

GAME-BASED LEARNING IN ELEMENTARY IPAS: CHANGES IN STUDENTS' LEARNING OUTCOMES AFTER THE JEOPARDY CLASS GAME

Abd. Hamid¹, Yuliana Alfiyatin²

^{1,2} Institut Bahri Asyiq Galis, Bangkalan, Indonesia

Email : afkarinadiniyatulfahiroh@gmail.com¹, viviku8@gmail.com²

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Abstract :

This study examines changes in Grade IV students' learning outcomes following the implementation of the Jeopardy Class Game in Ilmu Pengetahuan Alam dan Sosial (IPAS), particularly on the topic of changes in states of matter. The study aimed to compare students' achievement before and after the intervention and describe their responses to the learning activity. A quantitative approach with a pre-experimental one-group pretest-posttest design was employed, involving 15 students at SDN Lombang Laok 2, Bangkalan, Indonesia. Data were collected through learning-outcome tests, a 15-item student-response questionnaire, classroom observations, and documentation. The data were analyzed using descriptive statistics, the Shapiro-Wilk normality test, a paired-samples t-test, and normalized gain (N-Gain). The findings showed that the mean learning-outcome score increased from 62.00 in the pretest to 73.20 in the posttest, representing an improvement of 11.20 points. Learning mastery also increased from 66.7% to 86.7%. The paired-samples t-test indicated a statistically significant difference between pretest and posttest scores, $t(14) = 4.924$, $p < .001$. However, the mean N-Gain of 0.324 indicated a moderate level of improvement. Student responses were highly positive, reaching 97.33%, particularly in motivation, participation, collaboration, and learning attractiveness. These findings suggest that the Jeopardy Class Game is a promising reinforcement strategy when integrated with teacher explanations, concrete experiments, and guided classroom discussions. Nevertheless, the small sample and absence of a control group limit causal interpretation. Further studies involving larger samples and comparison groups are needed to examine the effectiveness and generalizability of this approach.

Keywords : Game-Based Learning; Jeopardy Class Game; Learning Outcomes

Abstrak :

Penelitian ini mengkaji perubahan hasil belajar siswa kelas IV setelah penerapan Jeopardy Class Game dalam pembelajaran Ilmu Pengetahuan Alam dan Sosial (IPAS), khususnya pada materi perubahan wujud zat. Penelitian ini bertujuan membandingkan hasil belajar siswa sebelum dan sesudah intervensi serta mendeskripsikan respons siswa terhadap kegiatan pembelajaran. Penelitian menggunakan pendekatan kuantitatif dengan desain pra-eksperimen one-group pretest-posttest yang melibatkan 15 siswa di SDN Lombang Laok 2, Bangkalan, Indonesia. Data dikumpulkan melalui tes hasil belajar, angket respons siswa yang terdiri atas 15 butir, observasi kelas, dan dokumentasi. Analisis data dilakukan menggunakan statistik deskriptif, uji normalitas Shapiro-Wilk, uji-t berpasangan (paired-samples t-test), dan normalized gain (N-Gain). Hasil penelitian menunjukkan bahwa nilai rata-rata hasil belajar meningkat dari 62,00 pada pretest menjadi 73,20 pada posttest, atau naik sebesar 11,20 poin. Ketuntasan belajar juga meningkat dari 66,7% menjadi 86,7%. Uji-t berpasangan menunjukkan perbedaan yang signifikan antara nilai pretest dan posttest, $t(14) = 4,924$, $p < 0,001$. Namun, nilai rata-rata N-Gain sebesar 0,324 menunjukkan peningkatan dalam kategori sedang. Respons siswa terhadap pembelajaran sangat positif, yaitu sebesar 97,33%, terutama dalam aspek motivasi, partisipasi, kolaborasi, dan daya tarik pembelajaran. Temuan ini menunjukkan bahwa

Jeopardy Class Game berpotensi menjadi strategi penguatan pembelajaran apabila dipadukan dengan penjelasan guru, eksperimen konkret, dan diskusi kelas yang terarah. Meskipun demikian, jumlah sampel yang terbatas dan tidak adanya kelompok kontrol membatasi penarikan kesimpulan kausal. Penelitian selanjutnya perlu melibatkan sampel yang lebih besar dan kelompok pembanding untuk menguji efektivitas serta keterterapan pendekatan ini secara lebih luas.

Kata Kunci: Game-Based Learning; Jeopardy Class Game; Hasil Belajar

INTRODUCTION

Elementary science learning requires students to engage actively with concepts, phenomena, and learning experiences rather than merely receive information from teachers. In the Indonesian elementary curriculum, Ilmu Pengetahuan Alam dan Sosial (IPAS) is intended to help students understand natural and social phenomena through integrated, contextual, and meaningful learning experiences. Recent evidence from primary and STEM education indicates that well-designed game-based and interactive environments can support cognitive achievement, motivation, and participation when game mechanics are aligned with instructional goals (Arztmann et al., 2023; Koç & Kanadlı, 2025; Wang et al., 2022). This is particularly relevant for elementary-school learners, who benefit from concrete, interactive, and participatory learning experiences.

However, the pedagogical potential of interactive learning media had not been optimally utilized in Grade IV IPAS learning at SDN Lombang Laok 2. Preliminary classroom observation showed that instruction was still dominated by verbal explanation and conventional question-and-answer activities, while game-oriented media were rarely used. School daily-test records on the same topic showed scores ranging from 30 to 78; 4 of 15 students (26.7%) had not reached the minimum mastery criterion (KKM = 65). The classroom teacher also reported low participation and signs of boredom during lessons on changes in states of matter. These local data indicate a concrete instructional problem: students required more opportunities to retrieve concepts actively, discuss answers, receive feedback, and remain engaged with the learning task.

Game-based learning (GBL) embeds learning objectives within structured game activities involving challenges, rules, feedback, decision making, and problem solving. Recent syntheses show that game-based approaches can produce positive cognitive and motivational outcomes, but their effects vary across learners, subjects, game formats, and instructional conditions (Arztmann et al., 2023; Wang et al., 2022). In primary education, teacher scaffolding is also important because orientation, guidance, and feedback shape students'

engagement and knowledge construction during gameplay (Sun et al., 2023). Thus, GBL should be treated as an instructional design strategy rather than as entertainment added to a lesson.

The pedagogical value of GBL therefore depends on the alignment among learning objectives, subject content, game mechanics, instructional guidance, and feedback. A recent network meta-analysis in science education found that interactive digital games can outperform conventional instruction for cognitive outcomes, while also emphasizing heterogeneity across learning environments (Koç & Kanadlı, 2025). This evidence supports examining not only whether scores change after a game-based intervention, but also how the game is positioned within the instructional sequence and how students respond to it.

One form of game-based learning that can be integrated into classroom instruction is the Jeopardy Class Game. The format organizes questions into categories and levels of difficulty, allowing students to choose questions, discuss possible answers, collect scores, and participate in structured academic competition. In Indonesian elementary science education, a PowerPoint-based Jeopardy medium has been judged highly feasible and positively accepted by students (Afandi & Sayyi, 2023; Sari et al., 2023). The format is potentially relevant to IPAS because question choice, peer discussion, retrieval practice, and immediate feedback can be combined within one classroom activity.

Recent empirical studies strengthen this potential but also reveal different research emphases. Sari et al. focused mainly on the feasibility and student acceptance of a PowerPoint-based Jeopardy medium in elementary science (Sari et al., 2023), whereas Nuraini et al. used a quasi-experimental design and reported positive effects of Jeopardy on learning activities and outcomes in biology education (Nuraini et al., 2022). Satyaningrum et al. likewise reported the usefulness of Jeopardy for instructional evaluation in language learning (Satyaningrum et al., 2024). More recently, Uliah et al. found that Jeopardy integrated with STAD improved elementary IPAS problem-solving performance in a controlled quasi-experimental setting (Sayyi et al., 2021; Uliah et al., 2026). These studies demonstrate the versatility of Jeopardy, while also showing that the game is frequently examined as a developed medium, an evaluative tool, or a component integrated with another instructional model.

A more specific research gap therefore concerns how Jeopardy functions as a classroom reinforcement medium in regular Grade IV IPAS instruction when learning outcomes and student responses are examined together. Existing studies

provide limited evidence on the combination of (1) regular elementary IPAS content on changes in states of matter, (2) Jeopardy used after explanation and concrete experimentation rather than as a stand-alone product, (3) paired pretest-posttest evidence, and (4) structured response data covering motivation, participation, conceptual understanding, collaboration, and attractiveness. Addressing these dimensions allows the study to move beyond a simple difference in research setting and toward an examination of how game mechanics are aligned with concept reinforcement and measurable learning change.

Accordingly, the originality of the present study lies in examining Jeopardy as a structured reinforcement component within a regular Grade IV IPAS learning sequence and in interpreting cognitive change together with students' classroom responses. The study does not claim that Jeopardy is a new educational game or that a one-group design can establish definitive causality. Instead, it provides contextual evidence about within-group learning change after the intervention, the magnitude of that change, and the way students experienced the game-based activity. The study therefore aims to examine changes in Grade IV students' IPAS learning outcomes before and after the Jeopardy Class Game intervention and to describe students' responses to its classroom implementation.

RESEARCH METHOD

This study employed a quantitative approach with a pre-experimental one-group pretest-posttest design. The same participants were assessed before and after the instructional intervention, represented as O1-X-O2, where O1 is the pretest, X is the Jeopardy Class Game intervention, and O2 is the posttest (Creswell & Creswell, 2017). This design is appropriate for estimating within-group change; however, because it does not include a comparison or control group, it cannot by itself establish that observed changes were caused exclusively by the intervention.

The study was conducted at SDN Lombang Laok 2, Blega District, Bangkalan Regency, East Java, Indonesia, during the second semester of the 2025/2026 academic year. The population consisted of 85 students enrolled at the school, while the research participants were all 15 Grade IV students who participated in the IPAS learning intervention. The learning material focused on changes in states of matter, including melting, freezing, and evaporation. This topic was selected because it requires students to understand scientific concepts through concrete and interactive learning experiences and was consistent with

the Grade IV curriculum implemented at the research site.

The research procedure consisted of three main stages: pre-intervention, intervention, and post-intervention. During the pre-intervention stage, preliminary classroom observations and discussions with the classroom teacher were conducted to identify instructional conditions and prepare the learning activities. The pretest was administered on April 8, 2026, to measure students' initial cognitive achievement. The Jeopardy Class Game intervention was subsequently implemented on April 9, 2026, during IPAS instruction on changes in states of matter. Students participated in game-based learning activities in which questions were organized according to categories and levels of difficulty, and students worked collaboratively to discuss and answer the questions. Reinforcement and additional Jeopardy-based practice were conducted on April 10, 2026. The research concluded with classroom observation, administration of the student-response questionnaire, and the posttest on April 11, 2026.

Data were collected through learning-outcome tests, a student-response questionnaire, structured classroom observation, and documentation. The pretest and posttest measured cognitive learning outcomes before and after the intervention. The questionnaire consisted of 15 dichotomous items using a Guttman scale (Yes = 1; No = 0) and covered motivation/interest, active participation and confidence, conceptual understanding and retention, collaboration/discussion, and attractiveness/curiosity. Classroom observation used 15 indicators scored on a four-point scale (1 = poor, 2 = fair, 3 = good, 4 = very good) by two observers, producing 30 observer-item judgments used as supporting process data. Documentation recorded the sequence of instructional activities.

The learning-outcome instrument was examined for validity and reliability before its use in data analysis. Validity testing was employed to determine whether the test items appropriately represented the learning outcomes being measured, while reliability was used to assess the internal consistency of the instrument. The original research reported a reliability coefficient of 0.923, indicating high internal consistency. The use of reliability coefficients such as Cronbach's alpha is common in educational research, although the coefficient should be interpreted in relation to the number, purpose, and dimensionality of the items rather than treated as the sole indicator of instrument quality (Taber, 2018).

Data analysis proceeded in several stages. Descriptive statistics

summarized pretest and posttest scores (mean, standard deviation, minimum, maximum), learning mastery, individual score-change direction, questionnaire indicators, and structured observation coverage. The normality of paired difference scores was evaluated with the Shapiro-Wilk test. Because the paired differences met the normality assumption, a paired-samples t-test was used to examine whether the mean pretest-posttest difference was statistically significant at $\alpha = .05$ (Field, 2024). Statistical significance was interpreted together with descriptive change and normalized gain rather than as a stand-alone indicator of intervention success.

A paired-samples t-test was used because the same 15 students completed both measurements and the distribution of difference scores was approximately normal. The analysis focuses on within-group change and is therefore reported as evidence of association following the intervention, not as a definitive causal effect. This distinction is important because maturation, repeated testing, teacher guidance, and other instructional activities may also influence posttest performance in a one-group design.

The magnitude of learning improvement was additionally summarized using normalized gain (N-Gain), calculated relative to the maximum possible improvement. The N-Gain was used as a complementary descriptive index rather than a substitute for inferential analysis because normalized gain can be influenced by baseline performance and should be interpreted cautiously (Westphale et al., 2022). In this study, values below 0.30 were interpreted as low, 0.30 to below 0.70 as moderate, and 0.70 or above as high.

$$g = \frac{\text{Posttest} - \text{Pretest}}{\text{Maximum Score} - \text{Pretest}}$$

N-Gain interpretation:

$g < 0.30 = \text{Low}$

$0.30 \leq g < 0.70 = \text{Moderate}$

$g \geq 0.70 = \text{High}$

Figure 1. N-Gain Formula and Interpretation Criteria

FINDINGS AND DISCUSSION

Findings

The findings are organized around implementation evidence, student responses, changes in learning outcomes, and statistical analysis. Data were obtained from structured classroom observation, a 15-item student-response questionnaire, and paired pretest-posttest scores from 15 Grade IV students at

SDN Lombang Laok 2. The intervention focused on changes in states of matter.

Implementation of Jeopardy Class Game in IPAS Learning

The Jeopardy Class Game was implemented within the regular IPAS sequence after explanation and a simple experiment on changes in states of matter. Students worked in groups, selected questions from categories and difficulty levels, discussed answers, and responded to teacher prompts. Two observers independently used the same 15-item observation checklist on a four-point scale. The observation dataset therefore comprised 30 observer-item judgments covering clarity of instruction, content alignment, student participation, collaboration, motivation, teacher guidance, discussion time, and lesson completion.

Across the two observation sheets, the targeted classroom behaviors were consistently recorded during the session, particularly student participation, collaboration, motivation to answer questions, teacher guidance when difficulties occurred, and effective use of discussion time. Because the observation instrument served as supporting process evidence rather than as an outcome measure, these ratings are used to corroborate the questionnaire and test findings rather than to claim an independent treatment effect.

The intervention was integrated with concrete learning activities. Before the Jeopardy session, students observed changes from solid to liquid and vice versa using simple materials, recorded their observations in worksheets, and presented the results. Jeopardy was then used as a reinforcement activity, linking question selection and peer discussion to concepts that had already been introduced through explanation, experimentation, and presentation.

Students' Responses to Jeopardy Class Game

Students' responses were analyzed both overall and by the five dimensions represented in the 15-item questionnaire. Across 225 possible responses, 219 were positive (97.33%). Dimension-level percentages ranged from 93.33% to 100%, showing consistently favorable responses while also revealing modest variation across aspects of the learning experience.

Table 1. Student Responses by Questionnaire Dimension

Dimension	Items	Positive Responses	Possible Responses	Percentage
Motivation and interest	1, 2, 3, 15	60	60	100.00%

Active participation and confidence	5, 6	30	30	100.00%
Conceptual understanding and retention	7, 8, 9	42	45	93.33%
Collaboration and discussion	10, 11, 12	43	45	95.56%
Attractiveness and curiosity	4, 13, 14	44	45	97.78%
Overall	1-15	219	225	97.33%

Source: Primary data, 2026.

The strongest responses were recorded for motivation/interest and active participation/confidence, both of which reached 100%. Conceptual understanding/retention was the lowest dimension at 93.33%, although it remained very positive. Collaboration/discussion and attractiveness/curiosity were also strongly endorsed. This distribution provides a more informative view than a single overall percentage and suggests that engagement-related perceptions were especially strong.

The response pattern was consistent with the classroom observation, which documented participation, peer discussion, collaboration, and teacher-supported answering during gameplay. The convergence of the two sources indicates that the game was well accepted and that the intended participatory behaviors were present during implementation; however, these response data are interpreted separately from evidence of cognitive learning change.

Students' Learning Outcomes Before and After the Intervention

Students' cognitive learning outcomes were measured before and after the intervention. At the group level, the mean score increased, but individual change was heterogeneous: 13 students improved, one student obtained the same score, and one student obtained a lower posttest score.

Table 2. Descriptive Statistics of Pretest and Posttest Scores

Test	N	Mean	Standard Deviation	Minimum	Maximum
Pretest	15	62.00	12.60	20	72
Posttest	15	73.20	16.95	24	92

Source: Primary data, 2026.

The mean increased by 11.20 points. The higher posttest standard

deviation indicates that performance remained variable across students, so the group-level increase should be read together with the direction of individual score change.

Table 3. Direction of Individual Pretest-Posttest Score Change

Direction of Change	Students	Percentage
Improved	13	86.7%
Unchanged	1	6.7%
Decreased	1	6.7%

Source: Primary data, 2026.

Most students improved, but the unchanged and decreased scores show that the intervention did not produce uniform gains. This pattern is consistent with the moderate N-Gain reported below.

Table 4. Students' Learning Mastery Before and After the Intervention

Test	Students Achieving KKM	Percentage	Students Not Achieving KKM	Percentage
Pretest	10	66.7%	5	33.3%
Posttest	13	86.7%	2	13.3%

Source: Primary data, 2026.

Learning mastery increased by 20 percentage points, while the number of students below the KKM decreased from five to two. Together with the individual-change distribution, the mastery data indicate a generally positive but heterogeneous pattern rather than uniform improvement across all participants.

Normality and Paired-Samples Analysis

The distribution of paired difference scores was examined with the Shapiro-Wilk test before inferential analysis.

Table 5. Normality Test of Pretest-Posttest Difference Scores

Variable	Shapiro-Wilk Statistic	p-value	Interpretation	Variable
Difference scores	0.959	0.669	Normally distributed	Difference scores

Source: Primary data, 2026.

The p-value of 0.669 exceeded .05, supporting the use of a paired-samples t-test for the within-group comparison.

Table 6. Paired-Samples t-Test of Students' Learning Outcomes

Comparison	Mean Difference	SD of Difference	t	df	p-value
Posttest - Pretest	11.20	8.81	4.924	14	< .001

Source: Primary data, 2026.

The paired-samples t-test indicated a statistically significant within-group difference, $t(14) = 4.924$, $p < .001$. This result shows that posttest scores were systematically higher at the group level, but it does not establish that Jeopardy was the sole cause of the change. The inferential result is therefore interpreted together with descriptive change, mastery, and normalized gain rather than as the only indicator of educational improvement.

N-Gain of Students' Learning Outcomes

The magnitude of improvement was additionally summarized using normalized gain.

Table 6. N-Gain of Students' Learning Outcomes

Indicator	Value	Category
Mean N-Gain	0.324	Moderate

Source: Primary data, 2026.

The mean N-Gain of 0.324 placed the learning gain in the moderate category. This result tempers the statistically significant paired difference: the score change was consistent enough to be statistically detectable, but the proportion of the maximum possible improvement remained moderate. The finding is also compatible with the individual-level pattern in which one student did not improve and one student declined.

Taken together, the findings show a coherent but bounded pattern: student responses were strongly positive, most students improved, mastery increased, the paired difference was statistically significant, and normalized gain was moderate. The evidence therefore supports meaningful within-group improvement following the intervention while also showing variation in the magnitude and direction of change.

Discussion

The central finding is not merely that posttest scores were higher, but that a structured game-based reinforcement activity was followed by improvement across several complementary indicators. The paired comparison, mastery distribution, individual score direction, and moderate N-Gain point to the same general pattern while also showing that improvement was not uniform. This distinction is important because statistical significance describes the consistency

of the paired difference, whereas educational magnitude is better understood by considering the size and distribution of the gain together.

The pattern can be explained through the instructional mechanisms of game-based learning. Jeopardy required students to retrieve previously introduced concepts, choose among question categories, negotiate answers with peers, and receive immediate feedback. These processes increase opportunities for active retrieval and guided participation rather than passive reception. Recent research in STEM education similarly reports positive cognitive and motivational outcomes from game-based learning, while emphasizing that benefits depend on game design and learner characteristics (Arztmann et al., 2023; Sayyi, Afandi, et al., 2023; Wang et al., 2022). Teacher scaffolding is particularly important in primary education because orientation, prompting, and feedback help students connect gameplay with academic content (Sayyi et al., 2025; Sun et al., 2023).

The present results are partly consistent with earlier Jeopardy research but extend it in a different direction. Sari et al. showed that PowerPoint-based Jeopardy was feasible and attractive for elementary science, but their study emphasized product validation rather than pretest-posttest learning change (Afandi & Sayyi, 2025; Haris et al., 2026; Sari et al., 2023). Nuraini et al. reported positive effects on activity and learning outcomes using a quasi-experimental design in biology education (Nuraini et al., 2022; Sayyi & Rofiqi, 2024), while Satyaningrum et al. demonstrated the usefulness of Jeopardy as an evaluation medium in language learning (Satyaningrum et al., 2024). Uliah et al. provided stronger causal evidence in elementary IPAS by combining Jeopardy with STAD in a controlled quasi-experiment (Sayyi, Gaffar, et al., 2023; Uliah et al., 2026). In comparison, the present study contributes a narrower but practically relevant picture of Jeopardy used as reinforcement within a regular Grade IV IPAS sequence.

The very high student-response percentages should be interpreted as evidence of acceptance and engagement, not as proof that the game caused achievement gains. Motivation/interest and active participation received the strongest responses, whereas conceptual-understanding items showed slightly more variation. This pattern is pedagogically plausible: students can enjoy and participate in a game immediately, whereas conceptual learning also depends on prior explanation, experimentation, question design, discussion, and feedback. The observation data support this interpretation by documenting participation, collaboration, teacher guidance, and discussion during implementation.

The moderate N-Gain is especially important for explaining the apparent contrast between a highly significant paired t-test and only moderate normalized improvement. A small p-value indicates that the average paired difference is unlikely to be zero under the statistical model; it does not mean that the educational gain is large. N-Gain instead expresses improvement relative to the possible room for improvement and can itself be influenced by baseline performance (Ismail et al., 2025; Westphale et al., 2022). In this study, the moderate N-Gain and the presence of one unchanged and one decreased score suggest that the intervention benefited most, but not all, students to the same extent.

The findings also show why Jeopardy should not be treated as an isolated entertainment activity. It was implemented after explanation and a concrete experiment on changes in states of matter, so the game functioned primarily as reinforcement and retrieval practice. This alignment between prior concept exposure, peer discussion, question choice, and immediate feedback is consistent with recent evidence that interactive game environments in science are most useful when embedded in coherent instructional design (Koç & Kanadlı, 2025; Sayyi, Afandi, et al., 2023). The practical implication is that teachers should design Jeopardy questions around explicit learning objectives and use scaffolding to keep competition subordinate to conceptual understanding.

Methodological caution remains necessary. Because this study used a one-group pretest-posttest design with only 15 students, the observed improvement cannot be attributed exclusively to Jeopardy. Repeated testing, maturation, teacher guidance, the experiment preceding the game, and other classroom interactions may also have contributed. The study should therefore be read as evidence of promising within-group change and positive implementation, not as definitive causal proof. Future research should use larger multi-school samples, comparison groups, longer interventions, and additional outcomes such as retention, conceptual transfer, collaboration, and motivation to determine when and for whom Jeopardy-based IPAS learning is most effective.

Figure 2 synthesizes the principal findings without implying a causal pathway. It presents score change, mastery, inferential results, normalized gain, and student response as complementary indicators that should be interpreted together.

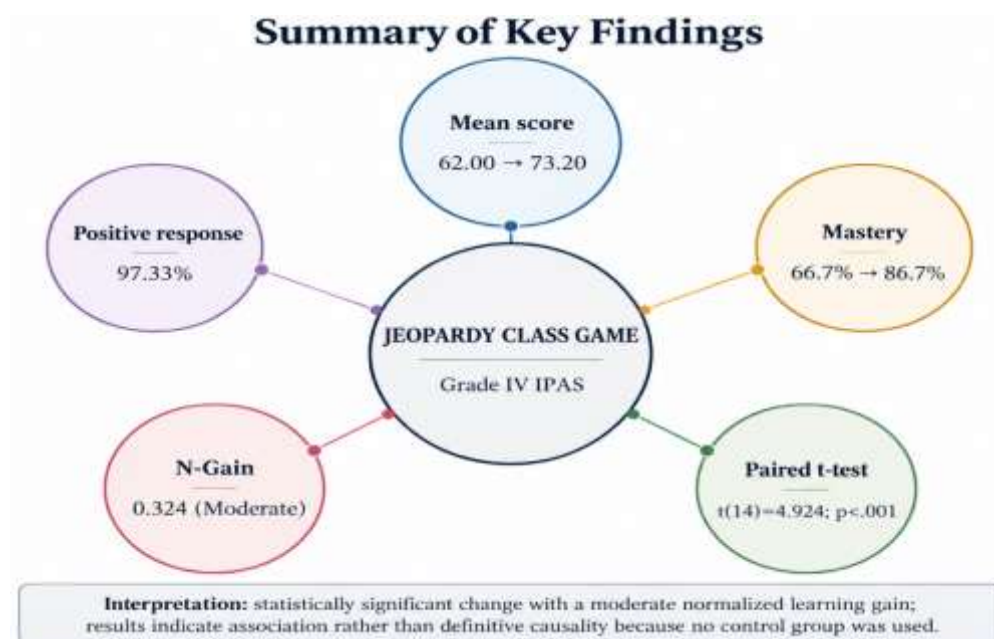


Figure 2. Summary of Key Findings after the Jeopardy Class Game Intervention

As summarized in Figure 2, the intervention was followed by a significant paired-score difference and higher mastery, while the N-Gain remained moderate and student responses were strongly positive. The figure therefore reinforces the main interpretation: classroom implementation was promising, but the magnitude of learning change and the limitations of the one-group design require cautious conclusions.

CONCLUSION

The study found meaningful within-group improvement in Grade IV IPAS learning outcomes after the Jeopardy Class Game was integrated as a reinforcement activity on changes in states of matter. Most students improved, learning mastery increased, the paired pretest-posttest difference was statistically significant, and the N-Gain indicated a moderate rather than high level of improvement. Students also reported very positive experiences, particularly in motivation, participation, collaboration, and attractiveness. Conceptually, the results suggest that the pedagogical value of Jeopardy lies in combining retrieval practice, peer discussion, question choice, challenge, and immediate feedback wi

thin a teacher-guided learning sequence. However, the one-group design, small sample, and absence of a control group prevent strong causal claims. Future research should employ larger multi-school samples, comparison groups, longer interventions, and retention or transfer measures to determine the robustness and generalizability of Jeopardy-based IPAS learning.

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