity. Resolving the duplicated indicator, completing methodological documentation, and obtaining the full ranking results are necessary before stronger explanatory or submission-ready claims can be made.

References

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