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The Development of an AI-Scratch Interactive Learning Model for Elementary Art Education

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ABSTRACT

This study sought to develop and assess an AI-Scratch interactive learning model for elementary visual art education at SD HighScope Indonesia Medan. The research was motivated by the limited integration of interactive digital media in visual art learning, which remained predominantly focused on conventional drawing activities and teacher-centered instruction. The study employed a mixed-method Research and Development (R&D) approach adapted from the Borg and Gall model, comprising needs analysis, model development, expert validation, revision, classroom implementation, and effectiveness evaluation stages. The developed model integrated Scratch-based animated digital comic activities with adaptive AI-supported interaction to facilitate visual storytelling, creative exploration, and interactive learning experiences. The findings indicated that the developed learning model met instructional feasibility criteria based on material expert and media expert validation results. The implementation of the AI-Scratch learning model significantly enhanced students' learning outcomes, as evidenced by the increase in the average pretest score from 61.42 to the average posttest score of 81.38. Statistical analysis employing paired sample t-test revealed significant differences between pretest and posttest results, while the average N-Gain score of 0.554 indicated moderate learning improvement. Furthermore, the calculated effect size value of 1.96 demonstrated a substantial instructional impact. The results also revealed positive development in students' creativity across fluency, flexibility, originality, and elaboration dimensions during animated digital comic creation activities. In summary, the AI-Scratch interactive learning model contributed to the development of adaptive, creativity-oriented, and visually interactive learning innovation in elementary visual art education.

KEYWORDS

Artificial Intelligence Scratch, Interactive Learning Model, Visual Art Education, Digital Comic, Animation

INTRODUCTION

Visual art education plays an important role in developing creativity, imagination, visual literacy, and self-expression among elementary school students. Contemporary art learning emphasizes not only artistic skills but also creative thinking, innovation, and problem-solving abilities that enable students to communicate ideas through visual forms. The integration of visual arts into learning activities has been shown to support creativity development, interdisciplinary learning, and meaningful learning experiences (Samaniego et al., 2024; Zhang & Jia, 2024).

The rapid development of digital technology has transformed learning environments, including visual art education. Various digital media such as audio-visual resources, video tutorials, educational comics, and virtual reality applications have been utilized to improve student engagement and facilitate artistic learning activities (Irawan & Wardoyo, 2025; Pranoto et al., 2021;

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Wahyu Purnomo et al., 2023). These developments indicate that digital technologies provide opportunities to create more interactive and student-centered learning experiences while supporting artistic exploration and creative expression.

One digital platform that offers considerable potential for creative learning is Scratch. Through its visual and interactive environment, Scratch enables students to create animations, stories, and multimedia projects that combine creativity with digital production. Such characteristics make Scratch suitable not only for computational activities but also for visual storytelling and digital comic creation. Furthermore, animation and interactive visual media have been reported to enhance communication, engagement, and creative participation in digital learning environments (Arsana, 2023; Zahra & Mansoor, 2024).

Alongside the growth of digital learning technologies, Artificial Intelligence (AI) has emerged as an important innovation in educational technology. AI learning tools have increasingly been implemented in K–12 education to support adaptive learning, personalized feedback, and learner engagement (Yim & Su, 2025). In this study, AI is implemented as a Rule-Based Adaptive Recommendation System integrated within the Scratch environment. The system analyzes student interaction patterns during digital comic creation activities, including animation usage, scene development, storyline progression, and visual object utilization. Based on predefined pedagogical rules, the system generates adaptive recommendations intended to support creativity, visual storytelling, and artistic exploration.

Although previous studies have demonstrated the effectiveness of digital learning media and technology-supported art education, several limitations remain. Existing studies predominantly focus on media effectiveness, digital content development, and student engagement, while adaptive AI-supported learning environments for visual art education remain limited. Furthermore, studies involving animation, digital storytelling, and interactive media generally do not incorporate adaptive recommendation mechanisms capable of providing personalized creative guidance during artistic learning activities.

This study was conducted at SD HighScope Indonesia Medan, an elementary school that actively integrates digital technology into student-centered learning activities. However, the use of Scratch in learning activities has not yet been supported by adaptive mechanisms capable of providing personalized creative guidance. Therefore, a significant research gap exists in the integration of adaptive AI support, Scratch-based digital storytelling, and visual art learning within a unified instructional framework.

The novelty of this study lies in the development of an AI-Scratch Interactive Learning Model that integrates digital comic creation, visual storytelling, and a Rule-Based Adaptive Recommendation System within elementary visual art education. Unlike previous studies that primarily emphasize digital media utilization or technology adoption, this study introduces adaptive AI-supported creative guidance designed to facilitate personalized artistic exploration. Therefore, this study aims to develop, validate, and evaluate the effectiveness of the proposed AI-Scratch Interactive Learning Model in improving creativity and learning outcomes among elementary school students.

METHOD

This study employed a mixed-method Research and Development (R&D) approach adapted from the Borg and Gall model to develop and evaluate the AI-Scratch Interactive Learning Model for elementary visual art education. The original Borg and Gall model consists of ten development stages; however, considering the scope and context of implementation, it was modified into eight stages: (1) needs analysis, (2) product planning, (3) prototype development, (4) expert validation, (5) product revision, (6) limited field testing, (7) final revision, and (8) product evaluation (Borg & Gall, 1983).

The conceptual relationship among adaptive AI integration, Scratch-based visual learning, creativity development, and learning outcomes is illustrated in Figure 1. The framework positions AI-Scratch as an interactive learning ecosystem designed to support personalized artistic exploration and student engagement in elementary visual art learning.

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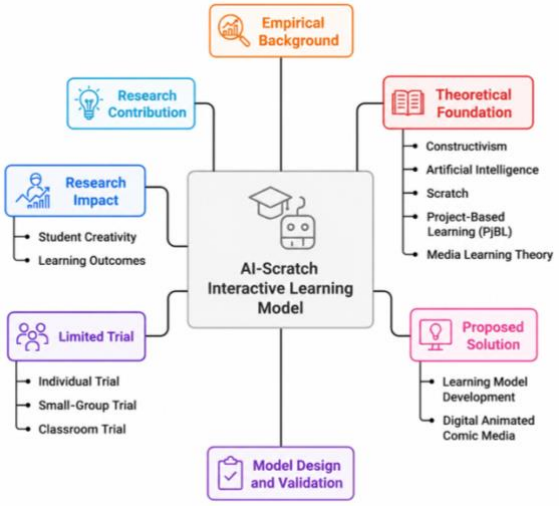

Figure 1. Conceptual Framework of the AI-Scratch Interactive Learning Model

The procedural stages of the model development are presented in Figure 2. The development process emphasized iterative revision and contextual implementation within elementary visual art learning activities.

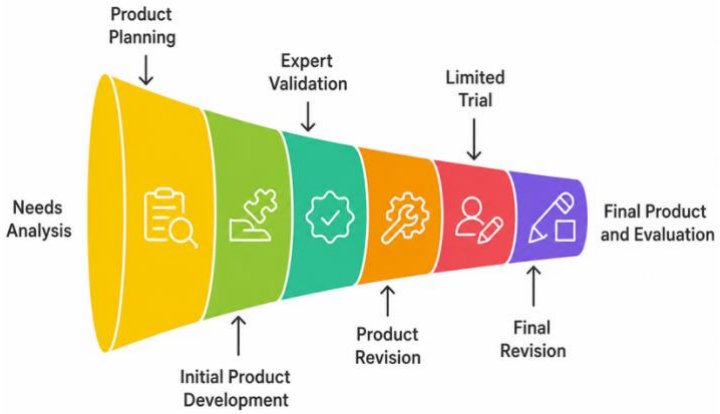

Figure 2. Research and Development Procedure of the AI-Scratch Interactive Learning Model

The study was conducted at SD HighScope Indonesia Medan during the 2024/2025 academic year. Participants consisted of 30 fourth-grade students aged 9–10 years, one visual art teacher, and two expert validators comprising a visual art expert and a digital learning media expert. Participants were selected using purposive sampling based on three criteria: (1) active participation in visual art learning activities, (2) basic digital literacy skills, and (3) readiness to engage in Scratch-based digital learning. The expert validators were responsible for evaluating the content quality, instructional suitability, media design, and technical feasibility of the developed model.

The AI-Scratch Interactive Learning Model integrated digital comic creation, visual storytelling, animation activities, and adaptive learning support. The digital comic component was developed based on the educational potential of comic-based learning media in visual art education (Wahyu Purnomo et al., 2023), while animation principles were adopted to facilitate visual communication and creative expression (Arsana, 2023). Interactive design elements were incorporated to enhance learner engagement and user experience within the digital environment (Zahra & Mansoor, 2024). Artificial Intelligence was implemented as a Rule-Based Adaptive Recommendation System. Consistent with adaptive AI learning tools in K–12 education, the system analyzed student interaction patterns and generated contextual recommendations to support creativity development and learning engagement (Yim & Su, 2025). Student interaction data included

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animation usage, scene development, visual object utilization, storyline progression, character development, and project completion status.

Data were collected through classroom observations, semi-structured interviews, expert validation questionnaires, student response questionnaires, learning outcome tests, and creativity assessment rubrics. Observation instruments focused on behavioral, emotional, and cognitive engagement during learning activities. Interview guidelines were used to explore teachers' and students' experiences regarding the implementation of the AI-Scratch model. The expert validation questionnaire consisted of five assessment aspects: content suitability, instructional design, media quality, usability, and technical functionality. Student response questionnaires employed a five-point Likert scale to assess practicality, attractiveness, ease of use, and perceived usefulness of the developed model.

Learning outcomes were measured using a pretest-posttest instrument consisting of 20 multiple-choice items developed according to the learning outcomes and learning objectives of the Merdeka Curriculum for Grade IV visual art education. Creativity was assessed using a rubric adapted from the dimensions of fluency, flexibility, originality, and elaboration, which are widely recognized indicators of creative thinking in art and design education. Fluency measured the number of ideas generated, flexibility assessed the diversity of approaches used, originality evaluated the uniqueness of visual and narrative ideas, and elaboration measured the level of detail and refinement demonstrated in students' digital comic projects.

Instrument validity was evaluated through expert judgment involving visual art and educational technology experts. Reliability was assessed using Cronbach's Alpha coefficient, with values above 0.70 indicating acceptable internal consistency (Izah et al., 2023). The validation and reliability procedures ensured that the instruments were suitable for measuring learning outcomes, creativity, and user responses.

Qualitative data obtained from observations and interviews were analyzed using thematic analysis to identify patterns related to student engagement, creativity development, and learning experiences. Quantitative data were analyzed using descriptive and inferential statistics. Prior to hypothesis testing, data normality was examined using the Shapiro–Wilk test (Afifah et al., 2022).

The effectiveness of the developed model was evaluated using the Paired Sample t-Test. Learning improvement was measured using the normalized gain (N-Gain) proposed by Hake (1998), while the magnitude of the intervention effect was determined using Cohen's d effect size (Cohen, 1988). Recent educational research also recommends the combined use of normalized gain and effect size measures to provide a more comprehensive interpretation of learning improvement (Fithriyani et al., 2026).

The effectiveness of the developed model was evaluated using the Paired Sample t-Test to determine significant differences between pretest and posttest scores. The t-statistic was calculated using Equation (1).

Equation (1). Paired Sample t-Test

$$t = \frac{\bar{d}}{S_d/\sqrt{n}}$$

where t represents the t-statistic, $\bar{d}$ represents the mean difference between paired observations, S_d represents the standard deviation of the differences, and n represents the number of paired observations.

Learning improvement was measured using the normalized gain (N-Gain) proposed by Hake (1999), as shown in Equation (2).

Equation (2). Normalized Gain (N-Gain)

$$N - Gain = \frac{S_{post} - S_{pre}}{S_{max} - S_{pre}}$$

where S_{post} represents the posttest score, S_{pre} represents the pretest score, and S_{max} represents the maximum possible score.

To determine the magnitude of the intervention effect, Cohen's Effect Size (Cohen, 1988) was calculated using Equation (3).

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Equation (3). Effect Size (Cohen's d)

$$d = \frac{\overline{X}_{post} - \overline{X}_{pre}}{SD_{pooled}}$$

where $\overline{X}_{post}$t represents the mean posttest score, $\overline{X}_{pre}$e represents the mean pretest score, and SD_{pooled} represents the pooled standard deviation. Statistical analyses were performed using SPSS version 26 with a significance level of 0.05.

RESULT AND DISCUSSION

1. Needs Analysis of the AI-Scratch Learning Model

The needs analysis findings indicated that visual art learning at SD HighScope Indonesia Medan still relied primarily on conventional drawing activities and teacher-centered instruction. Classroom observations revealed that students demonstrated strong interest in visual and interactive learning activities, particularly those involving digital storytelling and animation-based media. However, the integration of digital technology in visual art learning remained relatively limited.

Students' learning engagement was analyzed through four indicators consisting of enthusiasm, concentration, collaboration, and independence. The observation results showed that students possessed relatively positive engagement during visual art learning activities, as presented in Table 1.

Table 1. Students' Learning Activity during Visual Art Learning

Activity Indicator	Mean Score
Enthusiasm	3.25
Concentration	3.08
Collaboration	3.21
Independence	3.33

The results show that students demonstrated relatively positive engagement across all indicators. The highest score was observed in independence (3.33), indicating that students were capable of completing visual art tasks autonomously. However, the observation findings also revealed that existing learning activities provided limited opportunities for interactive digital creation and visual experimentation. These findings support the need for an innovative learning model capable of integrating digital technology with creativity-oriented visual art learning.

Interviews with teachers and students further revealed that technology-based learning media increased motivation, confidence, and classroom participation. Similar findings have been reported by Aisyah et al. (2023) and Zulfia Novrita et al. (2023), who found that digital instructional media contributed positively to student engagement and learning experiences in art education. These findings suggest that digital technologies can provide a more attractive and meaningful learning environment for elementary visual art instruction.

2. Validation Results of the AI-Scratch Learning Model

Prior to implementation, the AI-Scratch Interactive Learning Model was evaluated by two expert validators consisting of one visual art expert and one digital learning media expert. Validation employed a four-point rating scale ranging from 1 (poor), 2 (fair), 3 (good), and 4 (excellent). The validity percentage was calculated using the ratio between the obtained score and the maximum possible score.

Table 2. Material Expert Validation Results

Assessment Aspect	Mean Score	Percentage (%)	Category
Learning Material Suitability	4.00	100.00	Very Valid
Clarity of Learning Content	4.00	100.00	Very Valid
Integration with Scratch Media	3.00	75.00	Valid
Learning Activity Suitability	4.00	100.00	Very Valid
Creativity Development Relevance	4.00	100.00	Very Valid

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The results indicate that the developed model is highly appropriate for elementary visual art learning. Most aspects achieved the highest validation score, demonstrating strong alignment between learning objectives, instructional activities, and creativity development. These findings support previous studies emphasizing the importance of digital learning media in enhancing visual art instruction (Rinaldo & Sukmayadi, 2023).

Media validation was subsequently conducted to evaluate visual appearance, usability, instructional suitability, and media integration. The results are presented in Table 3.

Table 3. Media Expert Validation Results

Assessment Aspect	Mean Score	Percentage (%)	Category
Visual Appearance	4.00	100.00	Very Valid
Animation Clarity	3.00	75.00	Valid
Ease of Use	4.00	100.00	Very Valid
Instructional Suitability	4.00	100.00	Very Valid
Media Integration	4.00	100.00	Very Valid

The media validation results demonstrate that the AI-Scratch model is technically feasible and easy to use in classroom settings. Minor revisions were implemented to improve animation flow and instructional guidance before classroom implementation. Similar findings have been reported in studies showing that interactive digital media can support more effective and engaging learning experiences in art education (Irawan & Wardoyo, 2025; Zulfia Novrita et al., 2023).

3. Effectiveness of the AI-Scratch Learning Model

Prior to hypothesis testing, a Shapiro–Wilk normality test was conducted to determine whether the data met the assumptions for parametric statistical analysis. The results indicated that both pretest and posttest scores were normally distributed, with significance values greater than 0.05. Therefore, the data were considered suitable for further analysis using the Paired Sample t-Test.

Table 4. Shapiro–Wilk Normality Test

Variable	Statistic	Sig.
Pretest	0.942	0.180
Posttest	0.946	0.222

The descriptive statistics of students' learning outcomes are presented in Table 5.

Table 5. Paired Sample Statistic

Variable	Mean	N	Std. Deviation
Pretest	61.42	24	10.312
Posttest	81.38	24	10.099

The results indicate a substantial improvement in students' learning outcomes after the implementation of the AI-Scratch Interactive Learning Model. The mean score increased from 61.42 in the pretest to 81.38 in the posttest, representing an average gain of 19.96 points. This improvement suggests that the integration of digital comic creation, visual storytelling, and interactive learning activities contributed positively to students' understanding of visual art concepts. The comparison between pretest and posttest scores is illustrated in Figure 3.

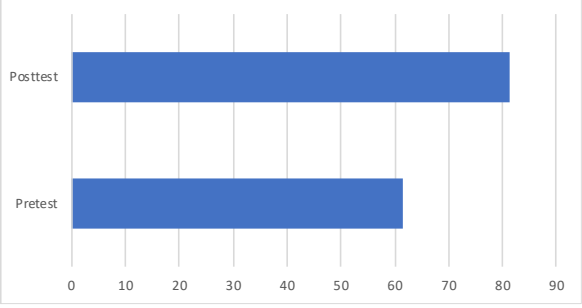

Figure 3. Comparison of Pretest and Posttest Scores

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To examine the relationship between pretest and posttest scores, a paired sample correlation analysis was conducted. The results are presented in Table 6.

Table 6. Paired Sample Correlations

N	Correlation	Sig.
24	0.997	0.000

The strong positive correlation indicates a high degree of consistency between students' pretest and posttest performance while demonstrating overall improvement following the intervention.

The significance of learning improvement was further examined using the Paired Sample t-Test.

Table 7. Paired Sample Test

Mean Difference	t	df	Sig. (2-tailed)
-19.958	-113.868	23	0.000

The paired sample t-test revealed a statistically significant difference between pretest and posttest scores ($p < 0.001$), indicating that the AI-Scratch Interactive Learning Model effectively improved students' learning outcomes. The significant improvement may be attributed to the integration of interactive digital activities that encouraged active participation, creative exploration, and visual communication throughout the learning process.

These findings support previous studies reporting that digital learning media enhance student engagement and academic achievement in visual art education (Pranoto et al., 2021; Irawan & Wardoyo, 2025). Unlike conventional instructional approaches, the AI-Scratch model actively involved students in creating digital comic projects, thereby promoting deeper engagement with artistic concepts and learning materials.

To determine the magnitude of learning improvement, N-Gain analysis was conducted.

Table 8. N-Gain Analysis Results

Minimum	Maximum	Mean
0.364	0.864	0.554

The average N-Gain score of 0.554 falls within the moderate category, indicating meaningful improvement in students' understanding of visual art concepts. The result suggests that the developed model effectively facilitated conceptual development and learning progression during the instructional process.

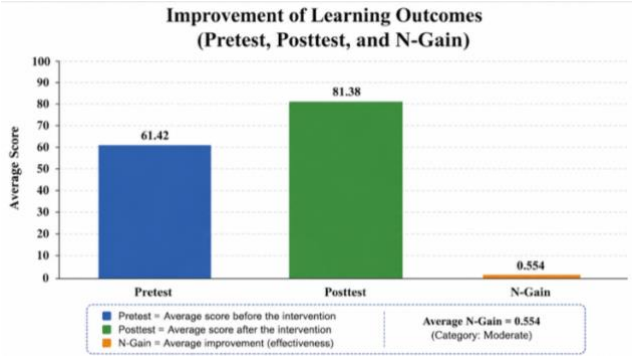

Figure 4. N-Gain Distribution of Student Learning Outcomes

In addition, effect size analysis was conducted to determine the practical significance of the intervention.

Table 9. Effect Size Results

Effect Size (d)	Category
1.95	Very Large

The effect size value of 1.95 indicates a very large practical effect of the AI-Scratch Interactive Learning Model on student learning outcomes. This finding demonstrates that the observed

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improvement was not only statistically significant but also educationally meaningful, highlighting the potential of AI-supported digital learning environments to enhance visual art learning in elementary education.

4. Students' Creativity Development

Student creativity was assessed using four dimensions adapted from Torrance's creativity framework, namely fluency, flexibility, originality, and elaboration (Alabbasi et al., 2022). Creativity scores were measured using a four-point rubric, where scores between 3.26 and 4.00 were categorized as high creativity. The results of the creativity assessment are presented in Table 10.

Table 10. Students' Creativity Assessment Results

Creativity Indicator	Mean Score	Category
Fluency	3.42	High
Flexibility	3.29	High
Originality	3.33	High
Elaboration	3.38	High

The results indicate that students achieved high creativity levels across all assessed dimensions. The highest score was obtained in fluency (3.42), suggesting that students were able to generate multiple visual ideas and narrative alternatives during digital comic creation activities. This finding demonstrates that the learning activities provided opportunities for students to explore various artistic concepts rather than relying on a single visual solution.

The elaboration dimension also achieved a high score (3.38), indicating that students were capable of developing visual ideas into more detailed artistic products. During the digital comic production process, students enriched their work through character development, scene composition, dialogue construction, and animation sequences. These activities encouraged students to refine and expand their initial ideas into more complete visual narratives.

Similarly, the originality and flexibility dimensions achieved high scores of 3.33 and 3.29, respectively. The originality results suggest that students were able to produce unique visual representations and personalized storylines, while the flexibility scores indicate their ability to approach artistic tasks from different perspectives. Rather than simply reproducing teacher-provided examples, students demonstrated the capacity to modify, combine, and reinterpret visual elements according to their own creative ideas.

The observed creativity development may be attributed to the interactive and exploratory nature of digital comic activities. Previous studies have reported that creative visual media can stimulate idea generation, artistic experimentation, and learner engagement. Wahyu Farosa and Irfansyah (2023) found that interactive visual media encourage students to reinterpret narratives through creative expression, while Halawa and Kholida (2022) demonstrated that visual transformation activities support the development of artistic imagination and innovation. These findings suggest that creative digital environments provide meaningful opportunities for students to construct artistic knowledge through active exploration and experimentation.

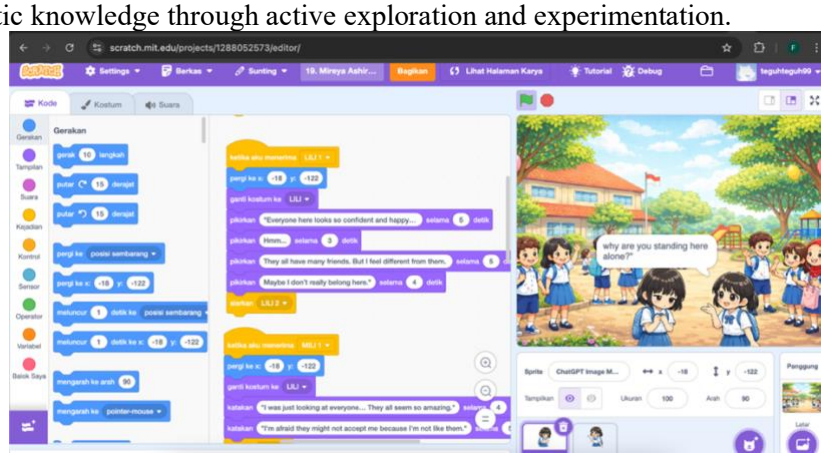

Figure 5. Example of Students' Digital Comic Animation Project

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Figure 5 illustrates a student-produced digital comic project developed using the AI-Scratch learning environment. The project demonstrates students' ability to integrate visual storytelling, character design, dialogue development, and animation into a coherent artistic product. The diversity of visual representations observed in student projects further supports the creativity findings presented in Table 10.

Overall, the creativity assessment results indicate that the AI-Scratch Interactive Learning Model successfully facilitated artistic exploration and creative expression within elementary visual art learning. The consistently high scores across all creativity dimensions suggest that the model provided a learning environment that encouraged students to generate ideas, develop visual narratives, and communicate artistic concepts through digital media.

5. AI Integration, Research Contribution, and Limitations

The primary contribution of this study lies in the integration of Artificial Intelligence within a Scratch-based visual art learning environment. Previous studies have demonstrated the effectiveness of digital learning media such as tutorial videos, electronic modules, mobile applications, and interactive learning resources in supporting visual art education (Aisyah et al., 2023; Rinaldo & Sukmayadi, 2023; Wahyu Farosa & Irfansyah, 2023b). However, these approaches generally provide identical learning experiences for all students and do not incorporate adaptive learning support.

In contrast, the AI-Scratch Interactive Learning Model integrates a Rule-Based Adaptive Recommendation System that analyzes students' interaction patterns during digital comic creation activities. Based on indicators such as storyline development, animation usage, visual object selection, and project progress, the system generates contextual recommendations to support artistic exploration and creative decision-making. This adaptive mechanism enables students to receive personalized learning support according to their creative progress and learning needs.

The findings indicate that the integration of adaptive recommendations, digital storytelling, and comic-based learning activities contributed to both improved learning outcomes and creativity development. Therefore, the novelty of this study lies not merely in the use of Scratch as a digital learning platform, but in its transformation into an adaptive artistic learning ecosystem that combines visual storytelling, digital comic production, and AI-supported learning guidance within elementary visual art education.

Nevertheless, this study has several limitations. The implementation involved only 24 fourth-grade students from a single elementary school and focused on one visual art topic within a limited intervention period. In addition, the AI component was implemented as a rule-based adaptive recommendation system rather than a machine-learning model. Future studies are encouraged to involve larger participant groups, multiple educational settings, and more advanced AI techniques to further investigate the long-term impact of adaptive visual art learning on creativity and learning outcomes.

CONCLUSION

This study developed and evaluated an AI-Scratch Interactive Learning Model for elementary visual art education through digital comic creation and visual storytelling activities. The findings indicate that the developed model is pedagogically feasible and effective in supporting student learning and creativity development. The integration of adaptive AI-based recommendations within the Scratch environment enabled students to engage more actively in artistic exploration, visual communication, and creative problem-solving.

The main contribution of this study lies in transforming Scratch from a digital creation tool into an adaptive artistic learning ecosystem that provides personalized support during the creative process. This approach offers an alternative strategy for integrating digital technology and artificial intelligence into elementary visual art education while maintaining a strong focus on creativity and artistic expression.

Practically, the model can be utilized by teachers as an interactive learning medium to facilitate digital storytelling, comic-based learning, and creativity-oriented visual art activities. Future research is recommended to involve larger and more diverse participant groups, implement longer

intervention periods, and explore more advanced AI techniques to further enhance adaptive support and creativity development in visual art learning.

REFERENCES

Afifah, S., Mudzakir, A., & Nandiyanto, A. B. D. (2022). How to calculate paired sample t-test using SPSS software: From step-by-step processing for users to the practical examples in the analysis of the effect of application anti-fire bamboo teaching materials on student learning outcomes. *Indonesian Journal of Teaching in Science*, *2*(1), 81–92.

Aisyah, S., Ondira Asa, F., & Mutia Sari, D. (2023). Kelayakan Media Pembelajaran Berbasis Video Tutorial Pada Materi Batik Di Program Studi Pendidikan Seni Rupa. *Gorga : Jurnal Seni Rupa*, *12*.

Alabbasi, A. M. A., Paek, S. H., Kim, D., & Cramond, B. (2022). What do educators need to know about the Torrance Tests of Creative Thinking: A comprehensive review. *Frontiers in Psychology*, *13*, 1000385.

Arsana, I. G. Y. (2023). Visualisasi Karakter Superhero Film Animasi 2D Satria Barong. *Gorga : Jurnal Seni Rupa*, *12*.

Borg, W. R., & Gall, M. D. (1983). *Educational Research: An Introduction*. Longman. https://books.google.co.id/books?id=KcE0AAAAMAAJ

Br Halawa, M. V., & Kholida, P. (2022). Transformasi Motif Tradisi Dari Media 2D ke 3D Sebagai Bentuk Pelestarian Budaya Visual Lampung. *Gorga : Jurnal Seni Rupa*, *11*.

Fithriyani, M., Nulhakim, L., & Dewi, R. S. (2026). The Effectiveness of Edpuzzle-Based Interactive Video on Fifth Grade Students' Learning Outcomes in Fact and Opinion Materials. *FIKROTUNA: Jurnal Pendidikan Dan Manajemen Islam*, *15*(01), 38–57.

Irawan, A., & Wardoyo, S. (2025). The Effectiveness Of Audio-Visual Learning Media In Visual Arts Subjects: A Literature Review. *Gorga : Jurnal Seni Rupa*, *14*(1), 311–318. https://doi.org/10.24114/gr.v14i1.64556

Izah, S. C., Sylva, L., & Hait, M. (2023). Cronbach's alpha: A cornerstone in ensuring reliability and validity in environmental health assessment. *ES Energy and Environment*, *23*, 1057.

Pranoto, I., Daima Ulfa, Z., Natalia Silalahi, J., Herlina, I., & Sagarli. (2021). Pengembangan Video Media Pembelajaran Seni Rupa Tradisional Dayak Kalimantan Tengah Berbasis Virtual Reality SMPN 2 Palangka Raya. *Gorga : Jurnal Seni Rupa*, *10*.

Rinaldo, J., & Sukmayadi, Y. (2023). Pengembangan Modul Elektronik Seni Grafis Untuk Peserta Didik SMA. *Gorga : Jurnal Seni Rupa*, *12*.

Samaniego, M., Usca, N., Salguero, J., & Quevedo, W. (2024). Creative Thinking in Art and Design Education: A Systematic Review. In *Education Sciences* (Vol. 14, Number 2). Multidisciplinary Digital Publishing Institute (MDPI). https://doi.org/10.3390/educsci14020192

Wahyu Farosa, A., & Irfansyah. (2023a). Board Game RPG Sebagai Media Pengenalan Cerita Wayang Mahabharata Versi Jawa Untuk Remaja. *Gorga : Jurnal Seni Rupa*, *12*.

Wahyu Farosa, A., & Irfansyah. (2023b). Perancangan Mobile Apps Kamus Sebagai Media Dokumentasi Bahasa Isyarat Khas Bandung Dengan Peraga AnimasI 3D. *Gorga : Jurnal Seni Rupa*, *12*.

Wahyu Purnomo, T., Mustika Aulia, S., & Elfisa Br Sembiring Milala, P. (2023). Komik Edukasi Ragam Hias Suamatera Utara Sebagai Media Pembelajaran Seni Rupa. *Gorga : Jurnal Seni Rupa*, *12*.

Yim, I. H. Y., & Su, J. (2025). Artificial intelligence (AI) learning tools in K-12 education: A scoping review. *Journal of Computers in Education*, *12*(1), 93–131. https://doi.org/10.1007/s40692-023-00304-9

Zahra, N., & Mansoor, A. Z. (2024). Warna Dan Emosi Untuk Media Desain Interaktif: Literature Review Color And Emotion For Interactive Design Media: A Literature Review. *Gorga : Jurnal Seni Rupa*, *13*.

Zhang, C., & Jia, B. (2024). Enriching STEAM education with visual art: education benefits, teaching examples, and trends. In *Discover Education* (Vol. 3, Number 1). Discover. https://doi.org/10.1007/s44217-024-00354-w

Zulfia Novrita, S., Fridayati, L., & Vebyola, F. (2023). Pengembangan Video Tutorial Teknik Batik Tulis Sebagai Media Pembelajaran Pada Mata Kuliah Batik Di Departemen IKK FPP UNP. *Gorga : Jurnal Seni Rupa*, *12*.