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The Implementation of AI-Assisted Digital Artwork Learning as an Innovative Strategy for Elementary School Teachers in Improving Student's Technological Literacy in the Era of the Independent Curriculum

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A B S T R A C T

The advancement of digital technology and artificial intelligence (AI) presents significant opportunities for art education in elementary schools, particularly within the Independent Curriculum framework that prioritizes creativity, autonomy, and technological literacy. This study examines the implementation of AI-assisted digital art learning by elementary school teachers and its impact on students' technological literacy development. Employing a descriptive qualitative approach with collective case study design, data were gathered through observations, interviews, and document analysis in multiple elementary schools implementing the Independent Curriculum. The interactive model of Miles, Huberman, and Saldaña guided the data analysis process. Findings revealed high student enthusiasm and active engagement in prompt-based digital art activities, demonstrating increased interest in continued participation. AI integration enhanced students' creativity, conceptual comprehension, and technical proficiency in digital artwork creation. Furthermore, the learning process strengthened technological literacy through prompt development skills, critical evaluation of AI-generated outputs, and independent application utilization. However, challenges emerged regarding teacher preparedness, disparities in students' digital competencies, and insufficient devices and infrastructure. This study concludes that AI-assisted digital art learning represents a relevant and innovative pedagogical strategy effectively supporting Independent Curriculum implementation in elementary education.

1. Introduction

The development of learning methods that are relevant to the demands of the digital era is one of the main focuses of the Independent Curriculum, especially at the

elementary school level which is the foundation for 21st century skills formation (Ummah, 2023). Recent studies have demonstrated that the implementation of the Independent Curriculum requires innovative pedagogical approaches that integrate technology meaningfully into learning processes (Asrial et al., 2020). The Merdeka Curriculum emphasizes project-based learning, differentiation, and the use of technology to encourage creativity, critical thinking, and independent learning from an early age. In this context, technology literacy is not only interpreted as the ability to operate devices, but also includes conceptual understanding, creative use, and ethical attitudes in interacting with digital technology. Research by Darmaji et al. (2021) emphasized that technological literacy in elementary education should encompass both technical skills and critical understanding of digital tools, enabling students to become creative and responsible digital citizens. Art as an expressive subject has the strategic potential to become a vehicle for developing technology literacy through the creation of meaningful and contextual digital artworks for students (Wahyudin et al., 2024; Escala et al., 2024).

The rapid development of artificial intelligence (AI) has prompted international research to evaluate its impact on visual arts learning in primary schools. A number of studies show that the application of AI in art activities is able to increase creativity, learning motivation, and the quality of students' products. AI-based digital art skills training systems have proven to be effective in helping children develop drawing skills, explore ideas, and expand their imaginations in a more targeted way, while providing automated feedback that speeds up the learning process. Other research confirms that AI-based digital learning design allows teachers to design visual arts activities that are adaptive to the differences in students' abilities and learning styles at the elementary school level. Furthermore, Maison et al. (2020) found that technology integration in creative subjects enhances student engagement and fosters higher-order thinking skills, particularly when learning activities are designed to be student-centered and inquiry-based. In addition, studies on AI literacy in primary education show that the integration of AI in art learning can be a strategic means to introduce the concepts, opportunities, and potential risks of AI technology to children from an early age (Chen & Chen, 2014; Li & Zhang, 2022; Holmes et al., 2019).

Research in Indonesia on the Independent Curriculum and digital literacy shows that the integration of technology in elementary schools still faces a number of challenges, especially related to teachers' digital skills, the availability of infrastructure, and learning models that have not been systematically arranged. A study conducted by Pathoni et al. (2022) revealed that elementary school teachers often lack adequate training in utilizing digital technologies for pedagogical purposes, resulting in limited implementation of technology-enhanced learning strategies. The study of digital literacy at the elementary school level generally focuses on the use of digital devices and the use of online learning platforms, such as educational gadgets and applications, without paying special attention to the use of AI-based digital artworks as a means of strengthening students' technological literacy. Research by Astalini et al. (2021) indicated that digital literacy development in Indonesian elementary schools remains superficial, focusing primarily on basic operational skills rather than creative production and critical

evaluation of digital content. Other research confirms that the digital literacy that develops in elementary schools is still limited to the ability to access and use digital media, so it has not reached more complex aspects of digital creation. On the other hand, studies on the application of AI in visual arts learning that are directly related to national education policies are still very limited in Indonesia, while most of the research on this topic comes from international contexts (Inayah et al., 2024; Munadzifah & Fradana, 2025; Nurdin et al., 2025; Chen & Chen, 2014).

The development of artificial intelligence (AI) has encouraged the emergence of innovative learning strategies oriented towards strengthening technological literacy starting from the elementary education level. In the context of digital arts learning, AI functions not only as a technical tool, but also as a pedagogical medium capable of fostering creativity, technological understanding, and independent learning in students. Several studies have shown that the integration of AI in language learning and digital skills has a positive impact on increasing productive competence, self-confidence, and readiness to face the demands of 21st-century learning (Mardhiah et al., 2025; Amara et al., 2025; Al Farizy et al., 2025). Moreover, Kurniawan et al. (2023) demonstrated that innovative teaching strategies utilizing digital technologies significantly improve students' learning outcomes and motivation, particularly when teachers receive adequate professional development and institutional support. Furthermore, the application of AI in learning practices at various levels of education in Indonesia has been shown to encourage innovation in teaching methods that are adaptive, contextual, and in line with the spirit of the Independent Curriculum (Septiani et al., 2025; Islami et al., 2025). Therefore, the implementation of AI-assisted digital arts learning is a potential strategy for elementary school teachers to improve students' technological literacy in a meaningful and sustainable manner.

This gap shows the need for research that not only explains the potential of AI technology in digital art learning, but also examines how primary school teachers in Indonesia implement AI-assisted digital art learning within the framework of the Independent Curriculum (Pratiwi et al., 2025). This study serves as a study that confirms previous findings regarding the positive influence of AI on students' creativity and learning motivation, while evaluating the limitations of the local context by presenting empirical data from elementary schools in Indonesia. A recent investigation by Fani et al. (2022) highlighted the importance of contextualizing technology integration within local educational settings, as cultural and infrastructural factors significantly influence implementation success. In addition, international research shows that AI has adaptive pedagogical potential in visual arts learning, but it has not been widely studied in the context of Indonesia's national curriculum. Research conducted by Hidayat et al. (2020) suggested that teacher competence in designing technology-integrated learning experiences is crucial for effective implementation of innovative curricula, particularly in resource-constrained environments typical of many Indonesian elementary schools.

The uniqueness of this research lies in its integrated approach which includes: (1) digital art as a creative product produced by students; (2) the use of AI as an instructional tool; (3) the role of teachers as innovative learning designers; and (4)

improving technology literacy as one of the main goals of the Independent Curriculum at the elementary school level. Based on this background, the purpose of this research is to analyze in depth the application of AI-assisted digital art learning by elementary school teachers in the context of the Independent Curriculum, identify the urgency and challenges that arise, and explain its contribution to improving students' technological literacy (Chen & Chen, 2014; Xie & Correia, 2023).

2. Methodology

This study uses a descriptive qualitative method with a collective case research design to in-depth analyze the application of digital art learning that utilizes artificial intelligence (AI) in several elementary schools that have adopted the Independent Curriculum. The qualitative approach was chosen because it allows researchers to understand learning phenomena in a natural context, focusing on the meanings, processes, and experiences of the participants during the course of learning. The selection of schools and participants, consisting of teachers and students, was carried out purposively based on certain criteria, namely: schools have implemented the Independent Curriculum, teachers use digital devices and AI-based applications in art learning, and all participants are willing to be involved in this research (Creswell & Poth, 2018).

Data collection was carried out through three main methods, namely participatory observation limited to the digital art learning process, semi-structured interviews with teachers and student representatives, and document analysis related to teaching materials, project modules, and portfolios of digital artworks created by students. The guidelines for observation and interviews were made based on the results of previous research on digital art learning using AI and technology literacy among elementary school students. This approach ensured the relevance and validity of the research instruments (Creswell & Poth, 2018; Chen & Chen, 2014).

The data analysis in this study was carried out interactively using models from Miles, Huberman, and Saldaña, which included three main steps: data processing, data presentation, and conclusion drawing and examination. At the data processing stage, interview transcripts, field notes, and supporting documents are organized through an open coding process to identify categories related to learning planning, AI implementation, student response, and technology literacy strengthening (Miles et al., 2014; Wang et al., 2024). Data presentation was carried out through thematic matrices and case narratives to show patterns between schools and between teachers comparatively. Furthermore, conclusions are drawn in stages by identifying patterns, relationships, and key findings relevant to the focus of the research. The validity of the findings is strengthened through verification using the source triangulation technique and member checking to teachers to ensure the accuracy of data interpretation (Creswell & Poth, 2018).

3. Results and Discussion

Classroom settings were generally conducive to AI-assisted digital art learning at the start of the learning implementation. Although their proficiency with digital devices varied, children in grade V were accustomed with using them. Students demonstrated curiosity, asked questions about the usage of AI applications, and eagerly explored the production of digital art in an active and engaging classroom setting. By adapting learning activities to device availability either through solo work or shared use teachers were able to control the class. The Independent Curriculum's emphasis on creativity and discovery was generally reflected in the classroom setting.

AI-assisted digital art instruction was carried out as part of routine art classes during the research phase using lesson plans created by the instructor. An introduction to artificial intelligence (AI) and the operation of image-generation software preceded guided practice in prompt creation, visual style exploration, and the presentation of students' digital artwork. Data collection and learning implementation were done at the same time. In order to document student engagement, interaction patterns, and reactions to AI use, observations were made. Additionally, following the learning sessions, teachers and chosen student representatives participated in semi-structured interviews to discuss their experiences, perceived advantages, and difficulties with applying AI-assisted digital art learning.

The interview process was guided by a set of semi-structured questions designed to explore teachers' and students' perspectives on the implementation of AI-assisted digital art learning, as presented in Table 1.

Table 1. Interview Questions for Teachers and Students

Respondent	Interview Questions
Teacher	How do you plan and implement AI-assisted digital art learning within the Independent Curriculum?
Teacher	What learning objectives do you aim to achieve through the use of AI in art learning?
Teacher	How do students respond to the use of AI-based applications during digital art activities?
Teacher	What benefits do you observe in students' creativity and technological literacy?
Teacher	What challenges do you face in implementing AI-assisted digital art learning?
Student	How do you feel about participating in digital art learning using AI?
Student	What parts of AI-assisted digital art learning do you find most interesting?
Student	Do you experience any difficulties when using AI to create digital artworks?
Student	What new knowledge or skills about technology do you gain from this learning?
Student	Would you like to participate in similar learning activities in the future? Why?

In-depth information about teachers' teaching methods and students' experiences with AI-assisted digital art learning was obtained from the interview questions in Table 1. Through data triangulation, this interview data strengthened the validity of the research findings in addition to the observation and document analysis.

Overview of the Implementation of AI-Assisted Digital Art Learning in Elementary Schools

AI-assisted digital art learning in this study was carried out on grade V students in one of the elementary schools that have implemented the Independent Curriculum. Teachers use prompt-based image generation AI applications that allow students to turn verbal ideas into digital visual works. Learning activities generally begin with a brief introduction to AI and how applications work, followed by exercises in creating simple prompts, exploration of drawing styles, and presentation of works. Throughout the learning process, students are encouraged to experiment independently and reflect on the results generated by the AI. In terms of learning experience, almost all students stated that they enjoyed AI-assisted digital art learning. A total of 21 students answered "Agreed" and 19 students "Strongly Agreed" to the statement "I feel happy to participate in digital art learning using AI", while only 1 student answered "Strongly Disagree". Thus, around 97.6% of students are in the positive category for the experience of participating in this learning. All students (100%) also expressed agreement or strongly agreed that they would like to participate in activities like this again in the future.

The students' open response corroborated the findings. The parts that are considered the most interesting include "very good drawings to make with writing", "can be creative with your own imagination", "make unreasonable drawings", and "fun to be enthusiastic". Students assess the learning process as a fun, creative, and different activity from the art learning they are used to. The teacher confirms this by stating that students seem enthusiastic, more daring to experiment with ideas, and show high engagement during the learning process. This response indicates that AI-assisted digital art learning successfully creates a positive learning atmosphere that encourages active participation and creative expression. From the perspective of the Independent Curriculum, the majority of students stated that this learning was in accordance with their way of learning, as illustrated in Figure 1. A total of 18 students voted “Agree” and 19 students “Strongly Agree” on the statement *“This learning is in accordance with my way of learning in the Independent Curriculum”*, while only 4 students were in the disagree category. This shows that the integration of AI-based digital art is felt to be in harmony with learning principles that provide space for exploration, creativity, and differentiation.

Figure 1. Results of the Implementation of AI-Assisted Digital Art Learning

The Urgency of Using AI in Digital Art Learning

The results of the study show that the use of AI in digital art learning is seen as urgent from both the perspective of teachers and students. From the teacher's side, AI is understood not only as a technical tool, but also as a means to develop technological literacy, creativity, and students' readiness to face the demands of the 21st century within the framework of the Independent Curriculum. The teacher stated that "AI can increase learning motivation" and bring a more interesting and interactive learning element. Quantitatively, this urgency is reflected in the high motivation and interest of students. As many as 85% of students agreed or strongly agreed that this learning made them more excited to learn art, and all students admitted that they wanted similar activities to be repeated. In addition, 93% of students stated that AI helps them create artwork more easily. In the open-ended answers, students write down reasons such as "because I write anything and the AI can show it", "it's easier to make drawings", "the results are good", and "it's really fun for me to know how AI works".

Teachers also see that AI-assisted digital art learning is relevant to the needs of students in the digital era, as well as an entrance to introduce the concept of technological literacy in the context of the Independent Curriculum. Teachers call technological literacy the ability not only to use devices, but also to think critically, creatively, and responsibly in utilizing technology. Thus, the use of AI in digital arts is seen as able to bridge the need to strengthen competencies in the 21st century and the implementation of the Independent Curriculum at the elementary school level.

Challenges in Implementing AI-Assisted Digital Art Learning

Although the response of students and teachers was generally positive, the implementation of AI-assisted digital art learning still faces a number of challenges.

Challenges of Competence and Technology Literacy

From the student's side, the main obstacles that arise are related to technical mastery and the formulation of ideas. Some students admitted that it was difficult to "figure out how to draw", "decide what to draw", or "write what to type in AI". There are also students who say they are "lazy to think about the problem", showing that the process of formulating a meaningful prompt is still a challenge in itself. This indicates that in addition to the technical skills of operating the device, the ability to manage ideas and translate imagination into command sentences also needs to be developed.

On the other hand, from the Likert scale data, it appears that most students feel quite capable in the basic technical aspects. About 90% of students agree or strongly agree that they are able to operate a laptop or tablet well, and about 90% also state that they can use digital art or AI applications quite easily. However, there are still a small number of students who are in the disagree category, indicating a variety of abilities that require differentiation of support from teachers.

Teachers themselves admit that teacher readiness and the need to strengthen competence are also important factors. In interviews, teachers stated that the effectiveness of AI is highly dependent on teachers' ability to design learning, provide appropriate guidance, and prevent misuse of technology. Teachers emphasized the need for training and mentoring so that educators are more confident and skilled in utilizing AI in the classroom.

Challenges of Facilities, Infrastructure, and Infrastructure

Another prominent challenge is related to the availability of facilities and infrastructure. Teachers mentioned "facilities and infrastructure" as the aspects that need to be improved, especially related to the availability of devices, the quality of internet networks, and the readiness of school digital infrastructure. In some cases, students also suggested that learning be improved by being done "more often" or supported by "better and faster" AI features, which implicitly related to the technical limitations they experienced. Limited number of devices and network conditions can potentially affect the flow of learning, especially when many students have to access AI applications at the same time. This challenge requires schools to make more serious planning and investments in device procurement, network upgrades, and time management and learning schemes (e.g. through group work or rotation of device use).

Classroom Management Challenges and Ability Variations

Classroom management is also a challenge when students use digital devices and AI. The variety of digital literacy skills makes teachers need to provide different guidance for students who are faster and who are still struggling. Although about 83% of students feel they are able to work independently without much help from teachers, there are still students who need intensive support. This requires an adaptive classroom management strategy, for example by utilizing more proficient students as "peer tutors", as can be seen from the high percentage of students who agree to help friends who are struggling.

The Contribution of AI-Assisted Digital Art Learning to Students' Technology Literacy

In general, the results of the study show that AI-assisted digital art learning makes a real contribution to strengthening students' technological literacy, both in terms of knowledge, skills, and attitudes.

Improved Technical Capabilities and Understanding of AI

Most students stated that they understood that AI can help create drawings or artwork, about 95% of students agreed or strongly agreed with the statement. About 93–95% of students also felt they were able to create simple *prompts*, improve them to make the results more as desired, and use additional features in the AI app such as styles, colors, and effects. This shows that learning not only introduces the use of applications on the surface, but also builds functional understanding and feature exploration capabilities.

Teachers confirmed the increase in technology literacy by saying that students are "better able to distinguish between AI technology that is useful for schoolwork and not", and is more skilled in using technology for learning purposes. This means that technological literacy that develops is not only related to technical skills, but also to the ability to choose and utilize technology more wisely.

Strengthening Creativity and Confidence

AI-assisted digital art learning also contributes to strengthening aspects of students' creativity and confidence. About 95% of students agree or strongly agree that they can create digital artwork according to their ideas, and 95% express pride in the work they create. In addition, 95% of students feel more creative when creating digital artwork using AI. In the open-ended response, students described that AI helps them create images that are "nonsensical", "more interesting/good/unique", and according to their imagination. Teachers stated that students appear to be "more creative and confident in using technology", and that AI opens up space for students who previously lacked confidence in drawing manually to still be able to express their visual ideas.

Positive Attitude to Technology and Learning Independence

This learning also encourages a positive attitude towards technology and learning independence. About 88% of students feel confident when creating digital artwork, and 83% say they can work independently without much help from a teacher. Many students expressed that they wanted this learning to be repeated because it was "fun", "fun", "helps learn", and "makes me feel confident in showing artwork". Teachers assessed that the use of AI makes the learning process more varied and motivates students to be more active in asking questions, exploring, and discussing. This is in line with the principles of the Independent Curriculum which encourages student-centered learning, strengthening *agency*, and developing competencies in the 21st century.

Synthesis of Findings and Implications for Learning Practice

Overall, the results show that AI-assisted digital arts learning in elementary schools:

- Runs effectively and is in demand by students, with a very high level of satisfaction and desire to repeat activities.
- It has a strong urgency in the context of the Independent Curriculum because it can integrate aspects of creativity, technology, and learning independence at the same time.
- Facing challenges in the aspects of teacher competence, variations in students' digital literacy, and limited infrastructure and network infrastructure.
- Makes a significant contribution to students' technological literacy, both in technical ability to operate AI devices and applications, creative skills in digital work, as well as positive attitudes and confidence in the use of technology.

The practical implications of these findings are the need to:

- Strengthening training and mentoring programs for teachers to be more ready to design and facilitate AI-based learning.
- Development of school policies that support the provision of adequate digital devices and infrastructure.
- The integration of AI-assisted digital art learning is more systematic in the learning planning of the Independent Curriculum, not only as incidental activities or momentary projects.

Thus, AI-assisted digital art learning has the potential to be one of the innovative strategies to improve the technological literacy of elementary school students, as well as operationalize the spirit of the Independent Curriculum in daily learning practices.

AI-Assisted Digital Art: The Potential to Enhance Students' Creativity and Technology Literacy

The results show that the application of AI-assisted digital art learning provides space for elementary school students to express creative ideas freely, explore with new media, and produce visual works that were previously difficult to realize with traditional media. The findings also support the opinion that students who used AI-assisted digital art systems showed significant improvements in drawing skills, imagination, creative flexibility, and color quality compared to control students. According to human collaboration with AI in art, can expand the boundaries of creativity and encourage students to think reflectively about their work. AI here acts as a creative partner, not a substitute for human creativity. Thus, the use of AI in digital art not only increases access to art creation media, but also supports the formation of technology and art literacy, namely the ability of students to understand, evaluate, and use digital tools creatively and critically.

AI Literacy in Elementary Schools: The Foundations of 21st Century Competency

Research shows that students are not only using digital tools, but also able to formulate ideas (prompts), evaluate results, and revise their work independently. This indicates that the learning process has formed a deep technological literacy so that it is more than just basic literacy. These findings are reinforced by the fact that AI literacy includes a conceptual understanding of AI, the ability to collaborate with AI agents, computational thinking, data literacy, as well as ethical awareness of the use of AI. The AI-based art approach is an effective strategy for teaching AI literacy to students, as art allows for personal expression, aesthetic reflection, and critical evaluation of digital creations. This is in line with the opinion that the use of AI-Based Painting Technology can help children experiment, customize, and refine their work, which increases their capacity in visual creativity and metacognition. Thus, AI-assisted digital art learning is not only an art medium, but also a means of technological literacy and creativity in accordance with the needs of 21st century competencies in the era of digital transformation (Yim & Su, 2025; Wang et al., 2025).

Student Motivation, Engagement, and Self-Efficacy

One of the strengths of this research is the high motivation and involvement of students: almost all students admitted that they were happy, enthusiastic, and wanted to continue the learning. This is in line with research results showing that the use of AI in art education increases student engagement, curiosity, and confidence in their visual and creative abilities. AI as a learning tool offers quick feedback and interactive experiences. Two aspects that in the digital education literature are proven to increase intrinsic motivation and student engagement. The students' activeness in exploration and visual experimentation, as well as their willingness to constantly try and improve their work, show that this kind of learning not only enhances technical skills, but also builds a creative attitude, courage to express themselves, and a desire to learn so that quality is essential in 21st century education (Zeng et al., 2025).

Implementation Challenges: Teacher Competence, Infrastructure, and Creativity Ethics

Although the results of the study show many advantages, this study also found real challenges, including: limited teacher competence, limited facilities/infrastructure, and the potential for homogenization of work when using AI. These findings are in line with various critical studies on the integration of AI in art. Research reminds that while AI expands the possibilities of creativity, ethical aspects such as originality, copyright, and artistic integrity should be a top concern. Experimental studies from also show that although AI-based painting technology improves children's art performance, the limitations of the system's design (e.g. lack of personalization for children) can inhibit creative expression and create homogeneous results (Amini, 2025; Wang et al., 2025).

In addition, the literature on digital literacy and AI integration in primary schools emphasizes that teachers need to be equipped with the competencies to design, facilitate, and evaluate AI-based learning ethically and pedagogically. Thus, to maximize the benefits of AI-assisted digital art learning, teacher training support, adequate infrastructure, ethical guidelines, and curriculum design that pays attention to aspects of creativity, literacy, and copyright are needed (Yim & Su, 2025).

Implications for Education Curriculum and Policy

These findings and analysis have several important implications:

- The integration of AI-assisted digital art learning into the curriculum (e.g. in a national context such as the Independent Curriculum) can help build students' technological literacy and creativity from an early age according to the needs of the 21st century.
- Schools and education providers need to ensure infrastructure readiness (devices, connectivity) and provide training for teachers to implement AI effectively and ethically.

- It is important to develop ethical and pedagogical guidelines regarding the use of AI in the arts, so that students' creativity is valued, originality is respected, and AI does not replace the human creative thinking process.
- AI can be used as a tool to democratize the arts, providing opportunities for students who may not have the ability to draw manually, to continue to express and create digitally.

Overall, AI-assisted digital arts learning can be an integral part of the renovation of basic education towards digital literacy, creativity, and access equity when implemented with the right pedagogical design and policies.

4. Conclusion

This research shows that AI-assisted digital art learning can be effectively applied by elementary school teachers in the context of the Independent Curriculum. This prompt-based learning provides a space for students to explore, create, and produce digital artwork that suits their imagination. The high level of student engagement and motivation proves that AI is able to strengthen the art learning process while creating a more enjoyable and meaningful learning experience. In terms of urgency, the use of AI is relevant to the needs of 21st century competency development, especially creativity, problem-solving, and technological literacy. However, the study also found challenges related to teacher readiness, variations in students' abilities, and limitations of digital devices and infrastructure, so adequate training support and facilities are needed. Overall, AI-assisted digital art learning has been proven to contribute significantly to improving students' technological literacy, both in the technical ability to operate devices, understand how AI works, and build a confident and positive attitude towards the use of technology. Thus, this learning deserves to be developed as an innovative strategy to strengthen the implementation of the Independent Curriculum in elementary schools.

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