Assessing Virtual Reality in Oil Painting Education: A Perspective from the Technology Acceptance Model

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Abstract

This research assessed the integration of virtual reality (VR) into oil painting education through the lens of the technology acceptance model (TAM). The study, limited to Guangdong Province, China, drew responses largely from educators and learners and modularly evaluated perceived educational value (PEV), perceived technological accessibility (PTA), intention to adopt VR (IAVR), and VR utilisation in education (VRUE). Based on a cross-sectional survey of 373 respondents, this study deployed structural equation modelling (SEM) to test five hypotheses. Both PEV and PTA significantly influence IAVR, which subsequently affects VRUE. PTA had a direct interface with VRUE, whereas PEV did not. This suggests that while the educational merits accrued through VR have decreased, user-friendly VR solutions is the more immediate determinant of the actualisation of VR in education. This research enriches the extant literature by extending the TAM to an arts educational environment and underscores the implications for the adoption of emergent technologies for the augmentation of pedagogical practises. This study also provides practical implications for stakeholders in educational technology, as it argues that the key to widespread acceptance of VR in educational settings lies in the availability of user-friendly, comprehensive, and accessible VR solutions.

Keywords: virtual reality, oil painting education, technology acceptance model, structural equation modelling, educational technology

1. Introduction

Virtual reality (VR) has become a transformative medium in several fields, including education, during a time of rapid technological advancement. The immersive and interactive elements are anticipated to significantly improve educational experiences, particularly in fields that traditionally rely largely on hands-on interaction, such as oil painting. This study investigated the incorporation of VR into oil painting education using empirical survey methods to assess its acceptance and operational efficiency. This exploration was made possible by utilising the established Technology Acceptance Model (TAM) by Davis (1989).

Integrating VR into educational settings prompts inquiries regarding its educational value and ability to challenge established teaching methods. VR's increasing role in educational technology research has been extensively studied (Kimmons & Rosenberg, 2019). However, its specific use in the realm of oil painting, which has a rich history dating back to the European Renaissance and focuses on depth, texture, and a vivid colour palette (Nagel & Wood, 2010), as well as intricate techniques such as glazing, impasto and scumbling (Stuyck, et al., 2017), remains largely uncharted. VR technology allows for modelling complex procedures and provides an interactive instructional environment for students to experiment without being restricted by tangible resources. VR can bridge traditional artistry with modern teaching methods. For oil painting students, an interactive way to explore the medium's history is offered by placing techniques within virtual reproductions of the cultural and historical contexts in which they originated (Fang & Chen, 2019). This combination of historical elements and contemporary technology could offer a distinctive approach to revitalising art education by making the traditional medium of oil painting more accessible to young artists.

This study explores the feasibility of using VR technology in oil painting education and assesses its acceptance among instructors and learners. This subject has not received much scholarly attention. A literature review indicates a

growing interest in using VR to enhance education, with the potential to enhance learning outcomes and engagement and to offer immersive experiences that are not possible with traditional teaching methods (Radianti et al., 2020). VR is rarely utilised in the arts and is much less common in the teaching of oil paintings. This study also explored the potential positive and negative effects of incorporating VR technology into an oil painting course. In addition, the study focussed on identifying the elements that may influence individuals to embrace VR in oil painting instruction. Hence, this study investigated how perceived utility and ease of use influence consumers' attitudes and intentions to embrace VR for educational purposes.

2. Literature Review

2.1 Historical Context and Evolution of Oil Painting Education

The progress of oil painting instruction has been influenced by substantial changes in media, technique, and cultural acceptance, as explored in the historical context of art development.

Viguerie et al.'s (2009) study is essential for comprehending the evolution of oil painting media, emphasising the significance of flow qualities in influencing the aesthetic and technical elements of oil paintings. This research demonstrates the evolution of media used in art from the Renaissance era, which involved either Newtonian or slight shear thinning, to later periods, when media became more purely viscous to ensure that brushstrokes remained visible on the canvas. This evolution shows the interplay between medium development and artistic innovation.

Joselit (2020) further elaborates on the persistence and adaptation of oil paintings in response to the emergence of modern art movements. Oil paintings have maintained their fundamental traits and traditions despite significant shifts in the art world. This display of the lasting flexibility of oil paintings confirms their ongoing significance in the constantly evolving art world. Yan et al. (2023) analysed the interaction between traditional oil painting methods and modern illustration art, focussing on the growth of oil painting styles and techniques and highlighting the significant shift from classical colour theory.

The advancement of materials and techniques in Western oil painting signifies a shift from traditional practises to its recognition as a standalone medium. Xu Min's research in 2006 demonstrated that ancient physical performance was enhanced by incorporating oil painting techniques, introducing new flexibility and variety. This integration expanded the range of materials available for artistic expression, resulting in a dynamic and transformative shift in the overall narrative of painting history.

The evolution of oil paintings is the outcome of interactions among materials, techniques, and cultural progress. Throughout the years, this has been the path of the medium, blending the historical foundations of Western oil paintings with modern creative needs.

2.2 Overview of Virtual Reality in Education

VR is an interactive computer-simulated environment that enables users to create and experience three-dimensional objects and images from different perspectives. Melinda and Widjaja (2022) stated that VR enables experiential learning that is not possible, dangerous, or costly in a conventional setting and expands the possibilities for hands-on learning. Serin (2020) examined the classifications of VR technology in education, detailing the accessibility and usefulness of desktop VR technologies, including 3D Emulation and VRML, in an accessible and practical instructional framework. VR is beneficial to education because of its multisensory nature, which enhances the learning process. Christou (2010) explained that virtual reality's integration of multisensory visualisation and interactivity fosters active learning by encouraging students to interact with and understand a diverse range of concrete and conceptual surroundings. Ludlow (2015) delved deeper into the increasing significance of VR in special education. Virtual immersive environments are transforming instructional simulations designed to meet the learning requirements and capacities of students with disabilities.

Educators' thoughts on incorporating VR into educational paradigms could ultimately determine how technology is received and integrated into the curriculum. Serin (2020) summarised key findings from a group of teachers, with many highlighting VR as a tool that enhances engagement and cognitive aspects of learning. These endorsements demonstrate VR's potential to become a dynamic and interactive tool for creating educational experiences. However, numerous problems may hinder the smooth integration of VR into educational settings. Rivas et al. (2020) emphasised the significance of incorporating VR into contemporary educational ideas, highlighting the proactive embrace and utilisation of VR technology as a way forward for educators. The discussion focussed on the advancement and use of VR and augmented reality (AR) in education, suggesting that educators may increasingly rely on VR to offer virtual laboratories and immersive experiences in the future (Devi, 2023).

The emergence of VR could represent a more significant leap in transformation than any previous technical advancement. VR enables immersive and interactive learning methods that go beyond typical educational tools. The above review demonstrated that VR is widely applicable across several educational fields, effectively enhances learning outcomes, and is well received by educators. For VR to be effectively integrated into educational environments, various instructional, technological, and accessibility obstacles must be addressed. As VR evolves due to technological progress, it is becoming evident that its potential to reshape teaching methods and create immersive learning settings is not just a fantasy endeavour.

2.3 Virtual Reality in Art and Design Education

The increasing focus on VR as a practical tool for art and design education signifies a significant change in the learning process. VR is not merely a passing technological fad diverting attention from conventional learning methods; it is a progression that will greatly impact the training of future artists and designers.

Song and Li (2018) discussed how VR technology might improve art design education by enhancing instructional content and blending art and technology. This approach has been suggested to improve understanding and proficiency in professional skills and theoretical concepts, thus helping students transition into the professional field. It serves as a crucial connexion to improve the process of art and design education and enhance the quality of instruction. Mu and Yu (2020) studied the potential of VR to improve aesthetics in art design education. Their research on VR application strategies suggested that this technology can improve aesthetic education, enhance the quality of education for art design students, enrich the teaching experience, and provide new directions for aesthetic education reform and innovation in the digital era. This challenges the notion that VR in art design education can be easily summarised. Hall and Sakatani (2002) introduced Virtual Studio, a VR educational environment aimed at teaching primary pupils various art techniques and styles. This technology creates a partially immersive VR art education environment called open-LAB, which simulates legendary artist studios, enhancing the perception and imagination of space and movement through a diverse selection of objects. The teaching setting used a partially immersive and interactive approach, drawing on the visual metaphor of an artist's studio to encourage deep interaction and engagement with art representations. This study proposed that virtual reality is crucial for enhancing educational settings by including various and captivating viewing perspectives, resulting in virtual educational environments that are both instructive and entertaining, particularly in the context of art exploration.

Song Xi (2010) examined how VR may enhance visual communication and analysed product prototypes in arts and design education. Song Xi (2010) suggested that VR is a powerful tool for enhancing the understanding and evaluation of product aesthetics by making multimedia information more meaningful and easier to perceive. Song Xi (2012) addressed the present obstacles in integrating VR into arts and design education and proposed future strategies for utilising VR in arts and design education. zgen et al. (2019) conducted a comparison study to assess the effectiveness of VR technology in fundamental design instruction compared with traditional paper-based design approaches. The research shows significant disparities in graduate students' willingness to use VR and their enjoyment of the VR-based design process. This finding implies that VR could be used as an additional tool in the design curriculum to provide a more enriched educational experience.

In 2019, Huaman et al. enhanced the combination of VR and gamification to create a virtual museum for teaching art history to higher education students. VR has been demonstrated to greatly improve knowledge retention and active learning compared with traditional teaching techniques, showcasing its ability to provide historical content in a novel, interactive, and engaging way. The works referenced provide a detailed overview of the various uses and educational advantages of VR in art and design education. This includes enhancing aesthetic education, creating immersive design experiences, and improving the understanding of art history. VR is a key element in the ongoing development of art and design education.

2.4 Virtual Reality in Oil Painting Education

Virtual reality and art history education scholars are also interested in improving art history instruction through virtual reality. Cecotti et al. (2020) showcased the efficacy of VR in this field with a virtual museum designed for art history educators. The developers demonstrated how VR can simulate and improve traditional learning experiences by creating a virtual space that accurately replicates an art gallery, allowing students to immerse themselves in environments that closely resemble real art spaces. Huaman et al. (2019) explored the use of VR and gamification in teaching art history by integrating them in a virtual museum simulation. Their study demonstrated that VR can enhance student engagement and facilitate active learning by incorporating game-like features into art history coursework, thus increasing the engagement and entertainment of students. Raya et al. (2021) also studied the use of VR for creating visual representations of figures, specifically by examining the narratives behind great artworks.

Their research demonstrated how VR can recreate characters from photos in three dimensions, thereby enhancing comprehension of the historical or cultural context of an artwork.

Lin et al. (2020) highlighted VR's revolutionary impact on art history by comparing VR-assisted art enjoyment with standard physical art viewing experiences. Their research indicated that VR does not diminish the emotional involvement or critical assessment provoked by viewing artworks, making it appropriate for art exhibitions and educational venues. They acknowledge that VR systems must be more skilfully and carefully constructed to effectively connect with people because their current limitations hinder the full replication of real-life experiences. Ornes (2022) investigated how VR could make abstract painting more accessible by analysing the work of the visual artist Alison Goodyear. The study demonstrated how VR technologies might make abstract painting more accessible, thus prohibiting artists from working only on a flat, two-dimensional surface.

2.5 TAM in Educational Settings

Scherer et al. (2019) conducted a meta-analytic study using structural equation modelling to investigate the influence of the TAM on teachers' use of digital technologies in educational settings. Examining 114 empirical TAM studies has confirmed the strong foundation of TAM in explaining technology acceptance. The study also highlighted the importance of model constructs and external variables in educational settings.

Granić and Marangunic (2019) conducted a systematic literature study to assess the capability of TAMs to elucidate technology adoption in various educational technologies and user groups. Their investigation indicated that the key components of the model, perceived ease of use and perceived usefulness, were significantly linked to the intention to use the programme. Besides, Granić and Marangunic identified external variables, including computer self-efficacy and subjective norms, that significantly influenced the perception of ease of use and utility. This display of the model's adaptability, which relies on the level of abstraction at which it is used, highlights the significance of contextual sensitivity while utilising the TAM.

Rad et al. (2022) used the theory of planned behaviour along with the TAM to create a questionnaire for evaluating technology acceptability among preschool educators in early childhood education. The researchers determined that the TAM was suitable for predicting the adoption of technology in a preschool educational setting because of its focus on usage intention and fostering favourable attitudes toward technology. Tang et al. (2023) employed TAM to investigate how multimedia tools impact early childhood education and to evaluate the influence of multimedia tool integration on educational efficacy. The researchers emphasised the significant impact of instructors' perceptions of the utility and simplicity of using multimedia technologies.

Furthermore, Holden and Rada (2011) expanded the TAM by including perceived usability and technology self-efficacy in the system acceptance process. This enhancement significantly increased the explanatory ability of conventional TAM constructs. This study highlights the significance of incorporating usability and self-efficacy into conversations about the acceptance of educational technology. Teo and Schaik (2009) focussed on preservice teachers to evaluate the prediction accuracy of the TAM. The researchers found that the factors affecting their willingness to use technology were significant. The study results proved that perceived utility, perceived ease of use, and computing attitudes significantly impacted behavioural intentions. Thus, the efficacy of TAM in educational environments was strengthened.

2.6 Application of TAM in this study

This literature review examines the incorporation of virtual reality in oil painting education and art history, and the use of TAM in educational environments. The researchers determined that using TAM as an analytical framework was inherently significant.

This study references the research conducted by Scherer et al. (2019), Granić and Marangunic (2019), and Tang et al. (2023) in applying the TAM to evaluate the uptake of contemporary technology by educators and students. The TAM components, PU and PEOU, are essential for comprehending instructors' and students' readiness to use virtual reality for teaching and learning about oil paintings.

According to previous studies, perceived utility refers to the extent to which instructors and students believe that VR can enhance the oil painting learning experience. VR enables students to understand art history, offers immersive art experiences, and shifts art education from a traditional teacher-centred approach to a more inclusive one. Perceived ease of usage refers to how readily VR in art education is accepted by instructors and students. Virtual reality in the art classroom is accessible. Both educators and students can easily learn to use VR tools. Therefore, these technologies can be seamlessly incorporated into current educational models without requiring significant technological advancements.

In addition, researchers include external variables, such as technology self-efficacy, as suggested by Holden and Radhakrishnan (2011), to gain a more thorough understanding of VR acceptability and usage in this field.

Essentially, this study uses the TAM to analyse how VR technology can transform oil painting teaching. The theoretical concepts of the TAM are applied to art education to explore how emerging technologies can be effectively incorporated into educational practises, enhancing the learning experience and engagement with art.

2.7 Theoretical Framework

Davis (1989) developed the TAM to explain the acceptance and subsequent use of new technologies. In the TAM framework (Figure 1.), PU is defined as the degree to which a person believes that using a particular technology enhances their job performance (Omar et al., 2019). In the context of education, this extends to how a technology such as VR could enrich the learning and teaching process. PEOU, on the other hand, is the degree to which a person believes that using the technology will be free of effort (Tahar et al., 2020). These beliefs in turn impact PU and PEOU, with attitude being what Davis refers to as the degree of positive or negative feelings towards using the technology. Attitude is then hypothesised to affect the Behavioural Intention to use the technology. Behavioural intention, in turn, is "the degree to which a person has developed conscious plans to perform or not perform some specified future behaviour" (Alhammadi et al., 2023). Behavioural intention is considered an immediate antecedent of actual system use, i.e., the real-world implementation of the VR system. In addition, PU is believed to influence PEOU under the premise that as the usefulness of a system increases, the effort required to use the system is often perceived to decrease.

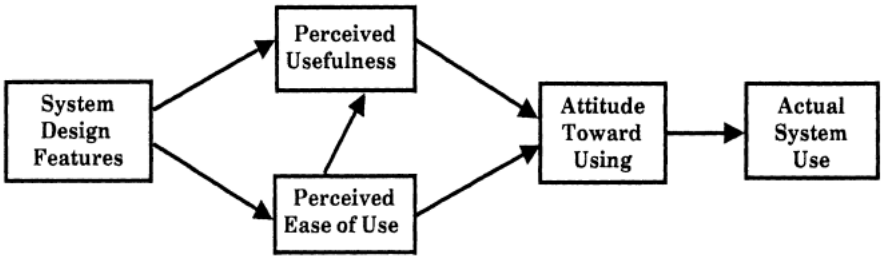

Figure 1. TAM Framework (Davis, 1989)

This study examines the use of VR technology in oil painting courses using the TAM framework. This version modifies the original TAM components to better represent the unique features of VR technology in educational innovation.

In this revised framework (refer to Figure 2), PU, typically linked to the overall benefits of technology, is reconceptualized as perceived educational value (PEV). This variable assesses the evaluative beliefs of educators and students regarding the educational utility of VR technology in oil painting teaching. VR can enhance the understanding of creative concepts, aid in learning oil painting techniques, and provide immersive experiences not found in traditional teaching approaches.

PEOU is redefined as perceived technological accessibility (PTA). This variable evaluates the perceived level of effort involved in engaging with VR technology from the user's perspective. The VR system has user-friendly features, intuitive software, and accessible tools and resources for users with varying levels of technological experience.

In this study, the behavioural intention to use technology in the original TAM model is redefined as the intention to adopt VR (IAVR). This construct signifies the probability of educators and students opting to integrate VR technology into their instructional methods. Their attitudes directly result from the perceived educational value and technological accessibility of VR.

Finally, actual system use has been redefined as VR utilisation in education (VRUE), representing the specific implementation and regularity of VR technology use in educational environments. VR quality is a true indicator of how well VR has been incorporated into the curriculum and teaching of oil paintings.

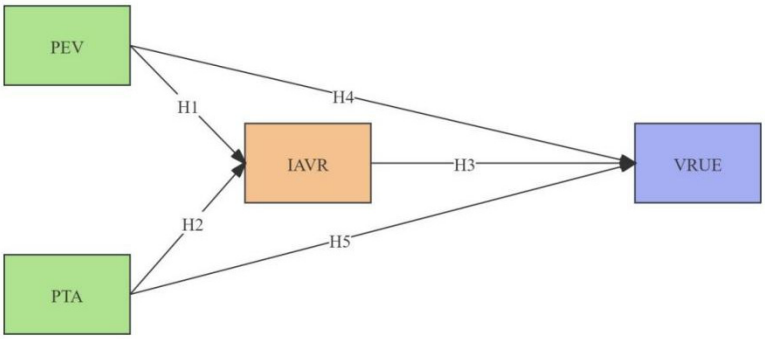

Figure 2. Research Model

Based on the variables adapted for the TAM within the context of VR in oil painting education, the research hypotheses for this study are articulated as follows:

Hypothesis H1: PEV has a positive effect on IAVR in oil painting education.

Hypothesis H2: PTAs have a positive effect on IAVR in oil painting education.

Hypothesis H3: IAVR positively affects VRUE in oil painting education.

Hypothesis H4: PEV has a direct positive impact on VRUE in oil painting education.

Hypothesis H5: PTAs have a direct positive impact on VRUE in oil painting education.

3. Methodology

3.1 Research Design

A quantitative research design was used to examine the relationships among the variables PEV, PTA, IAVR, and VRUE. A cross-sectional survey method was chosen to collect data at one time point. A structured questionnaire was developed to investigate the research questions and served as the primary instrument for data collection. The questionnaire comprises closed-ended questions and uses five Likert scales that allow participants to indicate their level of agreement or disagreement with the statements. The goal of this study was to gather quantitative information that could be statistically analysed to support or disprove the stipulated hypotheses. A data analysis plan was in place to use descriptive statistics to summarise the data and to use inferential statistics such as regression analysis to explore causal associations among variables. This study strives to provide empirical information on the acceptance of modern educational technology, particularly in the fine art field of art education. The cross-sectional survey method established a solid foundation for understanding the current level of VR acceptance in oil painting education and opened the door for potential longitudinal research to gauge unfolding developments over time.

3.2 Sample Size

For the quantitative analysis, the sample size was determined based on a power analysis and the requirements for conducting SEM. Power analysis was conducted using G*Power 3.1.9.7 software (Faul et al., 2009), considering a medium effect size ($f^2 = 0.15$), a power of 0.80, and a significance level of 0.05. For multiple regression analysis with four predictors (PEV, PTA, IAVR, and VRUE), the minimum required sample size was 85 participants.

Furthermore, the minimum sample size for SEM can be determined using the following formula (Westland, 2010):

$$n \geqslant 50r^2 - 450r + 1100$$

where n represents the minimum sample size and r denotes the ratio of indicators (observed variables) to latent variables. The proposed model comprises 12 observed variables and 4 latent variables (PEV, PTA, IAVR, and VRUE), resulting in a ratio of:

$$r = 12 \div 4 = 3$$

Substituting this value into the formula yields:

$$n \geqslant 50(3)^2 - 450(3) + 1100$$

$$n \geqslant 450\text{-}1350 + 1100$$

$$n \geqslant 200$$

According to this formula, the minimum sample size required for the study would be 200 participants.

However, to ensure robustness of the SEM analysis, a larger sample size was deemed necessary. Kline (2023) recommends a minimum sample size of 200 for SEM, whereas Hair et al. (2019) suggest a sample size of at least 10 times the number of estimated parameters.

Considering the complexity of the proposed model, the target sample size for the study was set at 300 participants, which aligns with recommendations for a more substantial sample to support the reliability of the results and is consistent with research of a similar nature in educational technology (Hair et al., 2019). This sample size allows for potential data loss and enhances the generalizability of the findings within the oil painting educational community in Guangdong Province.

3.3 Data Collection

The structured questionnaire was expressed as the main method for data collection and was prepared to quantitatively assess the variables obtained from the adapted TAM. This questionnaire comprised several sections, as shown in Table 1, and each section corresponded to one of the different constructs of the model: PEV, PTA, IAVR, or VRUE. The items that appeared in the questionnaire were prepared from the literature review and were formed in accordance with a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree), where participants could choose their level of agreement in response to several statements linked to the use of VR in oil painting education.

Table 1. Measurement Items

Variable	Original Representation	Measurement Item	References
PEV	"Perceived usefulness of the system in their job"	PEV_1.Using VR in oil painting classes improves the learning experience.	Davis, F. D. (1989)
	Adaptation of "Perceived usefulness" in educational context	PEV_2.VR helps in understanding complex oil painting techniques more easily.	Venkatesh, V., & Davis, F. D. (2000)
	Inspired by findings on engagement and learning enhancement	PEV_3.VR enables a more engaging exploration of art history compared to traditional methods.	Lee, M. K. O., Cheung, C. M. K., & Chen, Z. (2010)
PTA	"Perceived ease of use of the system"	PTA_1. I find VR technology easy to use for oil painting education.	Davis, F. D. (1989)
	Adaptation of "Perceived ease of use" in the context of skill acquisition	PTA_2. It is easy to become skillful at using VR for studying oil painting.	Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003)
	Related to self-efficacy and ease of use	PTA_3. I can access VR resources for oil painting education without significant help.	Compeau, D. R., & Higgins, C. A. (1995)
IAVR	"Behavioral intention to use the system"	IAVR_1. I intend to use VR in my future oil painting education practice.	Davis, F. D., Bagozzi, R. P., & Warshaw, P. R. (1989)
	Adaptation of "Behavioral intention" in the context of recommendations	IAVR_2. I will recommend the use of VR in oil painting education to others.	Venkatesh, V., & Bala, H. (2008)
	Reflecting future-oriented behavioral intention	IAVR_3. I plan to explore new VR tools for oil painting learning.	Fishbein, M., & Ajzen, I. (1975)
VRUE	"Actual system use" in an educational setting	VRUE_1. I regularly use VR applications in my oil painting classes.	Taylor, S., & Todd, P. A. (1995)
	Indicating frequency and integration of technology use	VRUE_2. VR technology is a part of my daily teaching/learning practice in oil painting.	Bhattacherjee, A. (2001)
	Suggesting variety and depth of technology use	VRUE_3. I have used multiple VR tools to enhance oil painting education.	Venkatesh, V., Thong, J. Y. L., & Xu, X. (2012)

The data were collected over a 3-week period, from February 1st to February 21st, 2024, and targeted educators and learners within the oil painting educational community in Guangdong Province, China. Participants were recruited using a mix of methods, including direct email invitations to art schools and universities, notices posted on educational forums and social media platforms, and snowball sampling, where initial participants were asked to refer

others who met the study criteria.

Upon agreeing to participate in the study, individuals were provided with a link to an online questionnaire hosted on the Wenjuanxing platform (www.wjx.cn). An online format was chosen because of the ease with which participants were able to access the survey and the enhanced ease with which data collection and processing could be executed subsequent to administration. Prior to beginning the survey, the respective informed consent pages were displayed to the participants. This page outlined the purpose of the survey, the confidentiality of their responses, and their rights as participants. Participants were asked to opt in by clicking an icon on a pen to electronically sign their consent, after which they were automatically taken to the first page of the survey.

3.4 Data Analysis

Statistical analyses were performed using SPSSPRO (Version 1.0.11), an online application software, to assess the reliability and validity of the constructs and to test the proposed model based on the TAM adapted for virtual reality in oil painting education (SPSSPRO, 2021). The analysis began with a Cronbach's alpha test to evaluate the internal consistency of the survey items. The KMO test and Bartlett's test of sphericity were used to assess the construct validity of the survey items. The SEM technique was then applied to examine the relationships within the adapted TAM framework. The focus was placed on how perceived educational value and technological accessibility affect the intention to adopt VR and its actual use in education.

4. Results

4.1 Demographic

Table 2. Demographic Information

Category	Options	Role				Total
		Educational Administrator	Educator	Learner	Other	
Age	18-24	6(8.1%)	33(44.6%)	31(41.9%)	4(5.4%)	74
	25-34	3(3.1%)	42(43.8%)	45(46.9%)	6(6.3%)	96
	35-44	5(6.8%)	25(33.8%)	39(52.7%)	5(6.8%)	74
	45-54	3(5.5%)	21(38.2%)	31(56.4%)	0(0.0%)	55
	55-64	0(0.0%)	9(34.6%)	17(65.4%)	0(0.0%)	26
	65 and above	1(9.1%)	4(36.4%)	6(54.5%)	0(0.0%)	11
	Under 18	0(0.0%)	15(40.5%)	19(51.4%)	3(8.1%)	37
Gender	Female	8(4.1%)	84(43.3%)	91(46.9%)	11(5.7%)	194
	Male	10(5.6%)	65(36.3%)	97(54.2%)	7(3.9%)	179
Educational Level	Associate Degree	2(5.4%)	14(37.8%)	19(51.4%)	2(5.4%)	37
	Bachelor's Degree	7(6.1%)	45(39.1%)	59(51.3%)	4(3.5%)	115
	Doctorate or higher	5(9.1%)	23(41.8%)	22(40.0%)	5(9.1%)	55
	High School or equivalent	0(0.0%)	3(16.7%)	14(77.8%)	1(5.6%)	18
	Master's Degree	3(3.2%)	40(43.0%)	47(50.5%)	3(3.2%)	93
	Other	1(5.6%)	7(38.9%)	9(50.0%)	1(5.6%)	18
	Some College, no degree	0(0.0%)	17(45.9%)	18(48.6%)	2(5.4%)	37
Experience with VR in Education	1-2 years	4(5.4%)	29(39.2%)	40(54.1%)	1(1.4%)	74
	3-5 years	2(3.6%)	23(41.8%)	28(50.9%)	2(3.6%)	55
	Less than 1 year	5(5.4%)	35(37.6%)	48(51.6%)	5(5.4%)	93
	More than 5 years	4(7.3%)	24(43.6%)	25(45.5%)	2(3.6%)	55
	No experience	3(3.1%)	38(39.6%)	47(49.0%)	8(8.3%)	96

A study of the adoption of VR in oil painting education provided the demographic distribution of participants, as presented in Table 2. A younger demographic of educators and learners engaged in VR emerged, with the majority of respondents 25-34 (30.6%) and 35-44 (25.3%) years old. Most of the respondents were learners, particularly within the 45-54 (55.6% of participants) and 55-64 (70.0% of participants) age brackets. Females, slightly outnumbered males across all age categories, were represented by learners more often than by educators. A diversity of educational levels is indicated by the sample, with the largest proportion being from bachelor's programmes, followed by those from master's programmes. The distribution of years of VR use in education indicates more recent adoption, with a large segment of respondents reporting 1-2 years of experience.

4.2 Reliability and Validity

The reliability analysis of our questionnaire, as shown in Table 3, revealed excellent internal consistency, as indicated by a Cronbach's alpha coefficient of 0.925 and a standardised alpha of 0.919. These values were derived from a scale comprising 12 items administered to a sample of 373 participants. Such high alpha values underscore the questionnaire's reliability, confirming that the scale's items cohesively measure the constructs of interest.

Table 3. Reliability Values

Cronbach's α coefficient	Standardised Cronbach's α coefficient	Items	Samples
0.925	0.919	12	373

Table 4 shows high values (> 0.9) for all items, suggesting that removing any single item would not significantly improve overall reliability. This finding demonstrates that the items within each construct are consistent and measure the same underlying concept, supporting the validity of the measurement scales and the robustness of the study's findings, and indicating that the adapted TAM framework is well-suited for assessing factors influencing the adoption and use of VR technology in oil painting education.

Table 4. Deletion of Statistical Summary of Analyses

	Average value after deletion of items	Variance after deletion of items	Correlation of deleted items with the total after deletion of items	Cronbach's α coefficient after deletion of items
PEV_1	46.324	30.085	0.416	0.928
PEV_2	46.335	29.895	0.427	0.928
PEV_3	46.314	30.028	0.411	0.928
PTA_1	46.3	29.307	0.572	0.922
PTA_2	46.295	29.338	0.567	0.923
PTA_3	46.292	28.863	0.633	0.92
IAVR_1	46.831	26.195	0.853	0.911
IAVR_2	46.823	26.022	0.85	0.911
IAVR_3	46.847	25.99	0.866	0.91
VRUE_1	46.684	26.034	0.842	0.911
VRUE_2	46.694	26.202	0.82	0.912
VRUE_3	46.694	26.218	0.833	0.911

The results, as shown in Table 5, from the Kaiser–Meyer–Olkin (KMO) measure and Bartlett's test of sphericity indicate the suitability of the data for factor analysis in exploring VR in oil painting education. A KMO value of 0.866 suggested a high level of sampling adequacy, indicating that the dataset was appropriate for factor analysis. Similarly, Bartlett's test showed a significant chi-square value of 4762.842 ($p < 0.001$), strongly rejecting the null hypothesis that the variables are unrelated and confirming the presence of significant relationships among them.

Table 5. KMO Test and Bartlett's Test

KMO		0.866
Bartlett's test for sphericity	Approximate chi-squared	4762.842
	df	66
	P	0.000***

Note: *** represents 1 per cent level of significance.

4.3 SEM Analysis

As displayed in Table 6, the model's constructs exhibit robust standardized loadings, manifesting strong relationships, and the associations are all statistically significant. The PEV construct is well operationalized by its indicators, with PEV_2 evidencing the highest loading. The indicators for PTAPTAs evince very high loadings, with PTA_2 appearing slightly more salient. The indicators for IAVR exhibit exceptionally high loadings, evincing a strong disposition among participants to adopt VR. The indicators for VRUE exhibit very high loadings also, notably VRUE_1 and VRUE_3, indicating a significant degree of actual use of VR within educational settings. The statistical significance of these indicators, as evidenced by very high z-scores ($p < 0.001$), attests to the constructs' sound measurement within the model.

Table 6. Factor Loading Factors

Latent Variables	Observed Variables	Nonstandard load factors	Standardised load factors	z	S.E.	P
PEV	PEV_1	1	0.814	-	-	-
	PEV_2	1.154	0.902	19.325	0.06	0.000***
	PEV_3	1.027	0.813	17.489	0.059	0.000***
PTA	PTA_1	1	0.906	-	-	-
	PTA_2	1.006	0.911	26.301	0.038	0.000***
	PTA_3	0.945	0.833	22.114	0.043	0.000***
IAVR	IAVR_1	1	0.933	-	-	-
	IAVR_2	1.028	0.932	33.55	0.031	0.000***
	IAVR_3	1.023	0.937	34.201	0.03	0.000***
VRUE	VRUE_1	1	0.981	-	-	-
	VRUE_2	0.942	0.927	40.838	0.023	0.000***
	VRUE_3	0.937	0.937	43.058	0.022	0.000***

Note: *** represents 1 per cent level of significance.

The standardised coefficient for the pathway from PEV to IAVR was 0.542 as shown in Table 7. Therefore, educators and learners are more likely to accept virtual reality (VR) if they believe it to have a high instructional value. The relationship's robustness was supported by the high Z score of 12.955 ($p<0.001$). The pathway from PTA has a higher standardised coefficient of 0.664.

Addressed to IAVR. Perceived technological accessibility significantly increased the intention to embrace VR, as indicated by the high Z score of 16.697 ($p<0.001$). The influence of IAVR on VRUE was substantial, with a standardised coefficient of 0.606. A high ambition to use VR substantially correlates with its actual utilisation in oil painting teaching, as shown by a Z score of 8.56 ($p<0.001$).

Table 7. Model Regression Coefficients

X	→	Y	Nonstandardised coefficients	Standardised coefficients	Standard errors	Z	P
PEV	→	IAVR	0.798	0.542	0.062	12.955	0.000***
PTA	→	IAVR	0.908	0.664	0.054	16.697	0.000***
IAVR	→	VRUE	0.66	0.606	0.077	8.56	0.000***
PEV	→	VRUE	0.099	0.062	0.086	1.15	0.250
PTA	→	VRUE	0.371	0.249	0.089	4.146	0.000***

Note: *** represents 1 per cent level of significance.

The direct effect of PEV on VRUE was not statistically significant, as indicated by a standardised coefficient of 0.062 and a P value of 0.250. The educational benefit of VR did not immediately impact the use of VR without

considering the aim to embrace VR. The direct impact of PTA on VRUE was robust and statistically significant, with a standardised coefficient of 0.249 and a P value of less than 0.001.

Figure 3 clearly shows the relationships between the latent variables of PEV, PTA, IAVR, and VRUE in the context of oil painting education.

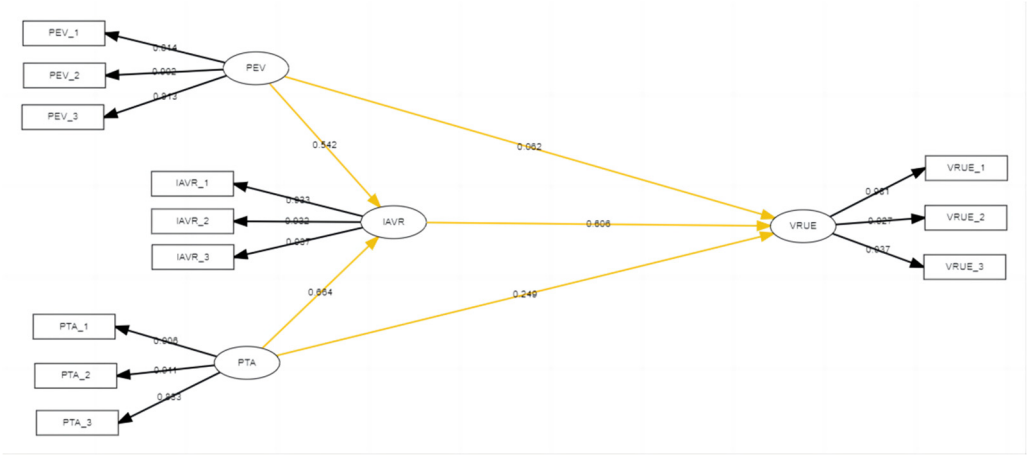

Figure 3. Structural Equation Modelling Path

Table 8 displays the SEM fit indices, which provide a varied evaluation of the model's capacity to depict the data from the oil painting VR integration survey. The chi-square value was statistically significant ($p < 0.001$), suggesting a discrepancy between the model and observed data. It is worth noting that this measure is known to be influenced by large sample sizes. The chi-square to degrees of freedom ratio exceeded the suggested maximum of 3, suggesting potential overfitting of the model. The goodness-of-fit index (GFI) was 0.956, while other comparison indices such as the comparative fit index (CFI), the normed fit index (NFI), and the nonnormed fit index (NNFI) showed a strong fit, all exceeding the recommended threshold of 0.9. The RMSEA was near the upper limit of acceptability and the RMR exceeded the target amount, indicating some misfit in the model's residuals.

Table 8. Model Fit Indicators

χ^2	df	P	chi-square degree of freedom ratio	GFI	RMSEA	RMR	CFI	NFI	NNFI
-	-	>0.05	<3	>0.9	<0.10	<0.05	>0.9	>0.9	>0.9
211.082	48	0.000***	4.398	0.956	0.096	0.168	0.966	0.956	0.953

Note: *** represents 1 per cent level of significance.

5. Discussion

These findings significantly contribute to the present knowledge on integrating VR in oil painting teaching, particularly in Guangdong's schools. The strong standardised loadings for the PEV and PTA constructs confirm previous research indicating that they influence technology acceptance and adoption, in line with the TAM by Davis. The use of the PEV_2 indicator in explaining complex oil painting processes is supported by Venkatesh and Davis's (2000) finding that perceived utility significantly influences user adoption behaviors. The PTA's significant influence on both the IAVR and the VRUE highlights the importance of user-friendly technology that can be easily accessed in an educational setting, as noted by Compeau & Higgins (1995) regarding the critical role of ease of use in technology adoption.

The z scores of the IAVR indicators represent high levels of intent to adopt VR, indicating an innovative educational community prepared to absorb new technologies to enhance learning processes, as proposed by Lee et al. (2010).

However, the direct impact of the PEV on VRUE was not substantial. This finding presents an intriguing juxtaposition to the anticipated outcomes as per TAM. Although VR is acknowledged as beneficial for the learning process by both educators and learners, this recognition may not be enough to inspire them to utilise it. It is crucial to explore additional aspects that could impact real usage.

The analysis of VR's impact on a field as conventional as art education is a noteworthy aspect of the study's empirical findings. This domain is a pioneer in transitioning from a hands-on, sensory-based style of knowledge generation to one that utilises electronic media, demonstrating these aspects. Demonstrating the importance of perceived educational value and perceived simplicity of use in shaping intentions to use provides a practical guide for designing and implementing VR solutions in this specific technological context.

This study is limited by its cross-sectional methodology, which hinders our ability to make causal inferences across time. Moreover, solely concentrating on Guangdong Province without considering other educational environments or areas could restrict the applicability of the results to diverse scenarios. In future studies, these limitations can be overcome by employing longitudinal designs to investigate changes in attitudes and behaviours towards VR uptake over time. Broadening the research scope to encompass a more diverse array of geographical and cultural contexts might enhance the generalizability of the results.

6. Conclusion

This study investigated the factors influencing the adoption and use of virtual reality technology in oil painting education within the framework of the TAM. The research aimed to provide empirical evidence for the relationships between PEV, PTA, IAVR and VRUE.

The results of the structural equation modeling analysis supported hypotheses H1 and H2, confirming that both PEV and PTA have significant positive impacts on IAVR. These findings highlight the importance of demonstrating the educational benefits of VR and ensuring its ease of use to encourage educators and learners to adopt this technology in oil painting education. The substantial standardized path coefficients for these relationships underscore the critical role of perceived value and usability in shaping users' attitudes and intentions towards VR.

Hypothesis H3, which proposed a positive influence of IAVR on VRUE, was also supported by the data. This finding suggests that once educators and learners develop a strong intention to use VR, they are more likely to integrate it into their educational practices. The significant predictive relationship between IAVR and VRUE emphasizes the importance of fostering positive attitudes and intentions to promote the actual use of VR in oil painting education.

Interestingly, hypothesis H4, which posited a direct influence of PEV on VRUE, was not supported by the data. This finding implies that the perceived educational value of VR alone may not be sufficient to drive its actual use in the absence of a strong intention to adopt the technology. This result highlights the mediating role of IAVR in the relationship between PEV and VRUE, suggesting that educators and learners must first develop a positive intention to use VR before its educational benefits can translate into actual usage.

In addition, Hypothesis H5, which proposed a direct and positive influence of PTA on VRUE, was confirmed by the data. This finding underscores the crucial role of technological accessibility in promoting the actual use of VR in oil painting education. The ease of access to VR resources and the ability to use them without significant technical barriers are essential factors in encouraging educators and learners to incorporate VR into their teaching and learning practices.

The study's findings contribute to the growing body of research on technology acceptance in educational contexts by extending the TAM to the domain of oil painting education. The adapted TAM framework, which includes PEV, PTA, IAVR, and VRUE, provides a comprehensive model for understanding the factors that influence the adoption and use of VR in this specific educational setting. The empirical support for the relationships between these constructs highlights the importance of considering both technological and educational factors when introducing emerging technologies in art education.

What is more, the results of this study have practical implications for educators, institutions, and technology developers. Educators should focus on demonstrating the educational value of VR and providing accessible and user-friendly VR solutions to encourage adoption among learners. Institutions should invest in the development of VR infrastructure and provide training and support to facilitate the integration of VR into art education curricula. Technology developers should prioritize the creation of intuitive, easy-to-use VR tools and platforms that cater to the specific needs of art educators and learners.

In conclusion, this study provides empirical evidence for the factors influencing the adoption and use of VR in oil painting education. The findings highlight the importance of perceived educational value, perceived technological accessibility, and intention to adopt VR in driving the actual use of this technology in educational settings. By understanding these relationships, educators, institutions, and technology developers can work together to harness the potential of VR to enhance teaching and learning experiences in oil painting education. Further research should

explore the long-term impact of VR on learning outcomes, as well as investigate the factors influencing VR adoption in other domains of art education.

References

Alhammadi, K., Marashdeh, H., & Hussain, M. (2023). Assessing the effect of innovation diffusion and technology readiness theories on attitude, behavioral intention and implementation of smart learning. *Cross Cultural & Strategic Management, 30*(4), 657-675. https://doi.org/10.1108/CCSM-12-2022-0213

Bhattacherjee, A. (2001). Understanding Information Systems Continuance: An Expectation-Confirmation Model. *MIS Quarterly, 25*(3), 351-370. https://doi.org/10.2307/3250921

Cecotti, H., Day-Scott, Z., Huisinga, L., & Gordo-Pelaez, L. (2020, June). Virtual reality for immersive learning in art history. In 2020 6th International Conference of the Immersive Learning Research Network (iLRN) (pp. 16-23). IEEE. https://doi.org/10.23919/iLRN47897.2020.9155108

Christou, C. (2010). Virtual Reality in Education. In A. Tzanavari & N. Tsapatsoulis (Eds.), *Affective, Interactive and Cognitive Methods for E-Learning Design: Creating an Optimal Education Experience* (pp. 228-243). IGI Global. https://doi.org/10.4018/978-1-60566-940-3.CH012

Compeau, D. R., & Higgins, C. A. (1995). Computer Self-Efficacy: Development of a Measure and Initial Test. *MIS Quarterly, 19*(2), 189-211. https://doi.org/10.2307/249688

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS quarterly*, *13*(3), 319-340. https://doi.org/10.2307/249008

Davis, F. D., Bagozzi, R. P., & Warshaw, P. R. (1989). User Acceptance of Computer Technology: A Comparison of Two Theoretical Models. *Management Science, 35*(8), 982-1003. https://doi.org/10.1287/mnsc.35.8.982

Fang, L., & Chen, S. C. (2019). Enhancing the learning of history through VR: The thirteen factories icube experience. In *Digital Turn in Schools—Research, Policy, Practice: Proceedings of ICEM 2018 Conference* (pp. 37-50). Springer Singapore. https://doi.org/10.1007/978-981-13-7361-9_3

Faul, F., Erdfelder, E., Buchner, A., & Lang, A.-G. (2009). Statistical power analyses using G*Power 3.1: Tests for correlation and regression analyses. *Behavior Research Methods, 41*(4), 1149-1160. https://doi.org/10.3758/BRM.41.4.1149

Fishbein, M., & Ajzen, I. (1975). *Belief, Attitude, Intention, and Behavior: An Introduction to Theory and Research*. Addison-Wesley.

Granić, A., & Marangunić, N. (2019). Technology acceptance model in educational context: A systematic literature review. *British Journal of Educational Technology, 50*(5), 2572-2593. https://doi.org/10.1111/bjet.12864

Green, S. B. (1991). How many subjects does it take to do a regression analysis? *Multivariate Behavioral Research, 26*(3), 499-510. https://doi.org/10.1207/s15327906mbr2603_7

Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2019). *Multivariate data analysis* (8th ed.). Cengage Learning.

Hair, J.F., Black, W.C., Babin, B.J., & Anderson, R.E. (2019). *Multivariate Data Analysis* (8th ed.). Cengage Learning.

Hall, D., & Sakatani, K. (2002). *Virtual studio: virtual reality in art*. Association for Computing Machinery: New York, NY, USA. https://doi.org/10.1145/1242073.1242140

Hamilton, D., McKechnie, J., Edgerton, E., & Wilson, C. (2021). Immersive virtual reality as a pedagogical tool in education: a systematic literature review of quantitative learning outcomes and experimental design. *Journal of Computers in Education, 8*(1), 1-32. https://doi.org/10.1007/s40692-020-00169-2

Holden, H., & Rada, R. (2011). Understanding the Influence of Perceived Usability and Technology Self-Efficacy on Teachers' Technology Acceptance. *Journal of Research on Technology in Education, 43*, 343-367. https://doi.org/10.1080/15391523.2011.10782576

Huaman, E., Aceituno, R., & Sharhorodska, O. (2019). Application of Virtual Reality and Gamification in the Teaching of Art History. In: Zaphiris, P., Ioannou, A. (Eds.), *Learning and Collaboration Technologies. Ubiquitous and Virtual Environments for Learning and Collaboration*. HCII 2019. Lecture Notes in Computer Science, vol 11591. Springer, Cham. https://doi.org/10.1007/978-3-030-21817-1_17

Joselit, D. (2020). *Heritage and debt: art in globalization*. MIT Press. https://doi.org/10.1162/octo_a_00381

Kimmons, R., & Rosenberg, J. M. (2022). Trends and topics in educational technology, 2022 edition. *TechTrends, 66*(2), 134-140. https://doi.org/10.1007/s11528-022-00713-0

Kline, R. B. (2023). *Principles and practice of structural equation modeling*. Guilford publications.

Lee, M. K. O., Cheung, C. M. K., & Chen, Z. (2010). Acceptance of Internet-Based Learning Medium: The Role of Extrinsic and Intrinsic Motivation. *Information & Management, 42*(8), 1095-1104. https://doi.org/10.1016/j.im.2003.10.007

Li, Q. (2021, September). Research and Implementation of Oil Painting Virtual Reality Based on Internet of Things. In *2021 4th International Conference on Information Systems and Computer Aided Education* (pp. 51-55). https://doi.org/10.1145/3482632.3482643

Lin, C. L., Chen, S. J., & Lin, R. (2020). Efficacy of virtual reality in painting art exhibitions appreciation. *Applied Sciences, 10*(9), 3012. https://doi.org/10.3390/app10093012

Ludlow, B. (2015). Virtual Reality: Emerging Applications and Future Directions. *Rural Special Education Quarterly, 34*, 10-3. https://doi.org/10.1177/875687051503400302

Melinda, V., & Widjaja, A. (2022). Virtual Reality Applications in Education. *International Transactions on Education Technology (ITEE), 1*(1), 68-72. https://doi.org/10.34306/itee.v1i1.194

Min, X. (2006). Development of Western Oil Painting Materials and Techniques. *Journal of Yangtze University*.

Mu, B., & Yu, C. (2020, November). Research on the Application of Virtual Reality Technology in Aesthetic Teaching of Art Design Major. In *International Conference on Education Studies: Experience and Innovation* (ICESEI 2020) (pp. 303-306). Atlantis Press. https://doi.org/10.2991/assehr.k.201128.056

Omar, N., Munir, Z. A., Kaizan, F. Q., Noranee, S., & Malik, S. A. (2019). The Impact of Employees Motivation, Perceived Usefulness and Perceived Ease of Use on Employee Performance among Selected Public Sector Employees. *International Journal of Academic Research in Business and Social Sciences, 9*(6), 1128-1139. https://doi.org/10.6007/IJARBSS/v9-i6/6074

Ornes, S. (2022). Virtual reality helps shape and respond to artistic impulses. *Proceedings of the National Academy of Sciences of the United States of America*, 119. https://doi.org/10.1073/pnas.2210323119

Özgen, D. S., Afacan, Y., & Sürer, E. (2021). Usability of virtual reality for basic design education: a comparative study with paper-based design. *International Journal of Technology and Design Education, 31*, 357-377. https://doi.org/10.1007/s10798-019-09554-0

Rad, D., Egerău, A., Roman, A., Dughi, T., Balaș, E., Maier, R., Ignat, S., & Rad, G. (2022). A Preliminary Investigation of the Technology Acceptance Model (TAM) in Early Childhood Education and Care. *BRAIN. Broad Research in Artificial Intelligence and Neuroscience, 13*(1), 518-533. https://doi.org/10.18662/brain/13.1/297

Radianti, J., Majchrzak, T. A., Fromm, J., & Wohlgenannt, I. (2020). A systematic review of immersive virtual reality applications for higher education: Design elements, lessons learned, and research agenda. *Computers & Education, 147*, 103778. https://doi.org/10.1016/j.compedu.2019.103778

Raya, L., García-Rueda, J. J., López-Fernández, D., & Mayor, J. (2021). Virtual reality application for fostering interest in art. *IEEE Computer Graphics and Applications, 41*(2), 106-113.

Rivas, Y., Valdivieso, P., & Rodríguez, M. (2020). Virtual reality and 21st century education. *International Research Journal of Management, IT and Social sciences*, *7*(1), 37-44. https://doi.org/10.21744/IRJMIS.V7N1.820

Scherer, R., Siddiq, F., & Tondeur, J. (2019). The technology acceptance model (TAM): A meta-analytic structural equation modelling approach to explaining teachers' adoption of digital technology in education. *Comput. Educ., 128*, 13-35. https://doi.org/10.1016/j.compedu.2018.09.009

Scientific Platform Serving for Statistics Professional 2021. SPSSPRO. (Version 1.0.11) [Online Application Software]. Retrieved from https://www.spsspro.com

Serin, H. (2020). Virtual reality in education from the perspective of teachers. *Amazonia investiga, 9*(26), 291-303. https://doi.org/10.34069/AI/2020.26.02.33

Song, Y., & Li, L. (2018, August). Research on application of VR technology in art design teaching. In *2018*

International Conference on Engineering Simulation and Intelligent Control (ESAIC) (pp. 343-345). IEEE. https://doi.org/10.1109/ESAIC.2018.00086

Stuyck, T., Da, F., Hadap, S., & Dutré, P. (2017, December). Real-Time Oil Painting on Mobile Hardware. *Computer Graphics Forum, 36*(8), 69-79. https://doi.org/10.1111/cgf.12995

Tahar, A., Riyadh, H. A., Sofyani, H., & Purnomo, W. E. (2020). Perceived ease of use, perceived usefulness, perceived security and intention to use e-filing: The role of technology readiness. *The Journal of Asian Finance, Economics and Business (JAFEB), 7*(9), 537-547. https://doi.org/10.13106/jafeb.2020.vol7.no9.537

Tang, X., Zainal, S. R. B. M., & Li, Q. Multimedia use and its impact on the effectiveness of educators: a technology acceptance model perspective. *Humanit Soc Sci Commun, 10*, 923 (2023). https://doi.org/10.1057/s41599-023-02458-4

Taylor, S., & Todd, P. A. (1995). Understanding Information Technology Usage: A Test of Competing Models. *Information Systems Research, 6*(2), 144-176. https://doi.org/10.1287/isre.6.2.144

Teo, T., & Schaik, P. (2009). Understanding Technology Acceptance in Pre-Service Teachers: A Structural-Equation Modelling Approach. *Asia-pacific Education Researcher, 18*, 47-66. https://doi.org/10.3860/TAPER.V18I1.1035

Venkatesh, V., & Bala, H. (2008). Technology Acceptance Model 3 and a Research Agenda on Interventions. *Decision Sciences, 39*(2), 273-315. https://doi.org/10.1111/j.1540-5915.2008.00192.x

Venkatesh, V., & Davis, F. D. (2000). A Theoretical Extension of the Technology Acceptance Model: Four Longitudinal Field Studies. *Management Science, 46*(2), 186-204. https://doi.org/10.1287/mnsc.46.2.186.11926

Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User Acceptance of Information Technology: Toward a Unified View. *MIS Quarterly, 27*(3), 425-478. https://doi.org/10.2307/30036540

Venkatesh, V., Thong, J. Y. L., & Xu, X. (2012). Consumer Acceptance and Use of Information Technology: Extending the Unified Theory of Acceptance and Use of Technology. *MIS Quarterly, 36*(1), 157-178. https://doi.org/10.2307/41410412

Viguerie, L., Ducouret, G., Lequeux, F., Moutard-Martin, T., & Walter, P. (2009). Historical evolution of oil painting media: A rheological study. *Comptes Rendus Physique, 10*, 612-621. https://doi.org/10.1016/J.CRHY.2009.08.006

Vimala, B. V. (2023). Augumented reality and virtual reality in education. *International Scientific Journal of Engineering and Management*. https://doi.org/10.55041/isjem00244

Westland, J. C. (2010). Lower bounds on sample size in structural equation modeling. *Electronic Commerce Research and Applications, 9*(6), 476-487. https://doi.org/10.1016/j.elerap.2010.07.003

Xi, S. (2010, November). Virtual reality for arts and design education. In *2010 IEEE 11th International Conference on Computer-Aided Industrial Design & Conceptual Design 1* (Vol. 1, pp. 679-682). IEEE.

Yan, Z., Guo, Z., & Guo, M. (2023). On the Combination of Oil Painting Techniques and Modern Illustration Art. *Highlights in Art and Design, 4*(1), 118-121. https://doi.org/10.54097/hiaad.v4i1.12015

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Authors contributions

Gao Nannan, the primary contributor and student, conducted the research, collected and analyzed the data, and wrote the initial draft of the manuscript. Yuhanis Bin Ibrahim and Mohd Firdaus Naif Bin Omran Zailuddin, as supervisors, provided guidance, oversight, and critical revisions to the manuscript. Yao Heng, also a student, assisted in data collection and preliminary analysis.

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The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

Data sharing statement

No additional data are available.