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Integrating Augmented Reality Into Visual Arts Education Among Elementary Students: A Comparison With Traditional Teaching and an Examination of Learning Style and AR Conceptual Model

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Summary

This study explores the integration of augmented reality (AR) into elementary school visual arts education, comparing its effectiveness with traditional instruction while examining the role of students' learning styles. With the growing prevalence of digital tools and mobile devices, AR has emerged as a promising medium for creating immersive, interactive learning experiences that enhance motivation and reduce cognitive load. Recognizing this potential, the research focused on evaluating how different AR conceptual models and varying learning style preferences influence students' learning outcomes.

The research was conducted in two experimental phases. The first phase compared traditional lectures with AR-assisted teaching methods. AR applications (App) were classified into three interface conceptual modes: observational (students explore artworks by moving their device around the object), exploratory (students navigate through virtual gallery spaces or 3D models), and selfie-based (students interact with virtual elements through facial recognition or body gestures).

The second phase considered students' learning styles, measured using the VARK (visual, aural, reading/writing, kinesthetic) framework. Based on their preferences, participants were

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categorized into single-mode, dual-mode, triple-mode, and quadruple-mode learning style groups. The study then examined how the interplay between AR modes and learning styles affected learning motivation and cognitive load.

The sample included 108 elementary school students from four classes in Taiwan. One class received traditional instruction using textbooks and slides, while three classes experienced AR-assisted teaching integrated with visual arts lessons. AR App were drawn from Google's Arts & Culture App, specifically the Pocket Gallery (exploratory), Art Projector (observational), and Art Filter (selfie). Each AR mode was paired with a specific art unit designed to develop aesthetic appreciation, color recognition, and contextual understanding of artworks. The instructional units spanned nine weeks, with both control and experimental groups taught by the same teacher to ensure consistency. To measure outcomes, validated questionnaires assessed students' learning motivation and cognitive load. Motivation was evaluated using Keller's ARCS (attention, relevance, confidence, satisfaction) model, while cognitive load was measured through perceived mental load and mental effort. Statistical analyses, including *t*-tests and two-way analysis of variance (ANOVA), were used to examine differences between groups and conditions.

Results consistently demonstrated that AR-assisted teaching outperformed traditional instruction in both motivating learning and reducing cognitive load. Across all AR modes, students reported greater engagement and satisfaction with lessons, highlighting AR's capacity to create immersive and meaningful learning contexts. Specifically, observational AR was particularly effective at stimulating attention and satisfaction, offering learners a compelling way to visualize artworks within their real-world environment. In contrast, Exploratory AR was associated with lower mental effort, allowing students to navigate virtual galleries in a more cognitively manageable way. Selfie-based AR provided highly interactive experiences but was less effective than the other modes in reducing cognitive demands.

Learning style preferences further influenced these outcomes. Students with single-mode preferences, who rely on only one sensory channel, such as visual or auditory, reported higher levels of mental load and effort, indicating they were more easily challenged by AR interactions. In contrast, those with dual-, triple-, or quadruple-mode learning styles benefited more, as the multimodal features of AR aligned with their ability to process information through multiple channels. These learners felt more relevant and confident, suggesting that AR's multisensory affordances are especially advantageous for multimodal learners.

The findings underscore several key contributions. First, AR integration enhances learning motivation and reduces cognitive load more effectively than traditional teaching in visual arts

education. Second, different AR conceptual modes exert distinct effects: observational AR excels in attracting attention, exploratory AR minimizes cognitive strain, and selfie-based AR maximizes interactivity. Third, learning style differences play a moderating role, with multimodal learners deriving greater benefits from AR environments. This implies that while AR is universally beneficial, its impact can be optimized by tailoring teaching to learners' individual preferences.

The study's implications are twofold. For educators, AR provides an effective tool for enriching art instruction, transforming abstract concepts into tangible, interactive experiences that stimulate curiosity and sustained engagement. Teachers should consider aligning AR modes with lesson objectives: Observational AR for detailed appreciation, exploratory AR for contextual immersion, and selfie-based AR for personal connection and role-play. Additionally, understanding students' learning style distributions can help teachers select appropriate AR tools and provide differentiated support to reduce overload among single-mode learners. For educational researchers, the study expands the literature on technology-enhanced learning by combining conceptual mode analysis with learning style theory. It highlights the need to go beyond comparing "AR versus non-AR" teaching, instead examining how variations in AR design and learner characteristics shape outcomes. This nuanced approach contributes to designing more effective digital learning interventions and informs future studies on AR's pedagogical role.

In conclusion, introducing AR into elementary visual arts education significantly promotes learning motivation and alleviates cognitive load compared with traditional methods. Observational and exploratory AR modes provide unique advantages, and multimodal learners are especially well-suited to benefit from AR's multisensory design. These results support AR's integration as a valuable pedagogical tool in art education and suggest broader implications for technology-enhanced teaching across subjects.