JURNAL EDUSCIENCE (JES)
p-ISSN : 2303 - 355X | e-ISSN : 2685 - 2217
PUBLISHED BY : LPPM of UNIVERSITAS LABUHANBATU

Ethnomathematical E-Comic: Enhancing Students' Self-Efficacy and Divergent Thinking

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ARTICLE INFO

Keywords:
Divergent Thinking Skills
E-Comic
Ethnomathematics
Self-Efficacy

ABSTRACT

Purpose—Mathematics learning often remains abstract and disconnected from students' cultural experiences, which limits creativity and engagement. This study addresses that gap by integrating ethnomathematical content into digital comic media to strengthen students' self-efficacy and divergent thinking skills.

Methodology—A quasi-experimental design using a pretest–posttest control group was employed. The population consisted of seventh-grade junior high school students, and the sample included two classes (N = 52) selected through cluster random sampling. Each class comprised 26 students, with one designated as the experimental group and the other as the control group. The experimental group received instruction using ethnomathematics-based e-comics, while the control group used PowerPoint. Instruments included a self-efficacy questionnaire and a divergent thinking test. Data were analyzed using descriptive statistics and a one-way MANCOVA.

Findings—The MANCOVA results showed a significant effect of ethnomathematical e-comic media on both self-efficacy and divergent thinking (Wilks' Lambda = 0.152, F (2,47) = 131.381, $p < 0.05$, $\eta^2 = 0.848$). Self-efficacy indicators such as persistence and task commitment improved significantly, while divergent thinking indicators, fluency and flexibility, also increased markedly between pretest and posttest.

Contribution—Theoretically, this study contributes to mathematics education by integrating ethnomathematics and digital learning media to support creativity-related skills. Practically, it provides teachers with innovative tools to make geometry learning more engaging and culturally relevant for students in the digital era.

Received 18 November 2025; Received in revised form 28 November 2025; Accepted 8 February 2026
Jurnal Eduscience (JES) Volume 13, No.1 (2026)
Available online 28 February 2026

INTRODUCTION

Effective mathematics instruction requires supportive learning media that help make abstract concepts more concrete (Febriyandani & Kowiyah, 2021). However, mathematics remains widely perceived as

abstract and challenging, which often reduces students' motivation and confidence in learning. The creative use of learning media enhances learning efficiency (Nurhayati et al., 2024) and facilitates more transparent communication throughout instruction (Harun et al., 2021; Masruri et al., 2020). Learning media also increase student engagement (Sholikah & Harsono, 2021), provide meaningful and enjoyable learning experiences (Andari, 2020), and strengthen learning motivation (Mayer, 2020). When used appropriately, media can improve performance and sustain motivation (Moundy et al., 2021) by linking instructional content with real-world contexts through relevant images and examples, making material easier to remember (David et al., 2023). Media further enable direct interaction with learning content and support collaborative learning (Gu et al., 2021). Therefore, teachers are expected to employ learning media creatively to improve learning outcomes and foster student enthusiasm (Febriyandani & Kowiyah, 2021).

One engaging form of learning media that can support mathematics instruction is comics (Muhaimin et al., 2023). Comics are non-projection media that combine text and compelling visuals, helping students understand and retell story content more effectively (Febriyanti & Mustadi, 2020; Puteri et al., 2022). Their illustrated narratives and concise dialogues make learning content easier to comprehend and increase student interest. As a visual cartoon form, comics depict characters and events sequentially to entertain readers while conveying instructional messages (Muhaimin et al., 2023). Although comics are commonly read for entertainment, their widespread popularity has encouraged many teachers to use them as tools for knowledge transfer (Ramadhani, 2020). In Indonesia, comic readership has grown, with 21.4% of young people reporting enjoyment in reading comics, indicating their strong cultural presence. This condition aligns with the findings of Danaswari et al. (2019), who reported that comics capture students' attention and enhance learning motivation.

Mathematics, however, remains widely perceived as abstract and challenging, which often reduces students' confidence and motivation to learn. In this context, learning media are not only tools for visualization but also bridges that connect mathematical concepts with students' everyday experiences (Febriyandani & Kowiyah, 2021). One promising approach for making mathematics more meaningful is ethnomathematics, which relates mathematical content to cultural contexts, traditions, and problem-solving practices familiar to learners. By integrating culture into mathematical learning, ethnomathematics provides students with meaningful connections between knowledge and real life, thus improving engagement and understanding (Nurhayati et al., 2024).

The abstract and deductive nature of mathematics often leads students to perceive the subject as complex and discouraging (Suci et al., 2024). Therefore, mathematics learning must remain connected to real-life contexts and students' experiences to support meaningful understanding (Bayrak & Aslanci, 2022; Eren, 2021). Although presenting geometry concepts through printed comics can support understanding, printed media have limitations such as susceptibility to damage, bulkiness, and limited flexibility (Rizzi, 2024). Consequently, developing comic-based digital learning media that address these weaknesses becomes necessary, particularly when combined with culturally relevant mathematics, or ethnomathematics. Ethnomathematics incorporates community-based symbols, strategies, and methods for solving mathematical problems, and research shows that linking mathematical ideas to local culture enhances conceptual understanding (Serepinah & Nurhasanah, 2023). In geometry learning, such contextualization supports the development of creativity in both abstract and concrete forms.

A central component of creativity is divergent thinking. Divergent thinking is defined by fluency and flexibility: fluency refers to producing multiple correct answers, and flexibility involves using varied methods or strategies to solve problems (Zhang et al., 2020). These indicators strongly predict creativity levels, demonstrating that divergent thinking plays a vital role in creative development (Said-Metwaly et al., 2024).

Previous research supports these relationships. Trisnawati (2022) found that integrating cultural concepts deepens mathematical understanding, while ethnomathematics-based learning has been shown to enhance creative thinking (Cahyono et al., 2023). Comic-based media have been reported to increase critical thinking skills and learning motivation (Suci et al., 2024), and e-comics have been shown to strengthen students' learning motivation (Astuti et al., 2023). Fitriani and Pujiastuti (2021) reported a positive

correlation between self-efficacy and mathematics achievement. Ethnomathematics-based learning media also improve conceptual understanding and creativity, particularly in geometry (Utami & Irawati, 2024). Hakim et al. (2022) examined students' reasoning skills using ethnomathematical comic-assisted learning, and Suherman and Vidákovich (2025) developed ethnomathematics-based instruments that effectively measure divergent thinking. However, these studies tend to examine cognitive and affective outcomes separately.

Based on previous studies, a research gap exists in the limited integration of specific local culture into digital comic-based ethnomathematics learning media that simultaneously target cognitive and affective outcomes. This study addresses this gap by integrating familiar local culture — specifically Sintren — into ethnomathematics-based digital comic media. The targeted outcomes are the enhancement of students' divergent thinking skills in geometry and the improvement of their self-efficacy. Ethnomathematics e-comics rooted in Sintren culture represent a learning innovation designed to foster both creativity and self-efficacy. Accordingly, the research question guiding this study is, "Is ethnomathematics e-comic media effective in improving students' self-efficacy and divergent thinking skills?"

METHODOLOGY

Research Design

This study employed a quantitative research approach using a quasi-experimental design. Specifically, a pretest–posttest control group design was implemented, involving two intact classes: an experimental class and a control class. This design was selected because the research aimed to examine the causal effect of ethnomathematical e-comic media on students' self-efficacy and divergent thinking skills in geometry, while random assignment at the individual level was not feasible in the school context.

The experimental class received instruction through a problem-based learning (PBL) model supported by ethnomathematical e-comic media. In contrast, the control class received the same PBL model assisted by PowerPoint media. Using the same instructional model across both groups was intended to control for instructional variables and ensure that any differences in outcomes could be attributed primarily to the learning media. The inclusion of pretest measurements enabled the researchers to control for initial differences between groups, thereby minimizing potential threats to internal validity, such as selection bias.

The research was conducted from July to August during the odd semester of the 2025/2026 academic year at SMP Negeri 2 Bantarsari, Cilacap, Central Java. Table 1 presents the pretest–posttest control group design employed in this study.

Table 1. Pretest Design-Posttest Control Group Design

Group	Pretest	Treatment	Posttest
Experiment	O1	X	O2
Control	O1		O2

Information:
O1: Pretest score (before being given ethnomathematical e-comic media).
O2: Posttest score (after being given the ethnomathematics e-comic media).
X: Treatment by being given a PBL model assisted by ethnomathematical e-comics.

Participants

The participants were Grade VII students at SMP Negeri 2 Bantarsari in the odd semester of the 2025/2026 academic year. The sample consisted of two intact classes totaling 52 students, with 26 students assigned to the experimental group and 26 students to the control group. The experimental group received PBL instruction supported by ethnomathematical e-comics, while the control group received PBL instruction supported by PowerPoint media.

Sampling was conducted using cluster random sampling, in which intact classes were randomly selected as the experimental and control groups, without accounting for population strata (Sukestiyarno,

2020). This technique was appropriate because students were already organized into fixed classroom groups, and random assignment at the individual level was not possible.

Although the sample size was relatively limited and drawn from a single school, it was considered adequate for quasi-experimental analysis using multivariate statistical techniques. The primary focus of this study was to examine the internal effectiveness of the learning media rather than to generalize findings broadly. Therefore, the results are interpreted within the context of similar educational settings, and future studies with larger and more diverse samples are recommended to enhance generalizability.

Overall, the student profile showed a higher number of female students (38) compared to male students. Approximately 90% of students were under 13 years old, and only 10 out of 52 students were categorized as having low academic achievement. More than half of the students demonstrated adequate information technology skills, a condition that supported the implementation of digital comic–based learning.

Data Collection

Data were collected using two primary research instruments: a divergent thinking skills test and a self-efficacy questionnaire, both administered as pretests and posttests to the experimental and control groups.

The divergent thinking skills test consisted of two open-ended items aligned with the indicators of fluency and flexibility. Fluency was measured by students' ability to generate multiple correct solutions, while flexibility was assessed based on the variety of strategies or methods used to solve geometry problems.

The self-efficacy questionnaire was constructed based on five indicators: confidence in one's abilities, confidence in overcoming obstacles, persistence, interest in exploring new situations, and strong aspirations and task commitment. The questionnaire consisted of 15 items measured using a five-point Likert scale ranging from 1 (very inappropriate) to 5 (very appropriate), including both positive and negative statements. Table 2 presents the distribution of questionnaire items across indicators.

Table 2. Self-Efficacy Questionnaire Distribution

No	Indicators	Item Number		Sum
		Positive	Negative	
1	Confident in one's abilities	1,2,3	-	3
2	Confident in success in the face of obstacles	4,5	6	3
3	Persistent in trying	7,8	9	3
4	Likes to explore new situations	10,11	12	3
5	Strong aspirations and commitment to duty	13,14	15	3
	Sum	11	4	15

Table 2 outlines the distribution of questionnaire items across indicators, showing that 11 items were positive and 4 negative. All indicators, except confidence in one's skills, contained one negative item.

Analysis of Data

Prior to hypothesis testing, the divergent thinking test and the self-efficacy questionnaire were assessed for content validity through expert judgment. The validation process involved two experts in learning evaluation and mathematics learning strategies, using a Likert scale ranging from 1 (disagree) to 4 (agree). The validation results were interpreted based on the criteria presented in Table 3.

An instrument was considered valid when the average validation score exceeded 75%. The results indicated that both the divergent thinking test and the self-efficacy questionnaire met the validity criteria. In addition to validity testing, instrument reliability was assessed using Cronbach's alpha coefficient in SPSS. An instrument was considered reliable when the Cronbach's alpha value exceeded 0.70 (Taber, 2017). The reliability analysis showed that both instruments satisfied the reliability requirements; therefore, the divergent thinking test and the self-efficacy questionnaire were appropriate for use in this study.

Table 3. Validity Categorization

Average	Category
Skor ≤ 25%	Invalid
25% < Skor ≤ 50%	Less Valid
50% < Skor ≤ 75%	Quite Valid
Skor ≥ 75%	Valid

To examine the effectiveness of ethnomathematical e-comic media, the data were analyzed using a one-way Multivariate Analysis of Covariance (MANCOVA) in SPSS. MANCOVA was selected because the study involved two dependent variables—divergent thinking skills and self-efficacy—and aimed to examine the effect of a single independent variable—ethnomathematical e-comic media—while controlling for students' pretest scores as covariates.

Before conducting the MANCOVA, assumption tests including normality, homogeneity of variance–covariance matrices, and linearity were performed to ensure that the data met the requirements for multivariate analysis. The level of significance for all statistical tests was set at 0.05. The research hypotheses were formulated as follows: (1) H_0: There is no significant effect of ethnomathematical e-comic media on students' self-efficacy and divergent thinking skills. (2) H_1: There is a significant effect of ethnomathematical e-comic media on students' self-efficacy and divergent thinking skills. The decision rule was that the null hypothesis (H_0) would be rejected if the significance value was less than 0.05. Otherwise, H_0 would be accepted.

FINDINGS

The findings of this study are organized into three main stages: testing the assumptions of normality and homogeneity, followed by the analysis of treatment effectiveness using a one-way MANCOVA.

Normality Test

The normality test was conducted using the Shapiro–Wilk test, which was selected as the primary basis for decision-making due to its suitability for small sample sizes. The data were considered normally distributed if the significance value exceeded 0.05. Normality testing included pretest and posttest scores for divergent thinking skills and self-efficacy in both the experimental and control classes. The analysis was performed using SPSS version 26.0. The results of the normality test are presented in Table 4.

Table 4. Normality Test Results

Aspects	Variable	Groups	Statistic S Statistic	haphiro - Wilk df	Sig.
Divergent Thinking Skills	Pretest	Control	0.917	26	0.057
		Experiment	0.929	26	0.073
	Posttest	Control	0.934	26	0.098
		Experiment	0.934	26	0.098
Self-Efficacy	Pretest	Control	0.927	26	0.064
		Experiment	0.887	26	0.058
	Post test	Control	0.957	26	0.328
		Experiment	0.925	26	0.059

Table 4 shows that all significance values for both variables, across pretest and posttest scores in the experimental and control groups, are greater than 0.05. These results indicate that the data for self-efficacy and divergent thinking skills are usually distributed and meet the assumptions required for further multivariate analysis.

Homogeneity Test

Following the normality test, a homogeneity-of-variance test was conducted using Levene's test. The data were considered homogeneous when the significance value based on the mean was greater than 0.05. This test was applied to the pretest and posttest scores of self-efficacy and divergent thinking skills in both groups. The homogeneity test results are presented in Table 5.

Table 5. Homogeneity Test Results

Aspects	Variable	Item	Levene Statistic	Sig.
Divergent Thinking Skills	Pretest	Based on Mean	66.349	0.058
	Posttest	Based on Mean	2.488	0.121
Self-Efficacy	Pretest	Based on Mean	3.379	0.072
	Posttest	Based on Mean	2.860	0.097

As shown in Table 5, the significance values for divergent thinking skills in the pretest (0.058) and posttest (0.121), as well as for self-efficacy in the pretest (0.072) and posttest (0.097), all exceed 0.05. These findings confirm that the data variance across groups is homogeneous, thereby satisfying the assumptions for conducting a one-way MANCOVA.

Effect Effectiveness Test

After the assumptions of normality and homogeneity were met, a one-way MANCOVA was conducted to examine the effectiveness of ethnomathematics-based e-comic media on students' self-efficacy and divergent thinking skills, while controlling for pretest scores as covariates. The multivariate test results are presented in Table 6.

Table 6. MANCOVA Multivariate Test Results

Effect	Item	Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared
Intercept	Pillai's Trace	0.832	116.367[b]	2.000	47.000	0.000	0.832
	Wilks' Lambda	0.168	116.367[b]	2.000	47.000	0.000	0.832
	Hotelling's Trace	4.952	116.367[b]	2.000	47.000	0.000	0.832
	Roy's Largest Root	4.952	116.367[b]	2.000	47.000	0.000	0.832
Pretest Self-Efficacy	Pillai's Trace	0.030	.738[b]	2.000	47.000	0.483	0.030
	Wilks' Lambda	0.970	.738[b]	2.000	47.000	0.483	0.030
	Hotelling's Trace	0.031	.738[b]	2.000	47.000	0.483	0.030
	Roy's Largest Root	0.031	.738[b]	2.000	47.000	0.483	0.030
Pretest Divergent	Pillai's Trace	0.041	1.013[b]	2.000	47.000	0.371	0.041
Thinking Skills	Wilks' Lambda	0.959	1.013[b]	2.000	47.000	0.371	0.041
	Hotelling's Trace	0.043	1.013[b]	2.000	47.000	0.371	0.041
	Roy's Largest Root	0.043	1.013[b]	2.000	47.000	0.371	0.041
Treatment E-Comic	Pillai's Trace	0.848	131.381[b]	2.000	47.000	0.000	0.848
Ethnomathematics	Wilks' Lambda	0.152	131.381[b]	2.000	47.000	0.000	0.848
	Hotelling's Trace	5.591	131.381[b]	2.000	47.000	0.000	0.848
	Roy's Largest Root	5.591	131.381[b]	2.000	47.000	0.000	0.848

Based on Table 6, the MANCOVA analysis yielded a Wilks' Lambda value of 0.152 with $F(2, 47) = 131.381$ and a significance level of 0.000 (< 0.05). These results indicate that the ethnomathematics-based e-comic intervention has a statistically significant simultaneous effect on students' self-efficacy and divergent thinking skills after controlling for pretest scores.

The partial eta-squared value for the treatment effect was 0.848, indicating a large effect size. However, this magnitude should be interpreted with caution, as the relatively small sample size may contribute to an

overestimation of the effect size. Despite this limitation, the consistently high effect sizes suggest that the ethnomathematical e-comic media exert a substantial influence on both dependent variables in this study.

The covariates self-efficacy pretest ($p = 0.483$) and divergent thinking pretest ($p = 0.371$) did not show significant effects. This finding indicates that the experimental and control groups were relatively equivalent at baseline, thereby strengthening the internal validity of the quasi-experimental design and suggesting that the observed posttest differences are primarily attributable to the treatment rather than initial group differences.

To further examine the effect of the treatment on each dependent variable, between-subjects tests were conducted, as shown in Table 7.

Table 7. Tests of Between-Subjects Effects

Source	Dependent Variable	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	Self-Efficacy	3	6589.579	104.940	0.000	0.868
	Divergent Thinking	3	254.456	12.388	0.000	0.436
Intercept	Self-Efficacy	1	5266.377	83.868	0.000	0.636
	Divergent Thinking	1	3513.423	171.049	0.000	0.781
Pretest Self-Efficacy	Self-Efficacy	1	79.623	1.268	0.266	0.026
	Divergent Thinking	1	6.827	0.332	0.567	0.007
Pretest Divergent	Self-Efficacy	1	117.528	1.872	0.178	0.038
Thinking	Divergent Thinking	1	2.312	0.113	0.739	0.002
Class	Self-Efficacy	1	15566.891	247.906	0.000	0.838
	Divergent Thinking	1	675.745	32.898	0.000	0.407
Error	Self-Efficacy	48	62.794			
	Divergent Thinking	48	20.540			
Total	Self-Efficacy	52				
	Divergent Thinking	52				
Corrected Total	Self-Efficacy	51				
	Divergent Thinking	51				

The analysis revealed a significant effect of the treatment on posttest self-efficacy, with $F(1,48) = 247.906$, $p < 0.05$, and a partial eta-squared of 0.838. A significant effect was also found for posttest divergent thinking skills, with $F(1,48) = 32.898$, $p < 0.05$, and a partial eta-squared of 0.407. Although these effect sizes are large, they should be interpreted cautiously due to the limited sample size. The absence of significant covariate effects further indicates that the observed gains are attributable to the ethnomathematical e-comic intervention rather than students' initial abilities.

Overall, these findings demonstrate that ethnomathematics-based e-comic media are effective in enhancing students' self-efficacy and divergent thinking skills in geometry learning. These results confirm that ethnomathematics-based e-comics effectively enhance students' self-efficacy and divergent thinking skills. The following section presents quantitative data on the pretest–posttest differences for both variables. Figures 1 and 2 illustrate the improvement patterns across the indicators of self-efficacy and divergent thinking.

Figure 1 illustrates the differences between pretest and posttest scores in the control and experimental classes for each self-efficacy indicator. The experimental class that received ethnomathematical e-comic media showed clear gains from pretest to posttest across all indicators. The most notable increase appeared in the aspiration and commitment to task indicator, which rose from 3.0 to 4.4. These findings demonstrate that self-efficacy improved significantly in the class that implemented ethnomathematical e-comics. Figure 2 presents similar improvements for divergent thinking indicators.

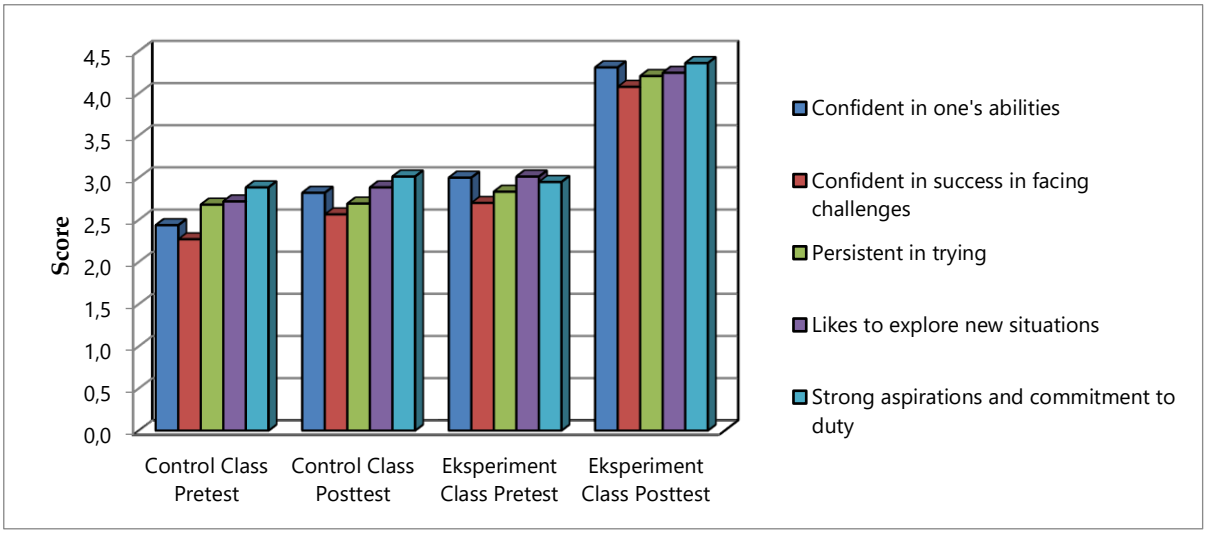

Figure 1. Pretest and Posttest Recapitulation of Self-Efficacy Aspects

Figure 2 illustrates substantial improvements in divergent thinking skills in the experimental group, particularly in the fluency and flexibility indicators, following the implementation of ethnomathematical e-comic media.

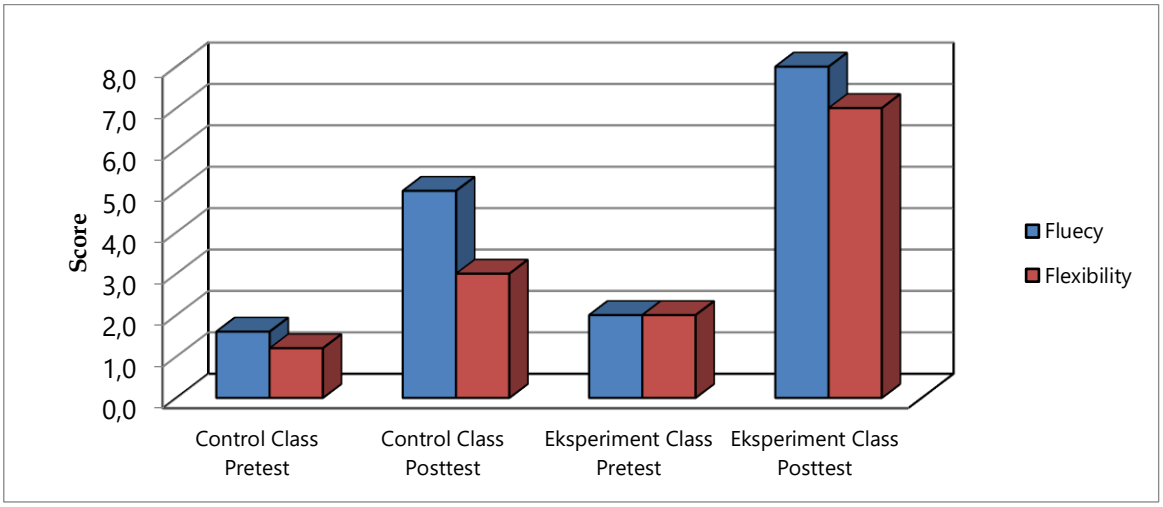

Figure 2. Pretest and Posttest Recapitulation of Divergent Thinking Skills Aspects

DISCUSSION

The findings of this study indicate that the use of ethnomathematics-based e-comic media is associated with improvements in students' divergent thinking skills and self-efficacy in geometry learning. Although the results suggest positive learning outcomes, the relationship between the use of ethnomathematical e-comics and these improvements should be interpreted cautiously. The enhancement of divergent thinking and self-efficacy cannot be attributed solely to the learning media itself, but rather to a combination of interacting factors, including instructional practices, student characteristics, and the learning context.

Engaging and interactive learning media such as e-comics have been shown to support students' ability to understand problems more quickly and generate creative ideas (Ilhan & Sin, 2024). Similarly, engaging and enjoyable media can stimulate students' problem-solving capacity using multiple approaches, a key component of divergent thinking (Sipayung et al., 2024). In the present study, the visual narratives and interactive features of ethnomathematical e-comics likely supported students' comprehension of mathematical problems. However, the extent to which this comprehension translated into divergent thinking may have depended on the teacher's role in facilitating discussion, providing scaffolding, and

encouraging students to explore alternative solution strategies. Without appropriate pedagogical guidance, students may focus primarily on visual or narrative elements rather than engaging in deeper mathematical reasoning.

The integration of cultural contexts into ethnomathematics also appears to enhance student engagement by making learning more relatable and meaningful (Surya et al., 2020). Cultural elements embedded in mathematical problems can help students better understand problem situations, thereby supporting the development of diverse and creative solution strategies. This finding is consistent with Suherman and Vidákovich (2022), who emphasize that problems framed in familiar contexts promote more profound understanding and enable students to generate alternative solutions. Nevertheless, the impact of cultural integration on divergent thinking is not automatic. Cultural contexts must align meaningfully with mathematical objectives; otherwise, they may serve merely as decorative elements with limited cognitive impact. Yulaichah et al. (2024) further suggest that incorporating community culture enriches learning experiences and strengthens students' motivation to learn, thereby indirectly supporting learning outcomes rather than directly determining cognitive gains.

Regarding affective outcomes, the results indicate that ethnomathematics-based e-comics are associated with increased student self-efficacy in geometry learning. The use of visual representations, structured narratives, and step-by-step explanations may reduce students' perceptions of geometry as abstract and complex, thereby fostering greater confidence in learning mathematics (Iskandar et al., 2024). Motivational elements embedded in e-comics—such as character success stories, scaffolded problem-solving, and encouraging dialogue—may also contribute to a more comfortable and enjoyable learning environment, as noted by Cahyono et al. (2023). However, it is important to consider that improvements in self-efficacy may be influenced not only by instructional clarity but also by the novelty effect of digital media, particularly when students have limited prior experience with interactive digital learning tools.

Beyond student outcomes, ethnomathematics-based e-comics represent an instructional innovation with implications for teacher professional development. The adoption of such media requires teachers to develop pedagogical competence in integrating cultural contexts, facilitating higher-order thinking, and managing interactive learning environments. While interactive and engaging media may enhance engagement and reduce monotony in learning, their effectiveness remains closely tied to instructional quality. This aligns with Hursen et al. (2023), who emphasize the importance of developing resilience and multifaceted competencies to address complex 21st-century challenges, and with Daniel et al. (2024), who highlight that engaging and creative instruction fosters a more conducive learning atmosphere and supports student understanding.

Several limitations of this study should be acknowledged when interpreting the findings. The research was conducted in a single school setting with a small sample size, which may limit the generalizability of the results. In addition, the relatively short duration of the intervention limits conclusions regarding the sustainability of improvements in divergent thinking and self-efficacy. Furthermore, this study did not fully control for external variables such as differences in teaching styles, classroom climate, or students' prior abilities, which may have influenced the observed outcomes.

Overall, this discussion suggests that ethnomathematics-based e-comics function as a supportive pedagogical tool rather than a stand-alone determinant of learning outcomes. Their potential benefits for divergent thinking and self-efficacy depend on thoughtful instructional integration, alignment between cultural content and mathematical objectives, and active teacher facilitation. These findings highlight the importance of viewing innovative learning media as part of a broader instructional ecosystem rather than as an isolated intervention.

CONCLUSION

This study demonstrates that ethnomathematics-based e-comic learning media are associated with positive developments in both students' divergent thinking skills and self-efficacy in geometry learning. The findings show measurable improvements in students' ability to generate multiple solution strategies as well

as increased confidence, persistence, and belief in their capacity to succeed in mathematical problem-solving from pretest to posttest. These results indicate that integrating interactive digital media with cultural contexts can support both cognitive and affective dimensions of learning in mathematics classrooms.

This research contributes to the field in several ways. First, it provides empirical evidence on the use of ethnomathematics-based e-comics as an instructional medium that integrates cultural relevance with digital learning to support divergent thinking and self-efficacy. Second, the study enriches the growing body of literature on creative and affective outcomes in mathematics education by examining both constructs simultaneously, rather than focusing solely on cognitive achievement. Third, the findings offer practical insights for teachers on the potential of culturally contextualized digital media within innovative instructional practices in the digital era.

Despite these contributions, several limitations should be acknowledged. The study involved a relatively small number of participants and was conducted in a single school context, which may limit the generalizability of the findings. In addition, the intervention lasted only a short time, making it difficult to conclude the long-term sustainability of improvements in divergent thinking and self-efficacy. Furthermore, external variables such as differences in teaching style, classroom dynamics, and students' prior abilities were not fully controlled and may have influenced the observed outcomes.

Future research is therefore recommended to involve larger and more diverse samples across different school contexts to strengthen the robustness of the findings. Longitudinal studies could examine whether the observed improvements are sustained over time. In addition, further investigation into the relationship between divergent thinking skills and self-efficacy is warranted. Qualitative approaches may be used to explore students' divergent thinking profiles through a self-efficacy perspective. At the same time, mixed-methods designs—combining quantitative analysis with in-depth qualitative exploration—could provide a more comprehensive understanding of how these constructs interact in ethnomathematics-based digital learning environments.

ACKNOWLEDGMENT

The researcher expressed his gratitude to Universitas Muhammadiyah Purwokerto for its support, which enabled the research to run smoothly and successfully.

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