Implication of a Case Study using Generative AI in Elementary School: Using Stable Diffusion for STEAM Education

Unggi Lee, Ariel Han, Jeongjin Lee, Eunseo Lee, Jiwon Kim, Hyeoncheol Kim, & Cheolil Lim

DOI:10.59668/1269.15633

AECT
THE JOURNAL OF APPLIED INSTRUCTIONAL DESIGN

This research investigates the use of generative artifical intelligence (AI) in elementary school STEAM education. The workshop involved 46 students and in-depth interviews with 7 participants. The results show students found using AI for creative expression enjoyable and personalized, potentially improving the creative process. The study also highlighted concerns about ethics and bias in generative AI that need further investigation. This study suggests generative AI can enhance art education for elementary school students.

Introduction

In the realm of generative artifical intelligence (AI), two categories are primarily well-recognized: those which generate text and those which produce images. While ChatGPT, the leading example in the text-generating category, has received extensive attention for its potential in interactive learning and personalized tutoring, there is less focus on the educational applications of image-generating AIs like Stable Diffusion (Baidoo-Anu & Owusu, 2023). Various studies have touched upon the pros and cons of using ChatGPT, some viewing it as revolutionary, while others suggest AI tools must be used to cultivate unique human skills (Zhai, 2023). To capitalize on the benefits of AI in education, curriculum should include AI concepts, focus on fostering creativity and critical thinking, and adopt evidence-based strategies (Miao et al., 2021). There is growing academic interest in utilizing AI in art education, especially as AI-generated content becomes more accessible (Ali et al., 2021; Fadel et al., 2019).

STEAM was coined, incorporating the "A" for humanities and arts into STEM education, designed to emphasize the integration of engineering and technology strategies to solve problems using concepts and procedures from science and mathematics (Aguilera & Ortiz-Revilla, 2021). The benefits of STEAM education, especially in early childhood and primary education, are that learning becomes more relevant to real life and fosters creativity (Dejarnette, 2018; Mohana et al., 2022; Shatunova et al., 2019). How and Hung (2019) emphasize most research in Artificial Intelligence in Education (AIED) focuses on empirical investigations which employ computer programs or robots to provide specific knowledge in STEM. Similarly, a study by Jang et al. (2022) underlines the value of AIED in STEM education in content and methodology. This study also advocates for integrating STEAM with AIED by proposing a K-12 educational model which does so. However, the field still needs more research on STEAM-focused AIED and relevant case studies.

Moreover, there needs to be more research exploring the use of generative AI within STEAM education. Therefore, there still needs to be more case studies on the design of classes incorporating AI in the STEAM context. In light of these needs, this study seeks to ascertain learners' reactions to generative AI and to identify the implications of these reactions for class design.

The study aims to examine the applicability and efficacy of leveraging generative AI tools in learning settings, mainly focusing on artistic expression for elementary school students. In this study, a qualitative method approach was employed. The first step involved a comprehensive literature review in gathering information on the use of generative AI in education and related concepts such as creativity, literacy, and the role of AI in enhancing students' artistic abilities. This information was then used to inform the design of a lesson plan for teaching an interdisciplinary class incorporating generative AI.

Method

The workshop occurred at an elementary school in Incheon, South Korea. Forty-six students participated in the one-day workshop for 90 minutes as part of an after-school program (Female: n=22, Male: n=24) ages between 10 to 11 years old in 5th grade. We conducted semi-structured interviews with seven students to understand students' thoughts and impressions of the workshop. We interviewed the seven students because of their quality and rigor in the project, as recommended by educators.

The workshop consisted of a warm-up, practice, creating artwork, and writing imaginative diaries. The workshop started with an introduction to the AI techniques it was anticipated students would use. The researchers used Dream Studio, a web application which generates images using Stable Diffusion, as a generative AI tool. Students were also introduced to Google Translate (since most students' native languages are Korean) and Google Docs to prepare and document their diary entries. We designed a prompt manual inspired by the previous study (Liu & Chilton, 2022) and gave it to the students. We asked them to consider three components: subject, additional explanation, and trend of art, and to generate prompts using Google Translate. Before inputting the prompts, we designed a prompt manual to give to the students, asking them to consider three components: subject, additional explanation, and trend of art, and to generate prompts using the translator. After that, the students were asked to generate images using Stable Diffusion (Stability AI, 2023) by typing in prompts as input as many times as they wanted. After selecting the most desirable outcomes, students began documenting their diary stories with the generated AI images.

The researchers took field notes during the workshop and collected students' artifacts for creating an imaginary picture diary. We video-recorded the semi-structured interviews and transcribed the script. The research team analyzed interview data using a thematic analysis technique (Creswell & Poth, 2017), categorizing the themes using deductive coding procedures. Using thematic analysis of the interview transcript and observations from the workshop, we have classified the themes into three categories (engagement, expressiveness, and effectiveness). We coded inductively based on the themes which emerged from the transcript to understand the efficacy of the generative arts AI in learning settings.

Result

After an interview with students, we found that their experiences with AI in creative art programs significantly impacted their perspective on learning and expression in three ways. First, using AI in the creative process enhanced their interest and participation. The analysis revealed that most students showed interest in leveraging AI in creative expression. Students stated that the activities were fun and exciting because they used the new tools (i.e., AI art generator) as they learned to create images. For example, P2 mentioned, “The tool is marvelous and so autonomous!”

Most students stated the experience was unique and original, and they were willing to continue learning more about using AI for creative expression. As students explained, the activity allowed them to create unique images, supporting personalized learning. The study showed art generators used with AI systems further initiated the learning process of AI systems and boosted youths’ perceptions about how to collaborate with AI. As P5 stated,

> *“Okay, first, because AI doesn’t have a brain or mind so my first assumption was that AI couldn't do any creative work, but I was surprised at how it generated such a creative and unique piece of work.”*

A second impact on students' perspective of their learning dealt with the capability of AI to extend human imagination in art creation. We highlighted expressiveness to understand whether the AI art generator could create expressive image outputs and investigate whether students thought the image result aligned with their own intentions regarding artistic expressions. P2 mentioned, “This is cool, it generates images that I didn’t even imagine.” P4 stated, “The AI generates things that I don’t even know exactly”, implying the means of expanding one's imagination.

Two distinct views of expressiveness (i.e., positive and negative) emerged. Students (n=4) stated they thought AI art generators created images as they imagined or even better than they initially anticipated, which allowed them to enhance their creative expressions. The other three students, though, claimed that AI somehow generated awkward visuals, suggesting a need for researchers to investigate further the issues around ethics and bias in AI art generators and appropriateness for education with youth (Ali et al., 2021).

Third, the AI tools increased the efficiency and convenience of the creative process. In order to examine the efficacy of the learning program designed using generative art AI tools to create picture diaries, we sought to understand the students' perspectives. The interview data revealed most students saw the great potential of using the tool to make their creative process easy and fast. P1 and P3 mentioned,

> *“If I needed to draw by hand like this, I would have hurt my hands and gotten tired, but AI does it so easily without giving me any stress on how to make it all by myself.”.*

> *“I like AI art generators because I get to choose the one that I like the most from many options as they generate images as fast as I want, it’s so convenient because I don’t need to spend a ton of time.”*

Discussion

The study examines the applicability and efficacy of leveraging generative AI tools in learning settings, mainly focusing on artistic expression for elementary school students in a class setting. We found workshop experiences with AI in creative art programs affected students’ perspectives on learning and artistic expression. Firstly, the students were fascinated by what generative AI could do for their creative expression, which inspired their enthusiasm and motivation towards art activities. In addition, students highlighted the efficiency of leveraging generative AI for their art activities to enhance their ideation and iterative design processes. However, there are contradictory views regarding AI-generated art, Some students pointed out AI did not generate as they intended, yet they are willing to customize and edit by themselves. Others suggested they want more agency over their creations. As a result, we developed design implications which enable students to openly edit and customize their art pieces, thereby co-creating with AI. Another implication is the need for promotion of generative AI literacy education (i.e. ability to understand and use the system). Also, students should be engaged in various methodologies to develop better prompts which may impact their results to improve child-AI co-creative interaction through prompt engineering education. The study results remain limited due to the small sample size and certain socioeconomic status. (The study took place in a privileged location with high STEM education demand.) It also emphasizes the importance of careful and ethically informed tool selection and implementation, ensuring the technology enriches the educational experience without inadvertently introducing biases or limiting students' creative potential. As researchers and educators continue to explore the intersection of AI and art, it will be essential to prioritize student feedback, adapt to their needs, and remain vigilant about this technological integration's potential pitfalls and challenges. Nevertheless, it would be worthwhile to investigate how AI-infused art-based STEM education can be accessible to a broader audience.

Conclusion

Generative AI has shown promising potential in STEAM education for elementary students, particularly in creative arts (Lee et al., 2023). Incorporating AI into creative programs boosts students' interest due to the novelty and potential of the tools. Generative AI tools, which can often amplify or surpass a student's artistic vision, offer excitement and challenges. While many students appreciate the unexpected creativity, some find the outputs must be aligned with their intent, highlighting the need to address AI's ethical and bias implications. Additionally, AI allows students to rapidly explore creative possibilities, removing manual skills and time constraints.

In summary, while generative AI can significantly enhance STEAM education, educators must balance its advantages with ethical considerations. Future studies should delve deeper into the nuances of how AI interacts with student creativity, aiming to address and rectify any biases and ethical concerns. Additionally, understanding the long-term implications of AI integration in STEAM education will be crucial to ensure a balanced and holistic learning experience.

References

Aguilera, D., & Ortiz-Revilla, J. (2021). STEM vs. STEAM education and student creativity: A systematic literature review. *Education Sciences, 11*(7), 331. https://doi.org/10.3390/educsci11070331

Ali, S., DiPaola, D., & Breazeal, C. (2021, May). What are GANs?: introducing generative adversarial networks to middle school students. In *Proceedings of the AAAI Conference on Artificial Intelligence, 35*(17), 15472-15479. https://doi.org/10.1609/aaai.v35i17.17821

Baidoo-Anu, D., & Owusu Ansah, L. (2023). Education in the era of generative artificial intelligence (AI): Understanding the potential benefits of ChatGPT in promoting teaching and learning. *Journal of Artifical Intelligence, 7*(1). http://dx.doi.org/10.2139/ssrn.4337484

Creswell, J. & Poth, C. (2017). *Qualitative Inquiry and Research Design: Choosing Among Five Approaches* (4th Edition). SAGE Publications, Thousand Oaks, CA.

DeJarnette, N. K. (2018). Implementing STEAM in the early childhood classroom. *European Journal of STEM Education, 3*(3), 18. https://doi.org/10.20897/ejsteme/3878

Fadel, C., Holmes, W., & Bialik, M. (2019). *Artificial intelligence in education: Promises and implications for teaching and learning*. The Center for Curriculum Redesign, Boston, MA.

Han, A., & Cai, Z. (2023). Design implications of generative AI systems for visual storytelling for young learners. In *Proceedings of the 22nd Annual ACM Interaction Design and Children Conference (*pp. 470-474). https://doi.org/10.1145/3585088.3593867.

How, M. L., & Hung, W. L. D. (2019). Educing AI-thinking in science, technology, engineering, arts, and mathematics (STEAM) education. *Education Sciences, 9*(3), 184. https://doi.org/10.3390/educsci9030184

Jang, J., Jeon, J., & Jung, S. K. (2022). Development of STEM-Based AI education program for sustainable improvement of elementary learners. *Sustainability, 14*(22), 15178. https://doi.org/10.3390/su142215178

Lee, U., Han, A., Lee, J., Kim, J., Lee, E., Kim, H., & Lim, C. (2023). Prompt aloud!: Incorporating image-generative AI into STEAM class with learning analytics using prompt data. *Education and Information Technologies*. https://doi.org/10.1007/s10639-023-12150-4

Liu, V., & Chilton, L. B. (2022, April). Design guidelines for prompt engineering text-to-image generative models. In *Proceedings of the 2022 CHI Conference on Human Factors in Computing Systems* (pp. 1-23).

Miao, F., Holmes, W., Huang, R., & Zhang, H. (2021). *AI and education: A guidance for policymakers*. UNESCO Publishing. https://doi.org/10.54675/PCSP7350

Mohana, M., Nandhini, K., & Subashini, P. (2022). Review on artificial intelligence and robots in STEAM Education for early childhood development: The state-of-the-art tools and applications. In *Handbook of Research on Innovative Approaches to Early Childhood Development and School Readiness* (pp. 468–498). IGI Global. https://doi.org/10.4018/978-1-7998-8649-5.ch019

Stability AI. (2023, Feb, 19). *Stable Diffusion*. Stability AI. https://stability.ai/blog/stable-diffusion-public-release

Zhai, X. (2023). Chatgpt for next generation science learning. *XRDS: Crossroads, The ACM Magazine for Students, 29*(3), 42–46. https://doi.org/10.1145/3589649