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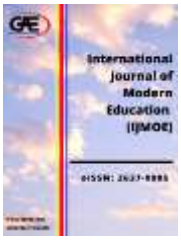

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EVALUATING A MULTIMEDIA-AIDED AI-INTEGRATED APPROACH TO ENHANCE ENGAGEMENT AND LEARNING OUTCOMES IN SHAANXI ART EDUCATION

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Abstract:

The rapid advancements in artificial intelligence will bring further changes within the field of educational technology in terms of how effectively students learn, the amount of hands-on experience gained, and the breadth of disciplines integrated into the learning experience. Art educators in Shaanxi province, China face the challenge of educational technology's potential generational gap, the distance and access divide, the time costs of teaching methods, and the pedagogy of art educators. Incorporating artificial intelligence in art education is of course an educational technology change that is taking place. This is a unique way of assessing the impact of a multimedia-assisted, artificial intelligence integrated approach in art education on the level of engagement and learning outcomes of students at the higher education level in Shaanxi, China. The research focused on 50 undergraduate (control group=25, experimental group=25) art students from Shaanxi. While the control group received traditional instruction using only PowerPoint presentations, the experimental group utilized a multimedia-assisted approach integrated with artificial intelligence. The peer collaboration of the students was measured at five intervals over the course of the semester using the LMS and a Likert scale survey wherein students rated peer collaboration. The use of multimedia and artificial intelligence (AI) also increased learning engagement in students. Specifically, students in the experimental group spent 14.88 more minutes learning than students in the control group. The experimental group had 13 more discussion contributors. Additionally, the experimental group had less distractibility (6.84 points less) and test anxiety (7.53 points less) than the control group. Overall, learning

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outcomes, as evidenced by creative projects, critical thinking, and collaboration, were also more positive in the experimental group, as were retention and overall academic performance. Therefore, the multimedia approach integrated with AI is highly effective in improving engagement and learning outcomes in art education in Shaanxi.

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Keywords:

Art Education; Cognitive Theory of Multimedia Learning; Engagement; Multimedia-Aided AI-Integrated Approach

Introduction

The last few years have seen changes in the role of artificial intelligence (AI) in education shifting from a theoretical concept to a tangible reality. Rapid changes in machine learning and generative AI tools, alongside immersive multimedia technologies, have transformed the global digital landscape, shifting the manner in which information is disseminated, experienced, and retained. In particular, the field of art education is transformed, offering emerging technologies the ability to create a highly customizable, deeply interactive, and culturally responsive learning environment.

At the 2025 World Digital Education Conference on 16 May 2025, the Ministry of Education of the People's Republic of China, in conjunction with the China AI Art Education White Paper, asserted that the Chinese educational art system had, for the first time, entered the age of intelligence. This guided document outlined the need not to pose the question of whether or not AI should be used in education, but to focus on the application of AI in ways that enhance educational outcomes for students and protect the culturally defined educational objectives.

The diverse forms of artistic expression within the province of Shaanxi in China, such as paper cutting, puppet shows, embroidery, clay figurine making, drum dancing, and the famous Qinqiang opera, present an opportunity and challenge for AI-enhanced education. Many of the aforementioned art forms have recently been included in China's national list of intangible cultural heritage. While this recognition is a great opportunity for the preservation of the art forms, it also presents significant challenges. The foremost challenge is the generational gap, where today's learners, who are heavily immersed in digital environments, often view these traditional art forms as being distant and irrelevant (Sun et al. 2022; Zhang & Liu 2024). Additionally, the geographical and socio-economic barriers also limit the transmission of the various art forms and skills to a greater community. The traditional model of master and

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apprentice is very localized and does not extend beyond certain community confines (Wang & Chen, 2025). A final factor that must be taken into consideration is the significant amount of time required for traditional forms of teaching. The need for prolonged periods of in-person teaching can disincentivize participation (Li & Wang, 2023).

The challenges described above illustrate the preservation paradox for intangible cultural heritage. While the survival of the art forms requires a broad global reach, the traditional forms of teaching that preserve the art forms are localized and very difficult to replicate at scale.

Technologies related to AI and multimedia can solve this problem. Multimedia, in this instance, means the combination of different modalities such as texts, pictures, videos, and sounds which together create a meaningful and organized learning experience (Zhao & Seong, 2024). With the help of high-fidelity digital documentation, nuanced artistic techniques can be preserved. AI can further personalize learning, providing feedback in real time as learners navigate through different cognitive and motor activities such as intricate patterns in paper cutting or the vocal ornamentation of Qinqiang opera.

Mayer's Cognitive Theory of Multimedia Learning (CTML) guides this study (Mayer, 2024). In managing cognitive load and employing dual coding (visual and verbal), multimedia and AI fusion can optimize multimedia learning. The theory of cognitive load, in relation to multimedia, offers a balanced, systematic approach, aligning the design of multimedia instructional and AI components, such as interactive graphics and responsive adaptive feedback, to the human cognitive architecture, balancing or alleviating cognitive loads, or working memory, and engaging learners meaningfully through a combination of visual and verbal articulations.

Research Purpose

The purpose of this research is to evaluate the extent to which a multimedia-aided AI-integrated approach improves engagement and learning outcomes in Shaanxi art education at the college level. The study seeks to answer three key questions:

1. To what extent does the approach enhance students' engagement compared to traditional multimedia teaching?

2. What measurable differences exist in learning outcomes—such as creative thinking, technical skill, and collaboration—between the two approaches?

3. How might these findings inform strategies for the preservation and revitalization of Shaanxi's intangible cultural heritage?

Research Design Overview

Fifty (50) undergraduate students majoring in Shaanxi art were part of a one semester quasi-experimental study. The students were randomly placed in a Control Group (CG, n=25) who, as a group, continued with the traditional instruction using PowerPoint presentations, and an Experimental Group (EG, n = 25) who, as a group, used AI-enhanced multimedia instruction with adaptive learning modules, VR rehearsal simulations, and paired collaborative learning on digital platforms. Both quantitative and qualitative data were used to triangulate the results.

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In other words, this study integrated, for the first time, the pilot study's real time AI platform analytics with student self-reports and instructor monitoring, to provide evidence on the impact of AI on higher art education. On the other hand, it proposes a culturally motivated, scalable pedagogical model that addresses the needs of digitally savvy learners while also meeting the culture-preserving objectives of education.

Literature Review

Art Education in Context

Art education may be understood in different ways. For example, it may be understood as training in a profession, as a means to develop and nurture artistic skills, as training for the cultivation of professional artistic skills, or, as a means to develop professionally. It can also, more narrowly, be understood as a form of aesthetic education to develop, nurture and foster creative, cultural, and holistic growth of the individual. For the purposes of this study, the narrower definition is used, with a focus on art education as a means of developing the individual's cognitive, emotional and social skills, more in the non-vocational area than in the vocational area (Rong et al., 2022).

Art education in China has different forms, including painting, sculpture, performance, and craftwork. These forms of artistic expression are often integrated into the local rural folk culture. For example, the Shaanxi artistic forms, including the Qinqiang opera, Huayin shadow puppets, paper-cutting, and rattan weaving, are examples of centuries-old artistic forms of Shaanxi, China and are considered to be a part of the national intangible cultural heritage. While the value of the culture of these expressed artistic forms is undeniable, so is the value of the culture of the individuals who do these forms. The culture is being lost. The participants are predominately children, and the situation is a direct result of modern influences such as globalization, movement to cities and digital entertainment.

Challenges In Traditional Art Pedagogy

In Shaanxi, the traditional art teaching employs a master-apprentice methodology, where the apprentice learns through long-term face-to-face interactions with the instructor. While such a technique guarantees high skill replication, the methodology suffers from scalability. Due to a resource deficiency, a narrowed scope of materials, and a focus of teaching around the instructor, students' ability to probe and stretch their capabilities are often hampered (Asare et al., 2023; Erickson, 2005). Significant obstacles are access, prolonged training, a lack of exposure, and inadequate assessment. From an access perspective, students are often required to travel to a specific geographical area or apprentice under a particular master. These obstacles impede the circulation of traditional art. In addition, with a high degree of excellence, training takes a very long time to complete because full attainment of all the desired skills takes several years of unbroken practice. The rapid pace of technological change contradicts the philosophy of traditional art education that emphasizes long periods of committed practice. Lastly, a major barrier is that learners often encounter very few artistic forms.

These methods try to avoid rote learning and technical skill building to encourage deep learning and critical thinking, but are more time intensive and closer to pedagogy, while resource investment and exposure to diverse elements still remain substantial (Asare et al., 2023; Erickson, 2005; Clark & Mayer, 2023). Finally, there are gaps to be assessed, which are still

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most relevant here. Traditional methods of evaluation tend to emphasize low value and often do not consider the potential for creativity and collaboration (Candy, 2014). In traditional education of the arts, mastering a technical skill and craftsmanship, wonlyis the most basic, fundamental, and traditional form of evaluation, is the most important and often, the only, consideration. Furthermore, traditional methods often emphasize the ability to replicate specific techniques of certain masters or particular styles of an artistic movement. Little to no emphasis is given to creativity and/or collaboration.

These restrictions are especially pertinent given the digitally focused interior design practices of learners, which encourage interactive engagement with multi layered media and allow for more individualized explorative approaches.

Multimedia Learning and Cognitive Load Theory

Mayer's Cognitive Theory of Multimedia Learning (CTML) illustrates how multimedia can facilitate learning by capturing both the verbal and picture (visual) thinking channels (Mayer & Moreno, 1998; 2003; Mayer, 2024). According to CTML, learning is said to have occurred when students select relevant details, organize these details into a meaningful structure, and integrate them with previous knowledge.

Sweller's Cognitive Load Theory (Sweller, 1989; Sweller et al., 1994) warns about the design elements of the multimedia and the possible negative effects on working memory and learning. To counter the negative effects of cognitive overload, Mayer and Moreno (2003) identified nine principles including segmentation, adaptive feedback, and verbal and visual synchrony. These principles were directly applied to the AI-integrated approach of this study to ensure that digital enhancements would aid learning, rather than impede it.

Ai In Education

AI has the potential to personalize learning experiences in ways that traditional multimedia cannot, such as customizing learning pathways, providing real-time analytics and adaptive feedback (Chen et al., 2020; Hamal et al., 2022). Intelligent Tutoring Systems (ITS) and AI-based learning platforms can monitor and analyze student engagement, identify and rectify misunderstandings, and modify the complexity of educational material. AI in art education encompasses the following:

- Generative technologies that create visual and auditory content (for example, Midjourney, Stable Diffusion, and Soundraw)
- simulated virtual rehearsal environments with adaptive lighting, set designs, audience members, and feedback
- automated evaluation of performances with computer vision and pattern recognition

All of these technologies address one of the specific challenges of art education in Shaanxi, where the skills being taught are often highly specialized and dependent on the unique characteristics of the context. AI technologies can provide specialized feedback on specific motor skills (for example, brushwork) or variations in performance (for example, the tonal

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quality of a singer's voice in opera) that are difficult to provide in large group instructional settings.

Technology And Cultural Heritage Preservation

The preservation of intangible cultural heritage increasingly depends on digital technologies for documentation, dissemination, and education (Artese & Gagliardi, 2014; Lazaro Ortiz & Jimenez de Madariaga, 2022). Virtual reality (VR) and augmented reality (AR) have been shown to enhance immersion, allowing learners to "experience" heritage environments and practices in ways impossible through text or static images alone (Liu et al., 2021; González-Zamar et al., 2020).

In the context of Shaanxi art, AI-enhanced multimedia can create enduring, high-resolution digital archives of ephemeral performances and intricate craft techniques, safeguarding this cultural legacy. Furthermore, they can generate interactive simulations, allowing students to practice skills in a virtual, risk-free environment. To dismantle language barriers, these platforms can also provide instant, multilingual contextual information, making the rich history and nuances of the province's artistry accessible to a global audience and fostering wider appreciation.

However, scholars caution that digital preservation must maintain cultural authenticity and avoid homogenizing regional diversity (Hamal et al., 2022). This requires involving cultural stakeholders—such as local artists—in the design and training of AI systems to ensure they reflect authentic practices and values.

Research Gap

Numerous studies have applied multimedia learning in art education and the use of AI in adaptive instruction. However, very few have studied AI-integrated methodologies for region-specific art forms, such as those from Shaanxi. Even less have done empirical studies that measure the impact of such methodologies on engagement and performance in real classroom settings. This study attempts to fill this gap by merging CTML-based multimedia design and AI personalization in the context of predominantly Shaanxi intangible cultural heritage–focused preservation and teaching.

Methodology

Research Design

This research has utilized a quasi-experimental design, and a mixed-methods methodology, to assess the effectiveness of multimedia-aided, and artificial intelligence (AI) integrated approaches within the Shaanxi art education. For the quantitative research, the focus was to measure and compare engagement and learning outcomes of the experimental group (EG) against the control group (CG). For the qualitative research, the focus was on understanding the perceptions of the students and teachers/case of the teachers, as well as the structure of the classroom interactions to provide context for the quantitative data.

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For this research, the integration of qualitative and quantitative strands utilized a convergent parallel design. That is, both qualitative and quantitative data were collected within a single semester, analyzed independently, and integrated for the purposes of triangulation.

Participants

Fifty undergraduate students studying Shaanxi art at a university in Xi'an took part in the research. The participants were randomly segmented into two groups after being recruited through convenience sampling and distributed across two accessible campuses: Control Group (CG) (n = 25) received traditional multimedia instruction through PowerPoint presentations. Experimental Group (EG) (n = 25) received instruction in AI-enhanced multimedia which included adaptive learning modules, VR rehearsal simulations, and collaborative digital tools. It should be noted that even though random assignment was used, the results are more illustrative than representative because of the sampling method used.

Inclusion And Exclusion Criteria

Students were eligible for inclusion if they met the following criteria: (1) undergraduate students majoring in art; (2) aged 16-22; and (3) with no prior formal or extensive informal experience using generative AI art tools. Students were excluded if they: (1) have taken a university-level course involving AI, (2) report using AI image generators more than 5 times for any purpose, or (3) have a concentration or major in a field related to digital media or professional art.

Intervention

The experimental group (EG) received instruction through a multimedia aided, AI integrated model, which was intended to improve learner engagement and learning outcomes. This model consisted of multiple, integrated elements. First, students received real-time adaptive AI feedback to help with their artistic skills, such as more precise papercuts or better tonal modulation in Qinqiang opera. Second, with AI assisted personalized learning, students were given lessons divided into short, thematic segments, which relates to one of Mayer's principles (2003) on cognitive load and knowledge retention. Third, students practiced in a VR simulation of a rehearsal studio, where they performed, designed lights, and spatially arranged for art exhibitions, in a safe VR setting. This model used collaborative digital tools, which provided students with a collaborative online workspace to co-create their documents, provide peer feedback, and edit. Finally, students were provided with creative-generative AI tools like Soundraw (music) and Midjourney (images) to help them think outside the box and go beyond traditional methods.

In contrast, the control group (CG) progressed with the standard Departmental curriculum, which utilized PowerPoint slides, static images, and oral Explanations. Lectures of this sort lack the adaptive, interactive, and immersive instructional means available to the EG, which offers a distinct contrast with traditional multimedia-based instruction, and the AI-based, technology-enhanced intervention.

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Data Collection Instruments

Data was collected using various methods to ensure data triangulation. The quantitative methods included the Creative Thinking Test, which is performance-based, and was adapted to an art at the college level, from a secondary school level test. It measured the dimensions of originality, flexibility, and elaboration. Behavioral data were measured using automated system data from the Learning Management system that captured mean daily learning duration, and an observable tally of students who participated in class discussions. Distractibility and test anxiety, which were self-reported and measured using a Likert scale, were described using distractibility and test anxiety. The qualitative dimension includes three types of data. The first was students' weekly reflection diaries, which were employed to record and describe their experiences and difficulties they encountered; the second was semi-structured interviews, which were conducted with 20 students who were purposively sampled, and were used to describe and analyze the effectiveness of teaching from the students' perspective, and the third was instructor field notes, which were used to record and describe the classroom environment The qualitative data illustrated the extent to which AI was used to teach and to facilitate students' engagement with the cultural heritage of Shaanxi, China (Braun & Clarke, 2006).

Data Analysis

Quantitative data covered independent t-tests focused on means for engagement and learning outcomes and set at $p<.05$ (Field, 2018). Engagement, cultural connection, and teaching experiences were the focus of the qualitative analyses of interview and diary data using Braun and Clarke's (2006) thematic analysis. For reliability and comprehensiveness of findings triangulation was applied to LMS logs, surveys, and diaries (Creswell & Plano Clark, 2018). The mixed-methods methodology offered the most effective way to answer the research question regarding the extent to which the AI-integrated approach was effective in the enhancement of outcomes in the art education.

Procedure

The research was performed over a semester length of 16 weeks and was divided over various phases of this time period. To begin with this study, a pre-test phase was employed in order to obtain a baseline measure for both the control and experimental groups. All study participants completed assessments designed to measure levels of creative ability and answer questionnaires measuring the levels of distractions, test anxiety, and so forth.

Upon the completion of the pre-test phase, a second phase, which for the purpose of the study will be referred to as the "intervention phase" began. This phase lasted the entire 16 weeks of the semester. For this study, the Experimental Group (EG) was taught using the AI-enhanced multimedia approach, while the Control Group (CG) was taught using the traditional multimedia (PowerPoint presentations) approach. For this period, active engagement logging was performed. The Learning Management System (LMS) captured the daily learning time of each student, while the instructor captured the engagement of the students in class discussions.

The last three weeks of the semester were dedicated to the collection of the primary qualitative data. As part of this process students kept reflection diaries, and in addition to those diaries, a series of semi-structured interviews were conducted. These processes occurred concurrently while the instructors completed field notes during the entire length of the intervention.

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Post-test phase commenced after the 16-week intervention, during which all participants were re-administered the same creative thinking test, as well as the distraction and anxiety scales, in order to assess their changes from the baseline. Moreover, to facilitate a thorough comparison between the two groups, the last learning outcomes comprising the scores of the creative projects and ratings of the technical skills were also retrieved.

Figure 1: Students Were Having a Class Delivered with The Aid of Multimedia

Figure 2: Students Were Having a Class with The Aid of Ai

Concrete Analysis

A mixed-methods strategy is the most suitable to evaluate the information gathered, as it incorporates both quantitative and qualitative elements. The data for the quantitative analyses were the independent-samples t-tests which compared the means of post-test scores for the Control Group (CG) and Experimental Group (EG). This statistical method is appropriate for assessing the variables for the two different instructional strategies. The other type of analyses is the descriptive one. The analyses described were used to stipulate the performance indicators of the two groups.

For the qualitative part of the analysis, some data obtained from student diaries and semi-structured interviews were subjected to thematic analysis by Braun and Clarke. Thematic analysis was used to study the data, as Braun and Clarke suggest, to study the data for possible themes with respect to student engagement, motivation, and perceived skill development.

Lastly, the validity of the findings is augmented by the use of triangulation, which is the cross-validation of the quantitative and qualitative data obtained from the interviews, questionnaires, and the scores from the tests. The authors reviewed the quantitative data to validate the qualitative data and the other way.

Ethical Considerations

Ethical approval was obtained from the university's Ethics Board. All participants provided informed consent, were assured of confidentiality, and could withdraw at any time without penalty. No personally identifiable information was stored in LMS logs.

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Results

This section presents the quantitative and qualitative findings from the study. Quantitative results compare post-test scores between the control group (CG) and experimental group (EG) on engagement and learning outcome indicators. Qualitative findings complement these results by providing insight into the observed behaviours and perceptions underlying the measured differences.

Quantitative Findings

The quantitative findings of the research are as follows:
The difference in scores from the creative thinking tests show that the AI-integrated approach helped the students from the Experimental Group (EG) generate, elaborate, and refine more artistic ideas than the Control Group (CG) with the score difference being 13.16. (78.20 vs. 65.04)

The students from the EG were able to spend more time learning, averaging 50.02 minutes which is 14.88 minutes more than the students from the CG who were learning 35.14 minutes a day. Consistent time-on-task intervals from the Learning Management System (LMS) cross the semester show the time increases.

Participation in classroom discussions from the EG is more than double when compared to the CG (22 vs. 9 participants). The students from the EG had lower scores for distraction and test anxiety which both show better concentration and lower stress when performing. The distraction score was 6.84 points less and test anxiety was 7.53 points less when compared to the CG. **Table 1** summarizes The Descriptive Statistics for Each Measured Indicator.

Table 1: Group Comparison Statistics

Metric	Control Group (CG)	Experimental Group (EG)	Difference (EG–CG)
Creative Thinking (score)	65.04	78.20	+13.16
Learning Duration (min/day)	35.14	50.02	+14.88
Classroom Discussion (count)	9	22	+13
Distraction Scale (lower=better)	42.36	35.52	–6.84
Test Anxiety Scale (lower=better)	55.78	48.25	–7.53

Figure 3 illustrates the comparative performance of the Cg and Eg across the five key metrics.

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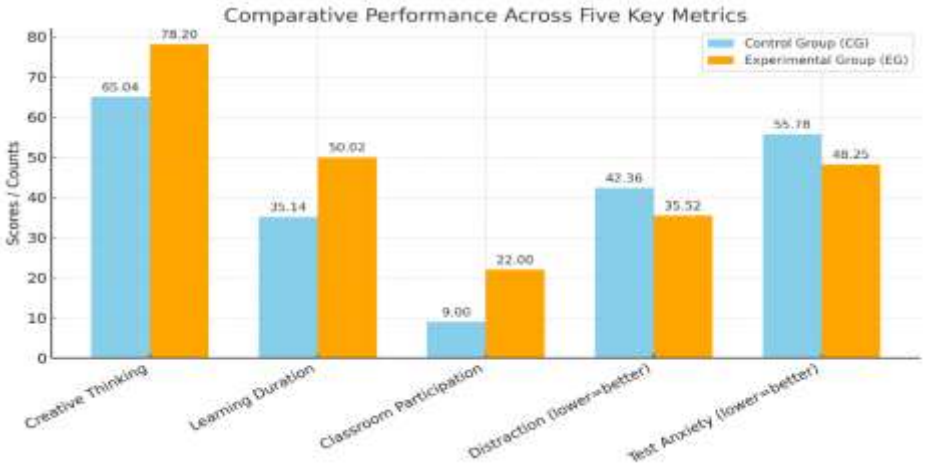

Figure 3: Comparative Performance Across Five Key Metrics

In addition, the experimental group had more positive learning outcomes from instruction enhanced by AI and multimedia. Learning outcomes are measured with an art knowledge test, creative projects, and observations made from the instructors. Preliminary data shows the students learning the module with AI and Virtual Reality Fine Arts outperform their peers in all significant metrics. As TABLE 2 shows, in the period of 16 weeks, there was an increase of 12.5% in the art knowledge test, 20% in the creative projects, and 20 % in the critical thinking skills. Additionally, there was an improvement of 22% in the technical skills measured by tasks utilizing VR in unity, and of 14% in the collaboration skills measured by rubrics from peer assessments. There was an increase in the mean of the overall grades from 3.1 to 4.3. There was a 15% increase in retention, and the student feedback went from neutral/negative to positive.

Table 2: Learning Outcomes

Learning Outcome Metric	Traditional Teaching Model	Multimedia-Aided AI-Integrated Model
Art knowledge test scores	72.5%	85.0%
Creative project scores	3.0/5.0	4.0/5.0
Critical thinking skills	2.8/5.0	3.8/5.0
Technical skills	3.2/5.0	4.3/5.0
Collaboration skills	2.9/5.0	4.2 /5.0
Overall grade	3.1/5.0	4.3/5.0
Retention rate	65%	80%
Student feedback	Neutral to Negative	Positive

Qualitative Findings

As indicated by the quantitative research findings, students in the experimental group (EG) showed greater reduction in anxiety (−7.53) and reduction in the distraction level (−6.84). The qualitative research findings corroborated the quantitative findings. From the analysis of the reflection diaries, interviews, and instructor notes, three themes were identified:

1. Increased Learning Engagement through Interactivity. EG students reported that the AI modules were “engaging” and “well-structured,” and that VR simulations enabled “complex

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movements" to "feel natural after some repeated virtual practice." He feedback enabled some students to stay focused and to work on improvements in their performance.

2. Increased Collaboration and Peer Learning. The EG students increased their peer interactions to an average of 5−6 students, as compared to the CG students who interacted with about 2 peers. This also confirms the quantitative participation results. Garrison (2017) notes that interactivity and multimedia can be utilized to form and maintain an inquiry community that fosters authentic and significant learning.

3. Lower Anxiety and Distractions: Constructing and Reflecting. Several EG participants stated that the ability to "practice in VR before performing in front of the class" and "get AI feedback that is constructive and not judgmental" helped them feel less anxious. Instructors reported that the EG sessions showed more on-task behaviors.

Based on the results of the interviews, the majority of students in EG demonstrated learning satisfaction, particularly with the aspects of teaching, curriculum, and environment. Students were able to grasp difficult artistic concepts and techniques with the aid of multimedia tools, which facilitated content delivery. Furthermore, the appreciation of technology motivated students to take responsibility for their learning. Consequently, this resulted in improved understanding and retention.

Discussion

This study sought to evaluate the effectiveness of a multimedia-aided, AI-integrated approach on student engagement and learning outcomes in Shaanxi art education, relative to traditional multimedia instruction. The results demonstrated that the AI-enhanced approach resulted in significant improvements in various measures of student engagement and performance, thus substantiating the study's hypotheses and aligning with the existing literature on the positive impact of technology on learning.

Interpretation Of Key Findings

Addressing research question 1, engagement improved via creative thinking, increased learning duration and time-on-task, increased classroom participation, as well as reduced distraction and test anxiety.

Creative Thinking

The improvement in creative thinking scores for the EG (+13.16 points) indicates that AI-enhanced multimedia instruction afforded students more opportunities for idea generation and elaboration. Mayer's Cognitive Theory of Multimedia Learning (CTML) suggests that extraneous cognitive load is minimized when the learning stimuli leverage both the auditory and the visual channels. The AI-integrated modules aligned with this approach by guiding learners through step-by-step task completion, providing feedback after each learning step, and offering learners the ability to control and modify the digital artwork. Hamal et al. (2022) and Chen et al. (2020) described adaptive digital tools that promote divergent thinking, owing to the variability in stimuli and the immediacy and personalization of feedback. Consistent with this, hands-on learning applied the theory and helped students actively engage with the cultural heritage of Shaanxi (Sun et al., 2022; Zeng et al., 2025).

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Learning Duration and Time-On-Task

EG's increase of 14.88 minutes in daily learning time shows their motivation and sustained engagement. This aligns with Self-Determination Theory of Deci and Ryan (1985), which states that motivation and well-being are optimal when psychological needs of self-determination (autonomy), competence, and relatedness are fulfilled. Increased intrinsic motivation because of the immersive, gamified components, like virtual reality (VR) rehearsals and artificial intelligence (AI) progress tracking, helped students continue learning activities outside of class time. This supports González-Zamar et al. (2020), who noted that immersive learning environments increased time spent on voluntary practice.

Classroom Participation

The increased participation in discussions in the EG is consistent with Vygotsky's (1978) social constructivists approach, where learners build knowledge through social engagement. The social barrier commonly found in performance critique activities is not present with the EG's collaborative digital tools which allowed for real-time co-creation and peer feedback. Similar to what we found, Artese and Gagliardi (2014) in their studies of collaborative projects in the digital heritage field found that the use of digital technologies increased group interactivity and sharing of skills.

Reduced Distraction and Test Anxiety

It is especially intriguing that distraction and test anxiety have decreased, as these are affective factors that have an impact on arts education. According to CTML, focus increases when there is less cognitive load, so perhaps the adaptive pacing of the AI feedback helped students stay on task. The AI-integrated approach lessened cognitive overload by segmented content delivery and adaptive feedback. AI, for instance, is programmed to identify students having difficulties and supply clarification in the form of simpler texts and additional graphics or even drawings (Sweller, 2020). In interactive videos and 3D imaging, Shaanxi artistic creations were represented in a variety of multisensory ways to avoid redundancy in the presentation of pictures and sounds (Mayer, 2024). Anxiety is probably less because of the VR simulations that allow for private practice and where mistakes can be fixed without being seen by others. This supports the findings of Lazaro Ortiz and Jimenez de Madariaga (2022) who noted that the anxiety of a performer is often less impacted by virtual rehearsal spaces.

More Outstanding Learning Outcomes

The answer to research question 2 provides a thorough explanation of the measurable, substantial, and positive difference in learning outcomes with an AI-integrated multimedia-aided approach versus the traditional teaching model. positive and substantial differences in learning outcomes. The data reveals positive and substantial differences in learning outcomes and positive and substantial differences in learning outcomes The findings of this study provide a comprehensive answer to research question 2, detailing the measurable, significant, and positive difference in learning outcomes with an AI-integrated multimedia-aided approach versus the traditional teaching model. The data supports a positive and substantial difference in learning outcomes across a wide range of dimensions, both qualitatively and quantitatively. quantitatively, the experimental group demonstrated a positive and substantial difference in learning outcomes across a wide range of dimensions, both qualitatively and quantitatively.

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Among the dimensions positively and substantially impacted were the students' mastery of the content, evidenced by a positive increase of 12.5% in the students' knowledge of the arts test scores. Additionally, there was a substantial increase in the students' scores of 20% in the creative projects, 20% in the critical thinking skill, and 20% in the critical thinking, demonstrating that the advancement was not merely surface learning. This was further substantiated by the notable improvement of 22% in technical skills and 14% in collaborative skills. This indicates that the AI-integrated module developed both the individual improvement and the necessary interpersonal skills within the students.

Holistic metrics further emphasize these quantitative advancements. The increase in overall grade means from 3.1 to 4.3 is an improvement in overall academic success. The most notable achievement, retention rate improvement, at 15%, stands out the most. This demonstrates that students have become more effective learners, but even more important, they are likely to remain more committed to the completion of their studies. Coupled with the change in student feedback from neutral/negative to positive, this indicates that student perception, and more importantly, student attitude has shifted. This integrated AI feedback model does not only provide skill development, but the feedback amplifies the overall educational experience, making it more effective and supportive, and even more likely to retain student engagement.

Contribution To Cultural Heritage Preservation

Regarding research question 3, perhaps the most notable aspect of this research is the potential it has for preserving and revitalizing the intangible cultural heritage of Shaanxi. The study paves the way for a model of integration of traditional artistic practices with multimedia approaches augmented by AI, as it captures the potential of high-fidelity recordings, adaptive tutorials, and VR (virtual reality) modules for instruction beyond the master-apprentice model. Furthermore, it offers the potential of preserving cultural and stylistic accuracy, as the AI (artificial intelligence) tools were developed using material created with Shaanxi artists. This approach also positively impacts the engagement of young people, as digitally immersive environments make the heritage arts more appealing and accessible, and most importantly, digitally unadulterated.

This practice supports UNESCO (2003) guidelines for the safeguarding of intangible cultural heritage, which encourage the preservation of innovative ways of transmission of culture, while maintaining the active role of the community.

Comparison With Previous Studies

Although previous studies have reported the advantages of multimedia usage in arts education (e.g., Erickson, 2005; Mayer & Moreno, 2003), there are barely any studies that have combined AI personalization and the teaching of cultural heritage. The present results build on González-Zamar et al. (2020) on immersive learning by providing evidence that AI adaptive responsiveness has positive effects on engagement and performance. Furthermore, this study responds to Hamal et al. (2022) shortage of culturally centred AI in heritage education by illustrating that the design of the learning tool in collaboration with cultural practitioners can be both effective and authentic.

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Limitations

Regardless of the amount of effort, the study will always have some limitations for objective reasons. The first of these is that the study's sample size and scope, consisting of 50 students from one institution, severely limits its generalizability. The second of these is that this study assessed learning outcomes after one semester, leaving the study's findings on the effects of long-term retention unknown. The third of these is that attempts at replication in regions that do not possess the technological means to support VR and AI will suffer from the greatest constriction, which is, of course, limited access to the technology in question.

Future research should seek to remedy these shortcomings by utilizing a design that is more longitudinal in nature, as well as one that is widening to include multiple institutions, and one that is focusing on more accessible AI solutions, especially those that are mobile based.

Conclusion And Implications

Conclusion

This study's main aim was to examine the effects of the multimedia-enabled and artificial intelligence (AI) integrated teaching approach on student engagement and learning outcomes in Shaanxi's art education. The findings suggest that the use of adaptive AI tools, immersive VR (virtual reality) simulation, and collaborative digital tools in teaching curricula increases creative thinking, time on task, classroom participation while decreasing distraction, test anxiety, and in measure, multimedia instruction.

These findings support Meyer's Cognitive Theory of Multimedia Learning which emphasizes that technology integrated formed instruction supports optimal cognitive processing and reduces cognitive load, supports dual-channel processing, and facilitates meaningful learning. From a cultural perspective, the findings also show that contemporary instructional approach to education, in support of preserving and revitalizing authentic culturally significant elements, in this case, the diverse and rich cultural heritage teaching materials. The study provides evidence demonstrating that AI-infused multimedia instruction positively affects the cognitive and also the emotional (affect) aspects of learning in higher art education and presents an instruction model that is culturally grounded and scalable to other art forms and regional traditions.

Implications For Policy and Practice

Educational Policy

Crafting policy at the intersection of AI Enhanced Cultural Heritage Education Systems and Art Education requires the integration of AI-Enhanced Cultural Heritage Education Systems into the existing curricula of national and regional arts education. Policies should focus on the integration of digital heritage education into formal curricula and prioritizing the education of students on the importance of preserving culture. In addition, funding programs should be created for the construction and upkeep of educational platforms in the VR/AR mediums focused on cultural heritage. Ensuring equitable access to VR/AR educational applications and web-based platforms specifically designed for cultural heritage education is vital (Yang et al., 2024). Of equal importance is the need to reduce the potential for students' data to be abused

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through the digital arts education tools within AI. Legislators will need to ensure that data collection is transparent, consent is obtained, and data security is adequate (Yang et al., 2024; Park & Kim, 2023).

Teacher Professional Development

Regarding teacher professional development, art educators need specific training in creating and teaching AI-integrated multimedia lessons. Educators need to learn how to incorporate intelligent tutoring systems and virtual reality (VR) modules into Shaanxi art lessons to improve cultural engagement. For example, experience VR (virtual reality) Qinqiang opera performances or paper-cutting workshops that bridge generational gaps and make traditional art forms relevant (Wang & Chen, 2025). However, in order to support authenticity and practicality, the collaboration of educators, cultural practitioners, and technologist cross-discipline should be championed. Art educators may lack the technical skills needed to create quality AI-integrated multimedia lessons and may be lacking inspiration from cultural practitioners, which makes support from technologists and cultural practitioners necessary in certain situations.

Curriculum And Pedagogical Design

When creating multimedia lessons, the different principles of cognitive load management that help sustain attention and aid retention have to be considered, such as coherence, modality, redundancy, spatial and temporal contiguity principles. The instruction should be divided into shorter thematic units to minimize cognitive load. Also, the use of collaborative digital tools can be integrated to foster social learning and peer feedback, more so in the case of the performance-based domains.

Technology And Infrastructure

Improvements in technology and infrastructure, including artificial intelligence and virtual/augmented reality, in rural and underfunded educational institutions will be inevitable. Furthermore, learning apps that are inclusionary and heritage mobile-optimized should be developed for students with limited access to sophisticated technology.

Recommendations For Future Research

This study suggests the following for future research: 1) Conduct longitudinal studies to assess long-term retention of skills and cultural engagement; 2) Broaden the participant base to several institutions for better generalizability; 3) Examine the explainability of AI in heritage education in relation to how feedback and recommendations are formulated; 4) Examine the impact of emotion and identity in AI-supported cultural learning environments.

Closing Remark

The intelligent educational model must integrate cultural heritage preservation along with teaching innovations. The innovations with multimedia and AI show that true innovations do not disregard traditions; they reinstate traditions. When students are not mere bystanders, but active participants and creators, we do not merely increase engagement and outcome. We spark a generation of artist-creator legacy defenders! In arts education, tradition and new

technologies are not oppositional. They are aligned in purpose to shape the future artists and cultural heritage custodians.

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