

Enhancing Elementary Students' Mathematical Creative Thinking in Fraction Learning through Canva-Assisted Digital Storytelling

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Article Info

Article History

Submitted: 15-01-2025

Revised: 09-03-2025

Accepted: 11-03-2025

Keywords:

Mathematical creative thinking;
Digital storytelling;
Canva-based learning;
Fraction learning;
Elementary mathematics education;

Abstract

Creative thinking has become an essential competency in contemporary mathematics education, particularly in helping students interpret and solve non-routine problems. However, fraction learning at the elementary level is often dominated by procedural instruction, which limits opportunities for students to develop creative mathematical reasoning. This study investigates the effectiveness of Canva-assisted digital storytelling in enhancing elementary students' mathematical creative thinking in fraction learning. A quasi-experimental design employing a nonequivalent pretest–posttest control group was implemented with 40 third-grade students at MIS Cirumput, Sukabumi, Indonesia. The experimental group received instruction using Canva-based digital storytelling, while the control group received conventional mathematics instruction. Mathematical creative thinking was assessed using essay-based tasks that measured fluency, flexibility, originality, and elaboration. The data were analysed using Analysis of Covariance (ANCOVA) after confirming the assumptions of normality and homogeneity. The results demonstrate a significant effect of the instructional intervention on students' creative thinking performance ($F = 117.9$, $p < 0.001$). Pretest scores were strongly associated with posttest outcomes ($\eta^2 = 0.558$), and the instructional approach contributed substantially to differences between groups ($\eta^2 = 0.299$). Post hoc comparisons indicate that students exposed to Canva-assisted digital storytelling achieved significantly higher posttest scores than those in the control group, with a very large effect size (Cohen's $d = 2.79$). These findings suggest that integrating digital storytelling through Canva can support the development of creative mathematical thinking and provide an engaging learning environment for fraction instruction in elementary education.

INTRODUCTION

Rapid developments in science and technology have reshaped expectations of what mathematics education should accomplish. Learning mathematics is no longer viewed merely as mastering procedures or performing calculations accurately; rather, it increasingly emphasizes the development of higher-order thinking skills that enable students to interpret, explore, and respond to complex problems (Gradini et al., 2025; Sutarni et al., 2024). Within this broader educational orientation, creative mathematical thinking has received increasing attention as an essential component of meaningful mathematical learning. Creative thinking in mathematics involves the ability to generate multiple ideas, approach problems from different perspectives, produce novel solutions, and elaborate reasoning in coherent ways that support deeper mathematical understanding (Ibrahim et al., 2024). These abilities are commonly reflected through the indicators

of fluency, flexibility, originality, and elaboration, which represent core dimensions of creative thinking frequently discussed in mathematics education research (Aditya & Suparman, 2023). Cultivating such competencies from the elementary level is particularly important because early experiences with mathematics influence the development of students' cognitive habits and their confidence in dealing with unfamiliar problems. Furthermore, creative thinking in mathematics is closely connected to broader scientific reasoning and science process skills, reinforcing its relevance within contemporary mathematics education (Hanifah et al., 2024; Yildiz & Yildiz, 2021).

Despite this growing recognition, many studies continue to report that elementary students' creative mathematical thinking remains limited, particularly when they engage with fraction concepts. Difficulties often appear when students are asked to propose alternative strategies, explain their reasoning in detail, or develop solutions that differ from common textbook procedures (Apriliani & Lisnawati, 2025). A similar situation was observed at MIS Cirumput, where preliminary classroom observations revealed that students' creative thinking performance in fraction learning tends to fall within the "less creative" category. While students are sometimes able to provide correct answers, their responses rarely demonstrate flexibility or originality. In particular, the indicators of flexibility and originality appear significantly weaker than the fluency indicator, suggesting that students tend to rely on familiar procedures rather than exploring diverse strategies or representations. Such patterns are often associated with classroom practices that remain strongly procedural and teacher-centred. Learning activities frequently focus on routine exercises and the application of predetermined steps, leaving limited opportunities for students to experiment with ideas, represent mathematical situations creatively, or articulate their reasoning in their own ways. These challenges are especially critical in Grade III of elementary education or Madrasah Ibtidaiyah, where students encounter formal fraction concepts for the first time. Insufficient conceptual understanding at this stage may lead to persistent misconceptions that affect students' learning of more advanced fraction topics in later grades (Mutaqin & Vkar, 2020).

At the same time, contemporary educational policies increasingly encourage the integration of digital technologies and innovative pedagogical approaches to create more engaging and meaningful learning environments. Within the Indonesian context, the Merdeka Curriculum emphasises learning experiences that are active, contextual, and student-centred, while also encouraging teachers to utilise digital tools that support these principles. One platform that has recently gained considerable attention in educational practice is Canva, a visual design application that offers a wide range of templates, illustrations, animations, and layout features adaptable for instructional purposes (Azizah & Ratnaningrum, 2025; Permatasari & Widagdo, 2025). By enabling teachers to design visually rich and interactive learning materials, Canva offers opportunities to present mathematical ideas in ways that are more accessible and engaging for young learners. Previous studies on Canva-based instructional media have reported positive outcomes in elementary classrooms, indicating that such media can increase students' motivation to learn and improve learning outcomes across several subjects, including mathematics (Feladi et al., 2023; Nisyaa & Widodo, 2025).

Beyond the visual affordances of digital media, digital storytelling has emerged as an approach that connects abstract academic concepts to students' everyday experiences. Through narrative structures supported by digital technology, storytelling-based learning environments enable students to interpret mathematical situations in meaningful contexts and reconstruct mathematical ideas through their own explanations (Khalimatu et al., 2022; Sirajuddin et al., 2025). Within mathematics education, digital storytelling can serve not only as a medium for presenting information but also as a framework that encourages students to interpret problems,

explore possible solutions, and express their reasoning creatively. By situating mathematical ideas within narrative contexts, students may find it easier to visualize relationships, generate alternative strategies, and articulate explanations that extend beyond routine procedures. Several studies in elementary education have shown that storytelling-based learning environments, particularly when supported by digital media, can foster students' conceptual understanding, increase engagement, and encourage more active participation in learning activities (Alegarit et al., 2025; Arifah et al., 2025). These characteristics suggest that digital storytelling holds considerable potential for supporting the development of students' creative thinking in mathematics.

Nevertheless, research that explicitly integrates Canva-based digital storytelling with the development of mathematical creative thinking in fraction learning remains relatively limited. Much of the existing literature has focused on developing Canva-based storybooks for literacy or other non-mathematical subjects, or has applied Canva to mathematical topics without specifically examining its impact on creative thinking abilities (Angio et al., 2025; Lailiyah & Oktaviarini, 2025). Other studies that employ digital storytelling in mathematics education often emphasise outcomes such as motivation to learn, engagement, or overall academic performance, rather than directly analysing changes in students' mathematical creative thinking (Chaabi & Younes, 2025; Hernandez-Martinez et al., 2025). Furthermore, studies investigating creative thinking in fraction learning often adopt descriptive approaches and do not explore innovative digital interventions that could actively stimulate creative reasoning. These conditions reveal a clear gap between the recognised need to strengthen elementary students' creative thinking in mathematics—particularly in learning fractions—and the potential benefits offered by narrative-based digital learning environments supported by platforms such as Canva.

In light of these considerations, integrating Canva-assisted digital storytelling into fraction learning represents a promising approach for addressing both pedagogical and technological challenges in contemporary mathematics education. By combining visual media, narrative context, and opportunities for collaborative exploration, such an approach may create a learning environment that encourages students to generate ideas, explore multiple representations, and communicate mathematical reasoning more creatively. Accordingly, this study investigates the role of Canva-assisted digital storytelling in supporting elementary students' mathematical creative thinking in fraction learning. Specifically, the study aims to:

- (1) Describe the implementation of Canva-based digital storytelling in teaching simple fractions to Grade III Madrasah Ibtidaiyah students.
- (2) examine students' mathematical creative thinking abilities before and after the implementation of Canva-based digital storytelling; and
- (3) Analyse the improvement of students' mathematical creative thinking skills following the implementation of Canva-based digital storytelling in fraction learning.

METHODS

Research Design

This study adopted a quantitative, quasi-experimental approach, employing a nonequivalent pretest–posttest control group design to investigate the effect of Canva-assisted digital storytelling on elementary students' mathematical creative thinking in fraction learning. The quasi-experimental design was selected because the research was conducted within intact classroom settings where random assignment of students was not feasible, a condition commonly addressed through quasi-experimental procedures in educational research (Maciejewski, 2020; Cook, 2015). Through this design, the study aimed to compare the learning outcomes of students who engaged

in Canva-based digital storytelling with those of students who received conventional mathematics instruction. Digital storytelling has increasingly been recognized as an instructional strategy that can support mathematical understanding by integrating narrative structures with visual and multimedia elements in learning activities (Ulutas et al., 2022), while the use of digital storytelling approaches in mathematics learning has also been associated with improved engagement and reduced affective barriers such as anxiety in mathematics contexts (Irmayanti et al., 2025). In particular, Canva-based learning media provide interactive visual features that can facilitate the presentation of mathematical concepts, including fractions, in ways that are more accessible and engaging for elementary students (Cahyaningtyas & Putra, 2025). The experimental design involved two groups: an experimental group receiving instruction through Canva-assisted digital storytelling and a control group receiving conventional instruction. Both groups completed a pretest before the instructional intervention and a posttest after the learning sessions, allowing the researchers to examine changes in students' mathematical creative thinking skills while controlling for their initial abilities.

Participants and Research Context

The study was conducted at Madrasah Ibtidaiyah Swasta (MIS) Cirumput, Sukabumi Regency, Indonesia, involving third-grade students who were studying simple fraction concepts as part of the mathematics curriculum. Participants were selected through purposive sampling, a technique that enables researchers to intentionally select participants who possess characteristics relevant to the study's objectives and can provide appropriate information for the research context (Campbell et al., 2020; Robinson, 2023). In this study, the sampling procedure accounted for similarities in students' academic characteristics across classes and the feasibility of implementing the instructional intervention within the existing school schedule. Two intact classes participated in the study. Class III A ($n = 20$) was designated as the experimental group and received instruction through Canva-based digital storytelling, while Class III B ($n = 20$) served as the control group and received conventional instruction consisting of teacher explanations, question-and-answer activities, and textbook-based practice exercises without the use of digital storytelling media. In total, 40 students were involved in the study, and the instructional intervention was implemented during regular mathematics lessons on fraction topics in accordance with the school's instructional schedule.

Variables of the Study

This study examined three main variables. The independent variable was the instructional approach using Canva-based digital storytelling implemented in learning simple fractions. The dependent variable was students' mathematical creative thinking skills, while the pretest score served as a covariate to control for potential differences in students' initial mathematical abilities. Mathematical creative thinking in this study was conceptualised through four widely recognised indicators in the creativity literature: fluency, flexibility, originality, and elaboration. These indicators represent students' capacity to generate multiple ideas, employ varied solution strategies, produce uncommon yet mathematically valid responses, and provide detailed explanations that reflect deeper reasoning in solving mathematical problems.

Research Instruments

The primary data were collected using an essay-type mathematical creative thinking test administered as both a pretest and a posttest. The test items were designed to assess students' creative thinking in solving simple fraction problems. The structure of the test was adapted from the Torrance Test of Creative Thinking (TTCT) framework (Alabbasi et al., 2022), which evaluates

creativity through dimensions such as fluency, flexibility, originality, and elaboration. The blueprint of the creative thinking test instrument is presented in Table 1.

Table 1. Blueprint of the Mathematical Creative Thinking Ability Test Instrument

No	Indicator of Creative Thinking Ability	Sub-indicator on Simple Fractions Material	Question Format	Question Number	Score
1	Fluency	Students can provide more than one correct method/answer for solving simple fraction problems	Open-ended essay	1	0–4
2	Flexibility	Students can provide more than one correct method/answer for solving simple fraction problems	Open-ended essay	2	0–4
3	Originality	Students can generate uncommon but correct ideas/answers, for example by independently creating a contextual story involving fractions (1/2, 1/3, 1/4) that differs from typical examples	Open-ended essay	3	0–4
4	Elaboration	Students can explain their strategies in detail and add details to drawings or explanations when solving fair-sharing fraction problems	Open-ended essay	4	0–4

Each item was scored using a **four-point rubric (0–4)** corresponding to the level of creative response demonstrated by the student.

Instrument Validity and Reliability

Before the study's implementation, the creative thinking test instrument was examined for validity and reliability. The analyses were conducted using Jamovi version 2.6.44. The reliability of the instrument was evaluated using **Cronbach's alpha**, and the results are presented in **Table 2**.

Table 2. Scale Reliability Statistics

Scale Reliability Statistics	Cronbach's α
Scale	0.869

The reliability analysis yielded a Cronbach's alpha value of 0.869, indicating strong internal consistency among the test items. According to commonly accepted criteria, an instrument is considered reliable when Cronbach's alpha exceeds 0.70, suggesting that the instrument used in this study is suitable for measuring students' mathematical creative thinking abilities. The validity of each test item was examined using corrected item–total correlation analysis in Jamovi. The results are presented in Figure 1.'

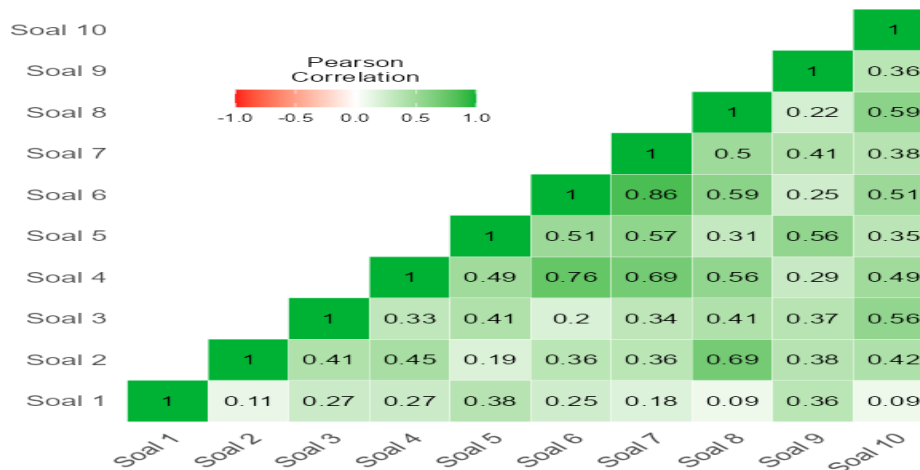


Figure 1. Pearson Correlation

Figure 1 illustrates the correlation values between each test item and the total score of the creative thinking instrument. Most items obtained item–total correlation coefficients above 0.30, indicating acceptable construct validity. Several items showed lower correlations, suggesting weaker contributions to the overall scale; however, these items were reviewed and revised to ensure alignment with the targeted creative thinking indicators. Overall, the instrument was considered sufficiently valid for use in the study.

Observation Instruments

In addition to the creative thinking test, observation instruments were employed to capture students’ creative activities during learning and to evaluate the implementation of the instructional process.

Student Creative Activity Observation

Observation guidelines were used to record students’ creative behaviours during fraction learning using Canva-based digital storytelling. The observation focused on indicators related to creative thinking and collaborative learning. The observation rubric is presented in Table 3.

Table 3. Observation Guidelines for Student Creative Activity

No	Aspect/Indicator	Description of Observed Behaviour	Scale (1–4)
1	Fluency	Students express more than one idea or solution strategy when solving fraction problems in a story context	1 2 3 4
2	Flexibility	Students use different representations such as drawings, symbols, or verbal explanations to represent fractions	1 2 3 4
3	Originality	Students present unique ideas or story contexts involving fractions that differ from their classmates’ responses	1 2 3 4
4	Elaboration	Students add detailed explanations, labels, and sequential steps when solving fraction problems	1 2 3 4
5	Engagement in Digital Story	Students pay attention to the digital story, respond to questions, and actively interact with fraction situations presented in the story	1 2 3 4

6	Collaboration and Students exchange ideas and discuss fraction problems with Discussion peers respectfully	1 2 3 4
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Observation of Learning Implementation

To ensure the instructional intervention was implemented as intended, classroom learning was also observed using an implementation rubric that focused on teacher practices. The observation guideline is presented in **Table 4**.

Table 4. Observation Guidelines for Learning Implementation

No	Aspect	Teacher Behaviour Indicator	Scale (1–4)
1	Use of Canva media	The teacher displays Canva-based digital stories aligned with fraction material and allocates appropriate time for their use	1 2 3 4
2	Connection of Story with Concept	The teacher explicitly links the narrative context to the mathematical meaning of fractions	1 2 3 4
3	Provision of Creative Thinking Opportunities	The teacher provides open-ended questions and encourages multiple solution strategies	1 2 3 4
4	Facilitation of Discussion	The teacher encourages classroom discussions and invites students to explain their reasoning	1 2 3 4
5	Reinforcement and Feedback	The teacher provides constructive feedback and appreciates students’ creative ideas	1 2 3 4

Data Analysis

Data analysis was carried out using both descriptive and inferential statistical techniques. Descriptive statistics were first used to summarise students’ pretest and posttest scores in fraction learning, providing an overview of students’ creative mathematical thinking performance before and after the instructional intervention. To evaluate the effect of the instructional treatment while accounting for possible differences in students’ initial abilities, the study employed one-way Analysis of Covariance (ANCOVA) with a significance level of 0.05. In this model, the pretest score was treated as a covariate, while the class group (experimental or control) served as the independent variable influencing posttest scores. Prior to conducting the ANCOVA analysis, several statistical assumptions were examined to ensure the appropriateness of the model. These included the normality of residuals, homogeneity of variances, linearity between the covariate and the dependent variable, and homogeneity of regression slopes. After confirming that these assumptions were satisfied, the ANCOVA analysis was performed using Jamovi version 2.6.44. Hypothesis testing followed the conventional decision rule, whereby the null hypothesis (H_0) was rejected when $p \leq 0.05$, indicating a statistically significant difference between the experimental and control groups after controlling for students’ pretest scores.

RESULT

This study was conducted with third-grade students at MIS Cirumput, involving 40 participants, divided into two groups: 20 in the experimental class and 20 in the control class. The experimental group received instruction through Canva-assisted digital storytelling to learn simple

fractions over five instructional sessions, whereas the control group received conventional mathematics instruction without digital storytelling. To examine the effect of the instructional intervention on students' mathematical creative thinking skills, the data analysis was conducted in several stages, beginning with the examination of statistical assumptions required for the ANCOVA model.

The first step involved testing the normality of residuals using the Shapiro–Wilk test, as presented in Table 5.

Table 5. Normality Tests

	statistic	p
Shapiro-Wilk	0.987	0.914

The Shapiro–Wilk test produced a W statistic of 0.987 with a significance value (p) of 0.914, which is greater than the predetermined significance level of 0.05. This result indicates that the null hypothesis of normality cannot be rejected. Therefore, the dataset's residuals can be considered normally distributed, satisfying one of the key assumptions of parametric statistical analysis. To further examine the distribution of residuals, a Q–Q plot was also generated, as shown in Figure 2.

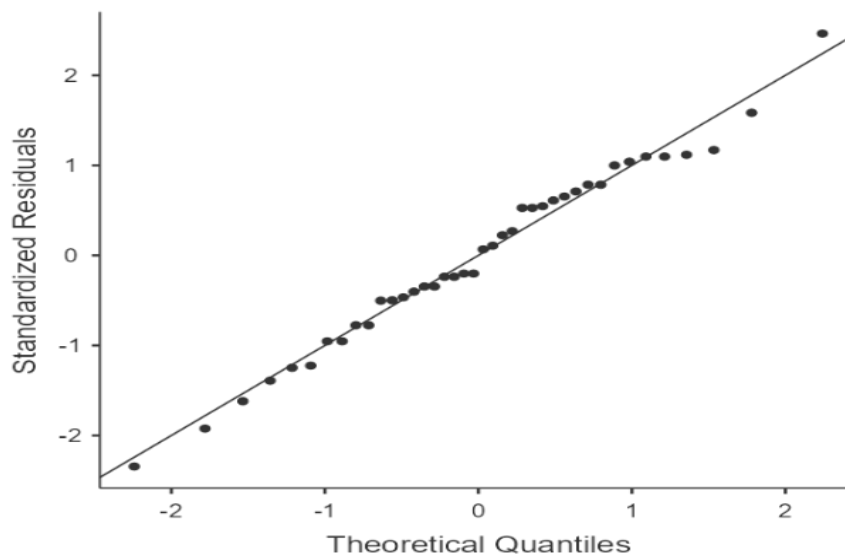


Figure 2. Q–Q Plot

The Q–Q plot illustrates the relationship between the theoretical quantiles of the normal distribution and the standardized residuals. Most data points appear closely aligned with the diagonal reference line, with only minor deviations at the distribution tails. This pattern suggests that the residuals approximate a normal distribution, confirming that the normality assumption for the ANCOVA model has been met.

The next assumption tested was the homogeneity of variances between the experimental and control groups using Levene's test, as presented in Table 6.

Table 6. Homogeneity of Variances Tests

	Statistic	df	df2	p
Levene's	3.78	1	38	0.059

The Levene's test produced an F statistic of 3.78 with $df_1 = 1$ and $df_2 = 38$, and a significance value of $p = 0.059$, which exceeds the threshold of 0.05. Consequently, the null hypothesis stating that the variances between groups are equal cannot be rejected. These results indicate that the assumption of homogeneity of variance is satisfied, allowing the data to be analysed further using ANCOVA. After confirming that the statistical assumptions were met, a one-way Analysis of Covariance (ANCOVA) was conducted to examine the effect of the instructional intervention on students' posttest scores while controlling for differences in pretest performance. The results of the ANCOVA analysis are presented in **Table 7**.

Table 7. ANCOVA – Posttest

	Sum of Squares	df	Mean Square	F	p	η^2
Overall model	988	2	493.86	117.9	<.001	
Pretest	643	1	642.83	144.1	<.001	0.558
Class	345	1	344.89	77.3	<.001	0.299
Residuals	165	37	4.46			

The ANCOVA results show that the overall model is statistically significant ($F = 117.9, p < .001$), indicating that the combination of the pretest covariate and the instructional treatment significantly explains variation in posttest scores. The relatively small residual mean square (4.46) suggests that the model accounts for a substantial proportion of the variance in students' posttest performance. The pretest covariate had a strong and statistically significant effect on posttest scores ($F = 144.1, p < .001$), with an effect size $\eta^2 = 0.558$, indicating that approximately 55.8% of the variance in posttest scores was explained by differences in students' initial mathematical abilities. More importantly, the class factor, representing the instructional approach, also demonstrated a statistically significant effect ($F = 77.3, p < .001$). The associated effect size ($\eta^2 = 0.299$) indicates that 29.9% of the variance in posttest scores is attributable to differences between the experimental and control groups. This result suggests that the instructional approach implemented in the experimental class contributed substantially to the improvement of students' mathematical creative thinking skills. To further explore differences between groups, a Tukey post hoc comparison was conducted, as shown in **Table 8**.

Table 8. Post Hoc Comparisons – Class

Comparison	Mean Difference	SE	df	t	p (Tukey)	Cohen's d	95% CI Lower	95% CI Upper
Control – Experimental	-5.88	0.669	37	-8.79	< .001	-2.79	-3.70	-1.87

The post hoc analysis revealed a statistically significant difference between the experimental and control groups. The mean score of the control class was 5.88 points lower than that of the

experimental class (Mean Difference = -5.88). This difference was associated with a t value of -8.79 and a Tukey-adjusted p value below .001, indicating a highly significant effect even after correcting for multiple comparisons. The 95% confidence interval ranged from -3.70 to -1.87, which does not include zero, further confirming the reliability of the observed difference. In addition, Cohen’s d value of -2.79 indicates a very large effect size, suggesting that the implementation of Canva-assisted digital storytelling produced a substantial improvement in students’ mathematical creative thinking compared to conventional instruction. In addition to the statistical analysis of test scores, classroom observations were conducted to examine students’ creative engagement during the learning process. The results are presented in Figure 3.

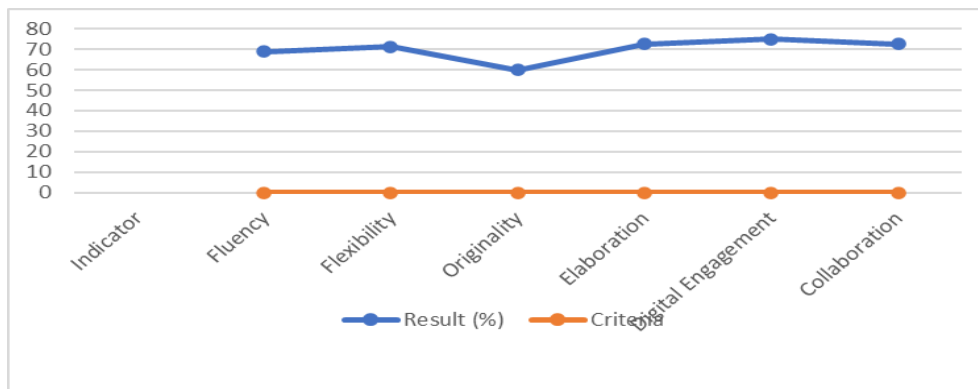


Figure 3. Results of Students’ Creative Activity Observation

The observational findings indicate that the use of Canva-assisted digital storytelling supported the development of students’ creative thinking behaviours and several competencies associated with 21st-century learning. The fluency indicator reached 68.75%, while flexibility reached 71.25%, suggesting that students were able to generate multiple ideas and modify their approaches when constructing digital stories involving fraction contexts. The originality indicator received a score of 60%, which, although categorised as good, is the lowest among the observed indicators. This result suggests that while students were able to produce some unique ideas, further instructional support may still be required to stimulate more original mathematical expressions. Meanwhile, elaboration reached 72.5%, indicating that students were able to develop their ideas by adding details to storylines, visual elements, and explanations presented through the Canva platform. From the perspective of broader learning competencies, digital engagement reached 75%, while collaboration reached 72.5%, both of which fall within the good category. These results indicate that students actively utilised Canva’s digital features and collaborated effectively with peers to develop and present their storytelling products. The effectiveness of the instructional implementation was also examined through observations of teacher practices during the learning process. The results are presented in Table 9.

Table 9. Observation Results of Lesson Implementation

No Aspect	Score	Description
1 Utilisation of Canva Media	3	Media is aligned with the material, presentation is clear, and timing is sufficient.
2 Connection of Story with Concept	4	The story is consistently linked to fraction symbols and their meaning.

No	Aspect	Score	Description
3	Provision of Creative Thinking Opportunities	3	Most students are given opportunities to express diverse ideas.
4	Facilitation of Discussion	4	Discussion is active, with several students explaining their reasoning.
5	Reinforcement and Feedback	3	The teacher frequently provides praise and constructive corrections.

The observation results indicate that the instructional implementation was effective, with most indicators falling within the good-to-very-good categories. The use of Canva-based media was appropriate to the learning material, with clear visual presentation and sufficient time allocation. The connection between narrative elements and mathematical concepts was particularly strong, as the storytelling context was consistently linked to the meaning of fractions. In addition, the teacher provided opportunities for students to express diverse ideas and facilitated active classroom discussions in which students explained their reasoning and solution strategies. Reinforcement and feedback were also delivered constructively, creating a supportive learning environment that encouraged student participation.

DISCUSSION

The findings of this study indicate that integrating Canva-assisted digital storytelling meaningfully contributes to the development of elementary students' creative mathematical thinking in fraction learning. The statistical results, including the significant ANCOVA model and the large effect sizes observed in the analysis, suggest that the instructional intervention influenced students' approaches to mathematical problems. Rather than relying solely on procedural solutions, students in the experimental class tended to explore multiple representations and narrative interpretations of fraction concepts. These results are consistent with previous research indicating that digital storytelling environments can strengthen students' engagement and confidence in mathematics learning. For instance, Niemi and Niu (2021) reported that storytelling-based digital activities enhance students' mathematical self-efficacy by allowing learners to contextualize mathematical ideas within meaningful narratives. Similarly, multimedia storytelling tasks in mathematics classrooms have been shown to promote authentic mathematical thinking and creative engagement with mathematical situations (Redmond-Sanogo et al., 2018).

Improvements in students' creative thinking were particularly evident in the indicators of fluency and flexibility. In the present study, fluency reached 68.75% and flexibility 71.25%, suggesting that students were able to generate multiple ideas and alternative representations when solving fraction problems. From a theoretical perspective, these indicators are widely recognized as essential components of mathematical creativity. Research on mathematical creativity has demonstrated that fluency reflects the ability to generate numerous responses, while flexibility reflects the capacity to shift between different solution strategies and conceptual representations (Kattou et al., 2013). Furthermore, recent studies on cognitive processes in creativity suggest that flexibility may represent a deeper cognitive dimension that extends beyond fluency and originality alone (Weiss & Wilhelm, 2022). In the present study, the storytelling tasks encouraged students to reinterpret fraction situations by modifying story elements, including characters, settings, and visual representations. Through these activities, learners explored multiple representations of fractions, thereby supporting the development of divergent thinking. Similar findings have been

reported in studies of interactive digital learning environments, which show that digital media can stimulate students' creative exploration by enabling them to manipulate visual and narrative elements to represent mathematical ideas (Nurhastuti et al., 2025).

Although all indicators demonstrated positive development, originality (60%) remained the lowest among the creativity dimensions. This finding suggests that generating novel mathematical ideas remains relatively challenging for elementary students. In many cases, students tended to adapt examples demonstrated during instruction or replicate ideas developed by their peers. Such tendencies are commonly observed in early stages of creativity development, where students first acquire fluency and flexibility before demonstrating stronger originality. Systematic reviews on the assessment of mathematical creative thinking also indicate that originality often requires extended opportunities for open-ended exploration and reflective reasoning in order to develop more fully (Suherman & Vidákovich, 2022). Consequently, instructional approaches that incorporate narrative tasks and open-ended problem contexts may help students gradually develop more unique mathematical responses.

The elaboration indicator, which reached 72.5%, further illustrates how digital storytelling activities can support the refinement of students' ideas. During the learning process, students expanded their stories by adding contextual details, visual representations, and explanations that clarified the relationships between parts of a whole in fraction situations. Such findings highlight the importance of visual representation in mathematical reasoning. Previous studies have demonstrated that visual models and representations can help students structure their mathematical thinking and make abstract relationships more accessible (Rifat et al., 2022). By allowing students to combine images, symbols, and narratives in a single digital environment, Canva appears to provide a platform that supports the elaboration of mathematical ideas in ways that extend beyond traditional written responses.

Observational findings also reveal the importance of digital engagement and collaborative interaction in the learning process. Indicators of digital engagement (75%) and collaboration (72.5%) suggest that students were actively involved in both the technological and social dimensions of learning. Students interacted with Canva's visual design features while simultaneously discussing ideas with peers to construct their digital stories. Such collaborative engagement reflects the social dimension of creative thinking, where ideas are refined through interaction and dialogue. Similar patterns have been observed in collaborative digital storytelling environments, where students co-construct narratives and develop ideas through shared digital platforms (Petousi et al., 2022). In educational contexts, these collaborative storytelling activities have been shown to foster active participation and enhance learners' engagement with complex concepts.

The effectiveness of storytelling-based approaches in supporting conceptual understanding has also been documented in various areas of mathematics education. Narrative learning environments provide opportunities for students to connect abstract mathematical ideas with meaningful contexts, thereby facilitating deeper conceptual interpretation. For example, Lemieux and Chapman (2025) demonstrated that story-based tasks can support students' conceptual understanding by situating mathematical reasoning within contextualized narratives. In the case of fraction learning, embedding mathematical relationships within stories may help students visualize part-whole relationships and interpret fractions within real-life scenarios. This process allows students to reconstruct mathematical concepts through their own explanations, thereby strengthening both conceptual understanding and creative reasoning.

More broadly, the findings of this study resonate with recent developments in research on technology-enhanced mathematical creativity. Emerging digital technologies—including interactive multimedia and augmented reality—have been increasingly explored as tools for fostering creative mathematical thinking. A systematic review by Hidajat (2024) highlights that digital technologies can create learning environments that encourage exploration, experimentation, and creative problem solving in mathematics education. Within this broader technological landscape, Canva-based storytelling represents a practical and accessible approach for integrating creativity-oriented learning into elementary classrooms.

The results suggest that integrating digital storytelling with visual design platforms such as Canva provides a promising instructional approach for fostering creative mathematical thinking. The combination of narrative structures, visual representations, and collaborative learning appears to create a learning environment that encourages students to generate ideas, explore alternative strategies, and communicate mathematical reasoning in more flexible ways. Beyond improving learning outcomes, such instructional approaches also support the development of broader competencies associated with 21st-century education, including creativity, collaboration, and digital literacy. In the Indonesian educational context, these competencies are closely aligned with the objectives of the Profile of Pancasila Students, which emphasize creativity, cooperation, and active participation in learning.

CONCLUSIONS

Based on the data analysis and research findings, it can be concluded that fraction learning through Canva-assisted digital storytelling for third-grade students at MIS Cirumput is effective in enhancing creative thinking skills compared to conventional instruction. The ANCOVA analysis on posttest scores is significant with large effect sizes for both the pretest covariate and the class factor, and this is further supported by the Tukey post hoc test, which shows that the mean posttest score of the experimental class is significantly higher than that of the control class, with Cohen's d , categorised as a very large effect. In addition to improved learning outcomes, observations indicate that the indicators of fluency, flexibility, originality, elaboration, digital engagement, and collaboration are all in the good category, suggesting that this approach not only strengthens students' understanding of fraction concepts but also develops their creative thinking and 21st-century skills. These findings align with studies reporting that Canva-based digital media and digital stories/comics can increase motivation, creativity, and understanding of mathematical concepts. In light of these results, it is recommended that elementary school teachers integrate Canva-assisted digital storytelling more systematically into mathematics instruction, particularly for abstract topics, while providing students with ample opportunities to explore ideas and foster the free development of originality. Schools are expected to facilitate teacher training and provide adequate infrastructure (devices and internet access) to ensure the optimal, sustainable implementation of Canva in learning. Future researchers are advised to expand the sample and school contexts, investigate other mathematics topics, and incorporate qualitative approaches to gain deeper insight into the dynamics of students' development of creative thinking during Canva-based digital storytelling activities.

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