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Improving Critical Thinking and Learning Motivation in Elementary Education: The Integration of STAD and Digital Diversity Challenge Media

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Critical Thinking Skills;
Learning Motivation;
Student Teams Achievement Division (STAD);
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ABSTRACT

Abstract: *The low levels of students' critical thinking skills and learning motivation provided the rationale for this study. This study aimed to improve students' critical thinking skills and learning motivation through the implementation of the Student Teams Achievement Division (STAD) cooperative learning model supported by Diversity Challenge digital media. This classroom action research employed the Kemmis and McTaggart model and was conducted in three cycles involving 31 students at SDN Sukorejo 2, Kediri, Indonesia. Data were collected using critical thinking essay tests and learning motivation questionnaires and analyzed through comparative descriptive analysis, Normalized Gain (N-Gain), and a paired-samples t-test. The findings revealed an increase in the mean critical thinking score from 58.55 in the pre-cycle to 86.94 in Cycle III, with an N-Gain of 0.70 (high category). Classical learning mastery increased from 22.58% to 90.32%. This improvement was statistically significant, as indicated by the paired-samples t-test (t (30) = 12.396, p < .001). The mean learning motivation score also increased from 56.71% (moderate category) to 88.10% (very high category). These findings demonstrate that the STAD cooperative learning model supported by Diversity Challenge digital media was effective in improving students' critical thinking skills and learning motivation.*

Kata Kunci:
Kemampuan Berpikir Kritis;
Motivasi Belajar;
Student Teams Achievement Division (STAD);
Diversity Challenge.

Abstrak: Rendahnya kemampuan berpikir kritis dan motivasi belajar murid melatarbelakangi penelitian ini. Penelitian ini bertujuan meningkatkan kemampuan berpikir kritis dan motivasi belajar melalui model pembelajaran kooperatif *Student Teams Achievement Division* (STAD) berbantuan media digital *Diversity Challenge*. Penelitian Tindakan Kelas model Kemmis dan McTaggart ini dilaksanakan dalam tiga siklus terhadap 31 murid SDN Sukorejo 2 Kediri. Data dikumpulkan melalui tes uraian berpikir kritis dan angket motivasi belajar, lalu dianalisis secara deskriptif komparatif, Normalized Gain (N-Gain), serta uji Paired Samples t-Test. Hasil penelitian menunjukkan peningkatan rata-rata berpikir kritis dari 58,55 pada Prasiklus menjadi 86,94 pada Siklus III, dengan N-Gain sebesar 0,70 (kategori tinggi). Ketuntasan klasikal meningkat dari 22,58% menjadi 90,32%. Peningkatan tersebut terbukti signifikan secara statistik berdasarkan uji Paired Samples t-Test (t (30) = 12,396; p < 0,001). Rata-rata motivasi belajar juga meningkat dari 56,71% (sedang) menjadi 88,10% (sangat tinggi). Dengan demikian, penerapan model STAD berbantuan media *Diversity Challenge* terbukti efektif meningkatkan kemampuan berpikir kritis dan motivasi belajar murid.

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A. INTRODUCTION

Students' civic attitudes and behavior are fundamentally cultivated through Pancasila Education, particularly in internalizing the values of social justice, humanity, and national unity (Norrahmah et al., 2025). Pancasila Education is expected to shape Indonesian children into individuals who are not only intellectually competent, but also socially and environmentally conscious (Roza, 2024). The instructional content of Pancasila Education in fourth-grade elementary school is designed to move beyond rote conceptual memorization, focusing instead on fostering cognitive competencies as well as student social behaviors and dispositions (Agustin et al., 2025). A critical topic addressed at this

grade level is respecting diverse communal identities, as this subject matter directly relates to learners' lived experiences within pluralistic social environments.To understand the dynamics of such diversity, students need higher-order thinking skills that enable them to critically and rationally examine social issues.

Critical reasoning skills are considered fundamental competencies that students need to address the challenges of modern education (Widiawati et al., 2024). In the elementary school curriculum, critical thinking should be integrated into every learning activity (Kusuma, 2024). Critical thinking skills in elementary education play an essential role in enabling students to analyze information in depth and construct meaningful knowledge (Aryani et al., 2025). In fourth-grade Pancasila Education, students are frequently required to analyze cases and solve problems, particularly in relation to interpreting phenomena, analyzing cause-and-effect relationships in diversity-related issues, evaluating social actions, and drawing conclusions that reflect the values of diversity.

The development of students' critical thinking skills is closely linked to the role of their learning motivation in the classroom. To attain academic success, high student learning motivation is paramount. Students with pronounced learning motivation tend to be more proactive, persistent, inquisitive, engaged in discussions, and committed to task completion (Fatin Syahirah et al., 2023). Conversely, low motivation may result in inattention, passivity during group work, susceptibility to disinterest, and reliance on peer answers. Sustained learning motivation fosters self-directed learning by instilling a sense of academic accountability (Novitasari, 2023). When examining sociocultural diversity, motivation is crucial because instruction must provide experiential, engaging opportunities closely aligned with students' daily realities and active participation.

However, these ideal expectations have not yet been fully reflected in actual classroom conditions. Based on preliminary observations of Pancasila Education lessons in the fourth grade at SDN Sukorejo 2, the learning process was found to have not fully encouraged students to think critically and participate actively. Some students still experienced difficulties in explaining the reasons behind particular actions, analyzing issues related to differences in community identities, and making decisions based on the values of Pancasila. Furthermore, student engagement in learning activities remained uneven. Some students tended to be passive, lacked confidence in expressing their opinions, and relied on their peers to provide answers.

These shortcomings were further confirmed by quantitative data obtained from preliminary tests and diagnostic assessments involving 31 students, which revealed that students' learning achievement remained considerably below the required Minimum Mastery Criterion (KKM = 75). Of the 31 students, only 7 (22.58%) achieved the mastery criterion, while the remaining 24 students (77.42%) did not, with a relatively low class mean score of 58.55. Frequency distribution analysis indicated that none of the students (0.00%) achieved the Excellent category (score range of 85–100), while the majority were classified in the Fair (41.94%) and Poor (35.48%) categories. These cognitive learning outcomes were consistent with students' initial learning motivation, which averaged only 56.71% (moderate category). Furthermore, 64.52% of students were classified in the moderate motivation category, and none had reached the very high motivation category.

Observational findings indicated that this underperformance stemmed primarily from systemic internal instructional factors. Instruction predominantly adhered to a conventional teacher-centered paradigm, characterized by didactic lecture methods and mechanistic drill exercises without contextual meaning-making or the integration of interactive instructional media (Bau, 2024). Because this pedagogical deficit cannot be left unaddressed, planned, systematic, and measurable interventions via Classroom Action Research (CAR) are imperative.

A viable strategic intervention entails implementing cooperative learning frameworks that afford students structured opportunities to interact and collaborate with peers. A pertinent model is the Student Teams Achievement Division (STAD). The STAD framework accommodates heterogeneous

cognitive capacities, allowing learners to interact and share understanding, thereby establishing a mutually reinforcing learning environment that strengthens cognitive reasoning (Dini & Murniawaty, 2026).

The STAD model consists of several instructional stages, including class presentation, team formation, team study, individual quizzes, calculation of individual improvement scores, and team recognition (Sekarini, 2022). A study conducted by (Widiastuti, 2025) demonstrated that the implementation of STAD increased students' learning motivation and active participation in the learning process.

Nevertheless, several empirical studies have identified limitations in implementing the STAD model independently. STAD implementation that relies on conventional printed worksheets often leads to procedural monotony among digitally oriented students, encourages the dominance of higher-achieving students, and provides limited opportunities for visualizing contextual concepts (Wulandari, 2022). Furthermore, the integration of physical game-based media, such as Monopoly or Snakes and Ladders, into STAD instruction (Dini & Murniawaty, 2026) generally remains focused on lower-order knowledge acquisition and memorization rather than developing critical reasoning skills through multidimensional problem-solving activities. Meanwhile, previous studies incorporating digital learning media, such as the *Baamboozle* platform (Agustin et al., 2025)or *Augmented Reality* (Amalia, 2026), have often positioned these technologies primarily as supplementary tools for quick quizzes without systematically aligning them with the structured stages of cooperative group learning.

This research gap highlights the need to integrate cooperative learning models with interactive, problem-based digital media. The novelty of this study lies in the comprehensive integration of the STAD cooperative learning model with *Digital Diversity Challenge* media developed using *Canva Sites*. The primary advantage of this integration is the design of digital media featuring contextual gamified challenges related to sociocultural identity diversity, organized into four progressively scaffolded levels. Digital learning media facilitate innovative and engaging content delivery through the integration of various interactive multimedia elements, including text, images, audio, and video, which can enhance students' comprehension and retention of learning materials (Novela et al., 2024). Through this integration, the team study and individual quiz stages of STAD are transformed into collaborative digital case-based problem-solving activities that promote transparency in team improvement scores and encourage active individual accountability among group members (Hapsari et al., 2023)

Based on these educational needs and the identified research gap, this study aims to improve the critical thinking skills and learning motivation of fourth-grade students at SDN Sukorejo 2 through the implementation of the STAD cooperative learning model supported by *Digital Diversity Challenge* media. This study is expected to make two contributions. Theoretically, it seeks to expand the existing body of knowledge concerning the integration of *Canva Sites*-based digital technology into cooperative learning procedures at the elementary school level. Practically, it aims to provide educators with an alternative instructional framework for designing interactive and collaborative diversity education that fosters students' critical reasoning skills.

B. METHOD

This study employed a collaborative Classroom Action Research (CAR) design adapted from the spiral cycle model developed by Kemmis and McTaggart. The research procedures were implemented iteratively through a series of continuous cycles, each comprising four main stages: planning, action implementation, observation, and critical evaluation or reflection (Tias et al., 2025). This study integrated both quantitative and qualitative data. The research participants consisted of

31 fourth-grade students at SDN Sukorejo 2, Ngasem District, Kediri Regency, East Java, Indonesia. The study was conducted from August to September, covering the pre-cycle stage through Cycle III.

Data were collected through learning achievement tests, learning motivation questionnaires, observations, and documentation. The critical thinking assessment instrument consisted of essay questions based on contextual problem-solving scenarios related to diversity. The instrument was developed with reference to four core indicators adapted from Ennis's critical thinking framework: interpreting phenomena, analyzing social issues, evaluating actions based on Pancasila values, and drawing logical conclusions. Each test item was assessed using a four-point analytical rubric (1–4) for each indicator, with the resulting scores converted to a 0–100 scale. Meanwhile, students' learning motivation was measured using a four-point Likert-scale questionnaire (1 = Strongly Disagree to 4 = Strongly Agree), without a neutral response option to minimize indecisive responses. The questionnaire covered five dimensions: (1) learning interest and enthusiasm, (2) achievement motivation, (3) perseverance in completing tasks, (4) persistence and peer support, and (5) learning independence and active participation.

Before implementation in the research classroom, the instruments underwent content validity assessment through expert judgment by two experts: an academic supervisor specializing in elementary education and a mentor teacher serving as an educational practitioner. The results indicated that all items were considered valid and suitable for use without substantive revisions. Reliability testing of the critical thinking assessment yielded a Cronbach's alpha coefficient of $\alpha = 0.812$, while the learning motivation questionnaire yielded $\alpha = 0.874$. Both coefficients indicated high internal consistency, suggesting that the instruments were reliable for assessing students' critical thinking skills and learning motivation.

Descriptive quantitative analysis was employed to calculate the class mean, median, score range, percentage of students achieving classical learning mastery based on the Minimum Mastery Criterion (KKM = 75), with a minimum success target of 85%, and standard deviation to examine the variability of students' performance within the class. In addition, learning motivation questionnaire scores were converted into percentages and classified into five qualitative categories. To measure the effectiveness of the instructional intervention while accounting for students' initial performance, Normalized Gain (N-Gain) analysis was conducted based on the criteria proposed by Hake (1999), as cited in (Y. Rahmawati et al., 2025):

$$g = \frac{Spost - Spre}{100 - S.pre} \quad (1)$$

To determine whether the improvements in students' critical thinking skills across the intervention cycles were statistically significant rather than attributable to random variation, a paired-samples t-test was employed. The use of this test was methodologically appropriate because repeated measurements were obtained from the same group of participants (31 students) across successive research cycles. The comparisons included the pre-cycle versus Cycle I, Cycle I versus Cycle II, Cycle II versus Cycle III, and the cumulative improvement from the pre-cycle to Cycle III. The statistical analysis was conducted at a significance level of $\alpha = 0.05$, with 30 degrees of freedom ($df = n - 1 = 30$) and a critical t-value of 2.042 for a two-tailed test. Statistical results were reported using standard parameters, including the mean difference, standard deviation of the paired differences, calculated t-statistic, degrees of freedom, and p-value. The null hypothesis was rejected when the absolute calculated t-value exceeded the critical t-value ($t > 2.042$) and the significance level was below 0.05 ($p < 0.05$).

Meanwhile, qualitative data collected through student activity observation sheets and teacher instructional implementation protocols were analyzed using the interactive model by Miles, Huberman, and Saldana, which includes data reduction, data display, and conclusion drawing or

verification (Widiastuti, 2025). Data reduction was carried out by screening and contextualizing field notes regarding group collaboration dynamics within the STAD model, interaction engagement with the Diversity Challenge digital media, and students' emotional responses during instruction. The data were subsequently presented in a narrative and thematic structure to delineate shifts in learning behaviors and address procedural constraints encountered in each cycle (Safrudin et al., 2023). The synthesis of both qualitative and quantitative findings served as the foundation for critical reflection to establish instructional adjustments in subsequent cycles.

C. RESULTS AND DISCUSSION

1. Pre-Cycle Results

This classroom action research commenced with a pre-cycle assessment to diagnose instructional needs and baseline student conditions prior to intervention implementation. During this preliminary phase, the primary focus centered on evaluating students' critical thinking competencies and learning motivation within the topic of sociocultural diversity. The instructional process at the pre-cycle stage was conducted conventionally through a teacher-centered approach, predominantly characterized by didactic lectures, passive rote transcription, and repetitive drill exercises devoid of interactive media or structured collaborative group learning.

Furthermore, a diagnostic assessment was administered to 31 students to evaluate critical thinking skills across four core indicators: interpretation, analysis, evaluation, and logical inference (Anggraini et al., 2022). Quantitative findings derived from this diagnostic test revealed substantially low conceptual mastery; learners exhibited persistent confusion when addressing evaluative tasks and displayed minimal enthusiasm throughout instructional activities (Isfaeni, 2023). The school's established Minimum Mastery Criterion was 75, with an expected classical mastery threshold of at least 85.00%, as shown in Table 1.

Table 1. Frequency Distribution of Students' Critical Thinking Test Scores in the Pre-Cycle Phase

Score Range	Category	Frequency	Percentage (%)	Mastery Status
85-100	Very Good	0	0.00%	Mastered
75-84	Good	7	22.58%	Mastered
60-74	Fair	13	41.94%	Unmastered
< 60	Poor	11	35.48%	Unmastered
Total	-	31	100.00%	7 Mastered (22.58%)

As presented in the Table 1 above, only 7 students (22.58%) attained the Minimum Mastery Criterion, while the remaining 24 students (77.42%) did not achieve mastery. The majority of the students were classified within the fair (41.94%) and poor (35.48%) categories. During the pre-cycle phase, the mean score of the class was only 58.55, with a median of 60.00. The highest score attained by a student was 80.00, whereas the lowest score reached an extreme point of 0.00. Based on classroom observations, the student receiving a score of 0.00 had special educational needs requiring comprehensive scaffolding and structured tasks tailored to individual capabilities. This substantial performance disparity reflects a considerable gap in conceptual mastery among the fourth-grade students. Students' capacity in conceptual understanding also corresponded proportionally with their learning motivation, as captured through the questionnaire administered in the pre-cycle phase across five dimensions: interest in learning, achievement striving, resilience when encountering difficulties, task perseverance, and learning autonomy (Rachman, 2026). The following is the distribution of students' learning motivation categories in the pre-cycle phase, as shown in Table 2.

Table 2. Distribution of Students' Learning Motivation Categories in the Pre-Cycle Phase

Percentage Range	Motivation Category	Frequency (*F*)	Percentage (%)
81% - 100%	Very High	0	0.00%
61% - 80%	High	10	32.26%
41% - 60%	Moderate	20	64.52%
21% - 40%	Low	1	3.23%
<20%	Very Low	0	0.00%
Total		31	100.00%

As illustrated in Table 2, the average learning motivation in the pre-cycle phase was only 56.71% (moderate category), with no students reaching the very high category. Observational data confirmed that learners appeared largely passive and reluctant to express their opinions during class questioning.

2. Implementation and Results of Cycle I Action

Prior to instructional implementation, the instructional design was developed, detailing the pedagogical approach, learning model, and instructional strategies to be deployed. The instructional modules integrated the STAD cooperative learning framework. The STAD cooperative approach relies on student collaboration and interpersonal communication to provide mutual support and foster learning motivation, ensuring that all team members achieve optimal conceptual mastery (Wulandari, 2022). The STAD model organizes cooperative learning within heterogeneous small groups, integrating diverse student capabilities to promote active collaboration toward designated learning competencies (Abrori et al., 2023).

Cycle I was conducted over an instructional allocation of 2 × 35 minutes by integrating the STAD cooperative framework with Level 1 of the Digital Diversity Challenge (thematic quizzes with scaffolding). The 31 students were divided into six heterogeneous teams (five groups of five and one group of six) based on mixed ability levels. Although students began collaborating, observational notes indicated that several members experienced procedural confusion and unequal participation, marking a transitional phase from didactic to active learning. The terminal evaluation in Cycle I indicated noticeable progress in critical thinking skills and cognitive learning outcomes relative to the pre-cycle baseline. The class mean score increased from 58.55 to 72.42 (+13.87 points). The evaluative distribution for Cycle I is detailed in the Table 3 below.

Table 3. Distribution of Students' Critical Thinking Test Scores in Cycle I

Score Range	Category	Frequency (*F*)	Percentage (%)	Mastery Status
85-100	Very Good	9	29.03%	Mastered
75-84	Good	11	35.48%	Mastered
60-74	Fair	6	19.35%	Unmastered
< 60	Poor	5	16.13%	Unmastered
Total		31	100.00%	20 Mastered (64.52%)

As outlined in Table 3, classical mastery reached 64.52% (20 students mastered). Concurrently, learning motivation rose to 70.42% (high category). Because the predefined classical mastery threshold (≥ 85.00%) was not yet fulfilled, instructional refinements, particularly establishing clear individual roles and presenting more challenging analytical cases, were planned for Cycle II.

3. Implementation and Results of Cycle II Action

During this stage, instructional planning was conducted by revising the learning modules based on the evaluation and critical reflection from Cycle I. The instructional module was updated to integrate Level 2 of the *Diversity Challenge*, featuring more rigorous problem-solving scenarios accompanied by authentic assessment instruments targeting intermediate-level critical thinking

(Higher-Order Thinking Skills). In the group division phase, explicit guidelines for individual role assignments were enacted, ensuring that every learner performed tasks strictly corresponding to their designated responsibilities (Wijaya et al., 2023). Additionally, team scores generated through the *Diversity Challenge* digital media were projected in real time onto a large display screen, enabling each group to monitor peer score progression transparently.

Instructional execution throughout Cycle II demonstrated a markedly more conducive classroom atmosphere than that observed in Cycle I. Students exhibited heightened learning enthusiasm, while collaborative capacity was visibly evident as learners with higher cognitive aptitudes actively assisted peers who encountered conceptual difficulties. The allocation of distinct roles within groups operated effectively; previously passive learners demonstrated greater confidence in articulating viewpoints and proposing alternative solutions during digital task completion. Furthermore, the critical thinking assessment in Cycle II yielded considerable advancement, with the class mean score rising to 81.45. The following is the distribution of students' critical thinking test scores by cycle, as shown in Table 4.

Table 4. Distribution of Students' Critical Thinking Test Scores in Cycle II

Score Range	Category	Frequency (*F*)	Percentage (%)	Mastery Status
85-100	Very Good	14	45.16%	Mastered
75-84	Good	11	35.48%	Mastered
60-74	Fair	4	12.90%	Unmastered
< 60	Poor	2	6.45%	Unmastered
Total		31	100.00%	25 Mastered (80.65%)

Although classical mastery reached 80.65%, the requisite research success threshold (> 85.00%) was not fully accomplished due to 6 students (19.35%) remaining below the Minimum Mastery Criterion = 75. These 6 unmastered students encountered persistent difficulties when addressing multi-tiered analytical questions on the digital media platform as well as individual evaluative assessments. Consequently, further pedagogical adjustments and targeted reflective interventions were required for the subsequent instructional cycle.

4. Implementation and Results of Cycle III Action

Cycle III focused on optimizing the learning mastery of the remaining unmastered students through structured peer tutoring, while deploying Levels 3 and 4 of the Diversity Challenge (reflective social action missions). Instruction proceeded within a highly cohesive and dynamic environment, where learners demonstrated strong teamwork and confidently articulated their ethical arguments. The following is the distribution of students' critical thinking test scores in Cycle III, as shown in Table 5.

Table 5. Distribution of Students' Critical Thinking Test Scores in Cycle III

Score Range	Category	Frequency (*F*)	Percentage (%)	Mastery Status
85-100	Very Good	23	74.19%	Mastered
75-84	Good	5	16.13%	Mastered
60-74	Fair	3	9.68%	Unmastered
< 60	Poor	0	0.00%	Unmastered
Total		31	100.00%	28 Mastered (90.32%)

Classical learning mastery in Cycle III reached 90.32% (28 students), successfully exceeding the targeted 85.00% benchmark. The class mean score peaked at 86.94, the standard deviation contracted further to 10.30, and no students scored in the poor tier (< 60). Overall learning motivation attained a class mean of 88.10% (very high category), with 83.87% of students occupying

the very high bracket. Because all success indicators were thoroughly achieved, the action was concluded.

The escalation of the learning motivation score to 88.10% in Cycle III was stimulated by interactive student engagement during small-group digital application activities. This finding reinforces the investigation by (Amalia, 2026), affirming that integrating interactive visual media within STAD syntax positively influences student learning enthusiasm and conceptual retention. STAD cooperative models exert a substantial positive effect on student academic outcomes (Simanjuntak & Sinaga, 2025). This success is inseparable from the instructor's proficiency in leveraging educational information technology to broaden competencies in designing creative and diverse pedagogical methods, thereby sustaining student academic engagement (Andi Sadriani et al., 2023).

5. Cross-Cycle Comparison and Inferential Testing

Table 6 summarizes the longitudinal comparative progression of critical thinking competencies from the pre-cycle baseline to Cycle III.

Table 6. Recapitulation of Critical Thinking Learning Outcomes Across Cycles

Parameter	Pre-Cycle	Cycle I	Cycle II	Cycle III	Overall Gain
Mean Score	58.55	72.42	81.45	86.94	+28.39 points
Median	60.00	75.00	80.00	87.00	+27.00 points
Maximum Score	80.00	100.00	100.00	100.00	+20.00 points
Minimum Score	0.00	10.00	20.00	60.00	+60.00 points
Score Range	80.00	90.00	80.00	40.00	-40.00 points
Standard Deviation	18.94	21.87	17.52	10.30	-8.64 points
Number of Mastered Students	7	20	25	28	+21 students
Classical Mastery (%)	22.58%	64.52%	80.65%	90.32%	+67.74%

As outlined in Table 6, the class mean score progressed continuously, reaching 86.94 by Cycle III. This upward trend confirms the efficacy of the STAD cooperative learning model integrated with the Diversity Challenge digital platform in enhancing critical thinking competencies. The observed gains occurred in a linear and incremental pattern across intervention cycles (+13.87 points in Cycle I, +9.03 points in Cycle II, and +5.49 points in Cycle III). Furthermore, to evaluate the efficacy of the instructional intervention objectively while eliminating potential bias from initial cognitive baselines, a Normalized Gain (*N*-Gain) analysis was performed utilizing Hake's formula (1999) (A. Rahmawati, 2025):

$$g = \frac{Spost - Spre}{100 - S.pre} \quad (2)$$

The following is an analysis of hake's normalized gain (N-Gain) across intervention stages, as shown in Table 7.

Table 7. Analysis of Hake's Normalized Gain (N-Gain) Across Intervention Stages

Stage Comparison	Pre-Intervention Mean	Post-Intervention Mean	Average *N*-Gain Score	*N*-Gain Percentage	Effectiveness Classification
Pre-Cycle – Cycle I	58.55	72.42	0.40	40.33%	Medium
Cycle I – Cycle II	72.42	81.45	0.28	27.82%	Low to Medium
Cycle II – Cycle III	81.45	86.94	0.35	34.60%	Medium
Cumulative	58.55	86.94	0.70	70.12%	High

The cumulative N-Gain score from the pre-cycle baseline to Cycle III reached 0.70 (70.12%), falling squarely into the "High" effectiveness category. In accordance with Hake's interpretive criteria, a normalized gain score of $g \geq 0.70$ establishes that the pedagogical intervention demonstrated substantial efficacy in bolstering students' critical thinking competencies. Furthermore, this pronounced gain underscores a decisive pedagogical transition from mechanical rote learning toward higher-order analytical reasoning. Such marked cognitive progression confirms that structured peer scaffolding effectively bridged conceptual deficits across heterogeneous learners. Consequently, the collaborative problem-solving framework succeeded in cultivating sustained intellectual engagement while establishing a foundation for self-directed inquiry. To evaluate the action research hypothesis, a paired-sample t-test was conducted at 30 degrees of freedom $df = 30$ with a significance threshold of $\alpha = 0.05$ (critical value $t_{table} = 2.042$). This statistical test aimed to substantiate empirically whether the recorded performance gains were statistically significant rather than an artifact of random chance. The following are the results of the paired-sample t-test on learning outcomes, as shown in Table 8.

Table 8. Results of Paired Sample t-Test on Learning Outcomes

Comparison Pair	Mean Difference	Std. Deviation of Difference	t_{count}	t_{table}	Significance	Statistical Conclusion
Pre-Cycle vs. Cycle I	13.87	8.64	8.947	2.042	$p < 0.001$	Statistically Significant (Positive)
Cycle I vs. Cycle II	9.03	10.45	4.816	2.042	$p < 0.001$	Statistically Significant (Positive)
Cycle II vs. Cycle III	5.48	8.42	3.627	2.042	$p = 0.0010$	Statistically Significant (Positive)
Pre-Cycle vs. Cycle III	28.39	12.75	12.396	2.042	$p = 2.47 \times 10^{-13}$	Highly Significant (Positive)

Based on the table, the comparison of learning outcomes obtained by fourth-grade students from the pre-cycle baseline to Cycle III yielded $t_{count} = 12.396$. Because $t_{count} > t_{table}$ (12.396 > 2.042), the action research hypothesis is formally accepted. This confirms inferentially that the STAD model integrated with the Diversity Challenge digital media exerted a highly significant positive effect on students' critical thinking competencies. Furthermore, this study also evaluated the longitudinal progression of student learning motivation. Table 9 details the comparative development of learning motivation from the pre-cycle baseline through Cycle III across the five established operational indicators.

Table 9. Longitudinal Progression of Learning Motivation Indicators Across Cycles

No	Learning Motivation Indicator	Pre-Cycle	Cycle I	Cycle II	Cycle III	Total Gain
1	Learning Interest and Enthusiasm	54.20%	72.50%	83.40%	90.60%	+36.40%
2	Need for Achievement Striving	58.10%	70.80%	81.20%	88.50%	+30.40%
3	Task Perseverance	56.40%	68.90%	78.50%	86.20%	+29.80%
4	Resilience and Peer Assistance	57.00%	71.60%	80.90%	87.90%	+30.90%
5	Learning Autonomy & Active Participation	57.80%	68.30%	78.40%	87.30%	+29.50%
Overall Average		56.71%	70.42%	80.48%	88.10%	+31.39%

6. Theoretical Underpinnings of Critical Thinking Improvement

The significant improvement in students' critical thinking skills, from a pre-cycle mean score of 58.55 to 86.94 in Cycle III, with a Normalized Gain (N-Gain) score of 0.70 (high category), can be explained through Vygotsky's sociocultural theory of cognitive development, particularly the concepts of the *Zone of Proximal Development* (ZPD) and scaffolding. During the team study stage

of the STAD model, students with lower and moderate initial abilities received direct assistance from higher-achieving peers in analyzing diversity-related cases. These collaborative interactions helped students overcome individual cognitive barriers, enabling them to progress beyond their initial levels of understanding in a supportive learning environment. This improvement was further facilitated by the integration of *Canva Sites*-based *Digital Diversity Challenge* media, which provided four progressively structured levels of contextual challenges. Rather than passively memorizing concepts, students were encouraged to interpret facts related to diversity, analyze cause-and-effect relationships in social phenomena, and evaluate actions based on Pancasila values. The integration of visual and interactive elements helped students understand abstract concepts through more concrete representations. This was accompanied by a reduction in the standard deviation of critical thinking scores from 18.94 to 10.30, indicating a narrower distribution of students' learning outcomes.

The substantial increase in students' learning motivation, reaching a mean score of 88.10% (very high category) by the end of the intervention, is consistent with Deci and Ryan's *Self-Determination Theory* (SDT). The digital cooperative learning intervention was designed to support three basic psychological needs. The need for autonomy was addressed through explicitly assigned roles, including team leader, digital operator, case analyst, and spokesperson, allowing each member to assume responsibility and actively express ideas. The need for competence was supported through progressively structured quizzes, immediate feedback, and transparent individual improvement scores that recognized students' learning progress. Meanwhile, the need for relatedness was fostered through a supportive cooperative learning environment in which team success depended on collective contributions, as reflected in the 30.90% increase in the perseverance and peer support dimension.

These findings support and extend previous research on the effectiveness of the STAD model in improving students' learning outcomes and active engagement. However, conventional STAD implementation relying on printed worksheets may lead to procedural monotony, while the integration of simple physical games often emphasizes lower-order knowledge acquisition and memorization. The novelty of this study lies in integrating the STAD model with scaffolded digital case-based challenges to address these limitations while promoting higher-order thinking skills (HOTS). The improvement in students' critical thinking performance was statistically significant, as indicated by the paired-samples t-test ($t(30) = 12.396$, $p < .001$). These findings are also consistent with previous studies on interactive learning media, suggesting that gamified learning environments can support knowledge retention and critical reasoning among elementary school students.

Despite these positive findings, several limitations should be acknowledged. First, this classroom action research was conducted with a single group of 31 students at SDN Sukorejo 2, Kediri, Indonesia. Therefore, the findings are context-specific, and caution is required when generalizing them to schools with different characteristics. Second, the implementation of the intervention depended heavily on the availability of digital devices and stable internet connectivity, which required technical adjustments during the initial cycle. Finally, although classical learning mastery reached 90.32%, three students (9.68%) had not yet achieved the Minimum Mastery Criterion (KKM = 75) due to fundamental learning difficulties. These students may require more intensive differentiated instruction and individualized support beyond regular cooperative learning sessions.

D. CONCLUSION AND SUGGESTIONS

The implementation of the Student Teams Achievement Division (STAD) cooperative learning model supported by *Diversity Challenge* digital media demonstrated effectiveness in progressively and consistently improving students' critical thinking skills and learning motivation. The improvement in critical thinking skills was reflected in a substantial increase in the mean class score,

from 58.55 in the pre-cycle to 72.42 in Cycle I, followed by 81.45 in Cycle II, and reaching 86.94 in Cycle III. Classical learning mastery also increased markedly from 22.58% to 90.32%. The effectiveness of the intervention was further supported by a Normalized Gain (N-Gain) score of 0.70, classified as high, and a statistically significant paired-samples t-test result ($t(30) = 12.396$, $p < .001$). Similarly, students' learning motivation improved from the moderate category (56.71%) to the very high category (88.10%). The integration of structured cooperative learning procedures with progressively scaffolded gamified digital media fostered an active learning environment, facilitated more equitable conceptual understanding through teamwork, and encouraged students to develop independent critical reasoning skills.

Future researchers are encouraged to expand the variety of case studies and challenge scenarios incorporated into *Diversity Challenge* digital media to cover a broader range of learning topics and examine their applicability across different grade levels and student characteristics. Furthermore, subsequent studies should consider integrating differentiated instruction and adaptive scaffolding strategies more extensively into the STAD learning procedures, particularly to support students experiencing fundamental conceptual difficulties or learning plateaus. Such improvements may help optimize individual learning outcomes and support efforts toward achieving 100% learning mastery.

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