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Leveraging Artificial Intelligence and the Arts to Enhance Critical Thinking in Primary Geography Education

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Abstract: This study investigates innovative educational interventions primarily leveraging advanced artificial intelligence tools to foster critical thinking in primary school Geography lessons. Complemented by various art forms, such as dramatic arts, painting, and music, these interventions engaged a sample of 46 students through 12 carefully designed instructional scenarios. The effectiveness was evaluated using a rigorous mixed-methods approach, combining quantitative data with qualitative tools. Results reveal significant improvement in critical thinking skills, alongside increased student engagement and positive attitudes towards learning, underscoring the transformative potential of integrating artificial intelligence with the arts as a holistic educational strategy for young learners.

Keywords: Artificial Intelligence, Artistic Activities, Critical Thinking, Geography Education, Educational Intervention, Mixed-Methods Research, Educational Technology



Introduction

Critical thinking is now a core goal in education, helping students manage information overload, rapid tech changes, and complex social issues. In primary education, developing skills like interpretation, evaluation, reasoning, and problem-solving empowers students as independent thinkers (Susanti, 2024). The main challenge is creating teaching methods that are age appropriate yet engaging and transformative. Recently, interdisciplinary approaches combining artificial intelligence and creative arts have gained attention (Saiz & Rivas, 2023; Yim, 2024). Artificial intelligence offers powerful tools for personalized teaching, feedback, and supporting complex learning, especially when human-centered and pedagogically sound, fostering higher-order skills like metacognition, creativity, and critical evaluation (Jafari, 2024). Artificial intelligence's advanced information-processing mirrors key human learning processes (UNESCO, 2024). Meanwhile, the arts encourage authentic, emotionally rich, collaborative learning through activities like drama, visual arts, and music, helping students engage multisensorily and cognitively (Lenakakis, 2024).

This study explores the potential of a hybrid teaching framework that combines AI and the arts in Geography to enhance critical thinking. Using twelve interdisciplinary teaching scenarios with 11-year-old students and a mixed-methods approach, it examines how this method fosters cognitive engagement, develops critical skills, and improves students' attitudes toward knowledge and learning.

Review of Current Research and Literature

Recent research increasingly explores the intersection of Artificial Intelligence, arts, critical thinking, and education. The article *Artificial Intelligence Literacy in Primary Education: An Arts-Based Approach to Overcoming Age and Gender Barriers* (Yim, 2024) underscores the value of transdisciplinary, arts-based methods in teaching AI literacy. It shows how such approaches can help overcome age and gender disparities, deepen conceptual understanding, and foster reflective thinking. Similarly, *The Challenges of Critical Thinking in the Era of Artificial Intelligence* (Kenedy, 2024) addresses the pedagogical implications of AI's growing presence, calling for active, reflective teaching strategies that build students' critical thinking capacities. In a related context, Chang and Kidman (2023) investigated the use of ChatGPT as a language-based AI tool in the teaching of Geography. Their study highlights how AI can support both cognitive and emotional development, particularly when addressing contemporary environmental challenges. Complementing this, Stampfl et al. (2024) employed ChatGPT as a supportive tool in arts-based role-playing activities, with results indicating a notable enhancement of participants' critical thinking skills. The above studies highlight the importance of developing human-centered, creative, and inclusive pedagogical frameworks that combine artificial intelligence and the arts, enhancing critical thinking and essential cognitive skills.

Research Aim and Research Question

The present study aimed to investigate the impact of Artificial Intelligence (AI) tools and arts on the development of critical thinking skills among 11-year-old students during the 6th grade Geography course. The central research question guiding this inquiry was: "To what extent and in what ways can



an educational intervention program, based on the integration of AI tools and artistic activities, enhance the critical thinking skills of 6th grade students in the context of Geography?" To address this question, a mixed-methods research approach was adopted, combining both quantitative and qualitative methods to provide a more comprehensive understanding of the phenomenon under study.

Research Methodology

A quasi-experimental design was employed to measure the intervention’s effectiveness through pre- and post-assessment, while qualitative data from observations and student reflections provided deeper insights into critical thinking during the activities. A literature review established the theoretical framework, research objectives, and twelve intervention sessions combining Artificial Intelligence tools and artistic activities such as drama, painting, and music to engage sixth-grade students. Critical thinking was defined as the dependent variable, with Artificial Intelligence and artistic activities as independent variables. Convenience sampling involved 46 students (22 control group, 24 experimental group), with all necessary permissions obtained. Quantitative data were collected using a revalidated questionnaire covering the five critical thinking skills under investigation: observation, induction, reliability assessment, abstraction, and problem solving. Qualitative methods included the critical friend technique, research diary, participant observation, focus groups, storytelling, hot-seating, and the AI platform Character AI. The questionnaire was administered before and after the two-month intervention, which was integrated into the Geography curriculum. The study concluded with analysis and dissemination of results based on the collected data.

Quantitative and Qualitative Data Analysis

During the final research phase, quantitative data from student questionnaires were processed and analyzed using Jamovi (v2.6.44) and R. Due to the small sample size ($n < 50$), the Shapiro-Wilk test showed the data were not normally distributed ($p = 0.018$). Therefore, the non-parametric Mann-Whitney U test was used to compare critical thinking performance between control and experimental groups before and after the intervention. Results showed no significant difference in pre-test scores between the control ($M = 11.682$, $SD = 1.887$) and experimental groups ($M = 12.625$, $SD = 2.901$), with $U = 192$ and $p = 0.052$, indicating comparable baseline performance [Table 1].

Table 1

Results of the normality test and Mann-Whitney U test for both groups based on overall performance in the pre-tests.

Mann-Whitney U						
Post-test Score		U				P
		192				0.052
Descriptive Data per Group						
	Group	N	Mean	Median	SD	SE
	Control	22	11.682	12.000	1.887	0.402



Score	Experimental	24	12.625	12.000	2.901	0.592
Post-Test						
Normality Test				p		
Shapiro-Wilk				0.018		

The normality test revealed that the data did not follow a normal distribution ($p = 0.023 < 0.05$); therefore, the non-parametric Mann-Whitney U test was applied to compare the performance of the two groups. The results indicated a statistically significant difference in overall performance scores between the control group ($M = 10.636$, $SD = 4.846$) and the experimental group ($M = 13.208$, $SD = 2.484$), with $U = 168$ and $p = 0.017 < 0.05$ [Table 2]. These findings suggest that the instructional interventions implemented in the experimental group had a significant positive impact on students' overall post-test performance.

Table 2

Results of the normality test and Mann-Whitney U test for both groups based on overall performance in the post-tests.

Mann-Whitney U						
Post-Test Score		U				P
		168				0.017
Descriptive Data per Group						
	Group	N	Mean	Median	SD	SE
Score Post-Test	Control	22	10.636	11.000	4.846	1.033
	Experimental	24	13.208	13.500	2.484	0.507
Normality Test				p		
Shapiro-Wilk				0.023		

Qualitative data were analysed using Thematic Analysis, enabling the identification and coding of recurring patterns, which were then organised into thematic categories. Within the context of the sixth-grade Geography curriculum, students engaged with AI tools and artistic techniques to explore environmental issues. This process enhanced their ability to identify key elements of each scenario, recognise emotional and narrative nuances, and develop empathy and attention to detail. Students' spontaneous comments, such as "I discovered something!" or "Let's investigate," reflected emerging critical thinking. Exposure to conflicting information sources—via digital content or role-play prompted them to question, verify, and reinterpret data. They also drew on personal experiences to understand character motives and build reasoned arguments, showing growing skills in analysis, inference, and reflection. A final triangulation of qualitative and quantitative findings informed the study's conclusions.



Conclusions

The findings of this study confirm the significant impact of the combined use of Artificial Intelligence and artistic activities on the development of students' critical thinking in primary education. The implementation of innovative instructional scenarios integrating AI-powered digital tools with artistic methods such as theatre, painting, and music–enhanced students' active participation and creativity. Moreover, the study contributes to the emerging field of human-centered AI in education (Anastasiades et al., 2024), highlighting its pedagogical potential when applied meaningfully. The study highlighted the importance of an interdisciplinary approach and the careful selection of educational tools that align with the developmental needs of children. In addition, the qualitative data offered deeper insight into students' engagement in complex cognitive processes. Overall, critical thinking was effectively fostered throughout the intervention. Future research could expand this study to larger samples and diverse educational contexts, while also examining the long-term impact of such interventions on students' learning trajectories.

References

- Anastasiades, P., Kotsidis, K., Stratikopoulos, K., & Pananakakis, N. (2024). Human-centered artificial intelligence in education: The critical role of the educational community and the necessity of building a holistic pedagogical framework for the use of HCAI in the education sector. *Open Education - The Journal for Open and Distance Education and Educational Technology*, 20(1), 29-51. <https://doi.org/10.12681/jode.36612>
- Chang, C. H., & Kidman, G. (2023). The rise of generative artificial intelligence (AI) language models - challenges and opportunities for geographical and environmental education. *International Research in Geographical and Environmental Education*, 32(2), 85-89. <https://doi.org/10.1080/10382046.2023.2194036>.
- Jafari, E. (2024). Artificial intelligence and learning environment: Human considerations. *Journal of Computer Assisted Learning*. Advance online publication. <https://doi.org/10.1111/jcal.13011>.
- Kenedy, R. A. (2024). The challenges of critical thinking in the era of artificial intelligence. *European Journal of Multidisciplinary Studies*, 9(2), 19-36. <https://doi.org/10.26417/hfdngd20>.
- Lenakakis, A. (2024). The contribution of drama/theatre pedagogy in revealing and enhancing the social role of art in education. In V. Pavlou (Ed.), *Critical arts education for sustainable societies: A handbook for arts educators* (pp. 83-93). Frederick University.
- Saiz, C., & Rivas, S. F. (2023). Critical thinking, formation, and change. *Journal of Intelligence*, 11(12), 219-245. <https://doi.org/10.3390/jintelligence11120219>.
- Stampfl, R., Geyer, B., Deissl-O'Meara, M., & Ivkić, I. (2024). Revolutionising role-playing games with chatgpt. *Advances in Artificial Intelligence and Machine Learning; Research*, 4 (2), 2244-2257. <https://doi.org/10.48550/arXiv.2407.02048>.



- Susanti, R. (2024). Effective strategies in developing critical thinking skills in elementary school age children. *West Science Interdisciplinary Studies*, 2(4), 732-736.
- Yim, I. H. Y. (2024). Artificial intelligence literacy in primary education: An arts-based approach to overcoming age and gender barriers. *Computers and Education: Artificial Intelligence*, 7, 100321. <https://doi.org/10.1016/j.caeai.2024.100321>
- UNESCO. (2024). *Artificial intelligence and the futures of learning*. <https://www.unesco.org/en/digital-education/ai-future-learning>.