JORNAL OF ASIA SOCIAL SCIENCE PRACTICE
www.shiharr.com

RESEARCH ARTICLE

EXPLORING THE APPLICATION OF VIRTUAL REALITY IN PHOTOGRAPHY EDUCATION: INNOVATIVE APPROACHES AND IMPLICATIONS

Yang Hao[1], Khairul Zahar Bin Jamaludin[1]

[1] Faculty of Education, Universiti Kebangsaan Malaysia (UKM), 43600 Bangi, Selangor, Malaysia

ARTICLE INFO

Submission 07 Feb., 2025
Acceptance 19 Feb., 2025

Keywords
VR technology;
Exhibition for Learning;
Innovative teaching methods

Corresponding Author
P145846@siswa.ukm.edu.my

ABSTRACT

This study is centred on the virtual reality (VR) photography exhibition. It takes the VR photography exhibition as its core, uses the action research method to explore the application of VR technology in the teaching of photography art, and proposes the innovative teaching mode of "Exhibition for Learning". This study utilizes VR technology to overcome the limitations of traditional photography education, particularly in work presentation, feedback mechanisms, and the overall learning experience. The integration of VR enhances students' artistic expression, technical proficiency, and overall skill development. Findings indicate that VR technology significantly enhances students' learning motivation and creativity, provides an immersive learning experience, and improves artistic comprehension through exhibition feedback. This study provides theoretical support and practical insights for the digital transformation and teaching mode innovation of art education.

1. INTRODUCTION

1.1. Background of the Study

The rapid development of VR technology has become a key tool for educational innovation. Its immersive and interactive nature provides a new learning experience for art education, stimulating students' creativity and practical skills. Photography education has long been constrained by traditional methods, focusing on techniques and aesthetic theories while ignoring the display and feedback of works, which limits the improvement of students' practical and performance abilities.

In order to solve this problem, more and more educators are trying to integrate the teaching concept of "Exhibition for Learning" into art education, and stimulate students' learning motivation and creativity through the display of works. However, traditional work display formats have many limitations in terms of space and cost, making it difficult to meet the current needs for personalized creation and immersive experience.

The introduction of VR technology provides a new solution to this problem. With the help of VR technology, we can break through the limitations of physical space and display students' photography works in the form of online exhibitions to achieve an immersive viewing experience. This innovative way not only improves the effect of work display, but also provides students with more opportunities for technological creation and application, which is conducive to cultivating students' comprehensive and practical abilities.

Taking the "Yellow River Guardianss" VR photography exhibition as the core and combining with the action research method, this study explores how to effectively integrate VR technology into the teaching of photographic art and promote the implementation of "promoting learning through exhibition". By displaying students' works in the virtual exhibition hall, it tries to solve the problems of traditional teaching such as limited display of works and ineffective feedback mechanism, which provides a new path and inspiration for the teaching practice of art education.

1.2. Problem Statement

The monolithic presentation of photography education limits the expression of students' creative abilities. By integrating digital photography with cultural contexts, photography education can provide opportunities for deeper expression and reflection(Rubinstein, 2009). Adopting diverse curriculum designs, such as combining practice and theory, can further enhance student performance (Kim, 2015).

Traditional educational models that lack diverse feedback and interactions may limit students from gaining new perspectives from their audience and peers (Cross, 2014). Research indicates that incorporating a more interactive and socially engaged model in photography education can significantly enhance students' creative development (Stanley, 2003).

Immersive experiences play an important role in enhancing students' creativity and innovation. Exploring more immersive and open education modes, such as "one core, three combinations", can stimulate students' artistic potential (Zhang, 2024). In addition, the use of online education technologies to further optimise the learning experience is also a viable direction.

Despite the fact that digital photography technology has been widely used in society, many courses have failed to adequately integrate it into their teaching. Introducing multimedia teaching methods into photography course design can improve learning outcomes and student engagement (Liang et al., 2010). An approach that combines theory and visual culture can effectively remedy the lack of technology integration (Nam, 2016).

1.3. Research Objectives

Enhance the understanding of photographic themes, artistic expression and technical application by guiding students to participate in thematic photographic creation and online exhibition production. Use VR technology to create an immersive exhibition experience, overcome the limitations of the traditional display of photography works, and explore more vivid and diverse ways of displaying teaching results. With the help of the VR exhibition, an interactive platform is built between students, teachers and the audience, and a multi-level feedback mechanism is established to encourage students to reflect on and improve their works. Combined with the action research method, this study aims to verify the actual effect of the VR exhibition-centred "Exhibition for Learning" teaching mode in enhancing students' motivation in learning, practical skills and comprehensive skills, provide practical cases and theoretical support for art education, and provide innovative ideas and practical experience for the digital transformation of art education in the future.

1.4. Research Problems

a. How to effectively integrate VR technology into photography art teaching through the "Yellow River Guardians" VR photography exhibition, and realise the innovative display of teaching achievements?

b. How does the teaching mode of "Exhibition for Learning" centred on VR exhibition affect students' learning motivation, artistic creation skills and comprehensive quality?

1.5. Research Significance

1.5.1. Theoretical Significance

This study combines VR technology and photography art education, extends the digital application of the concept of "Exhibition for Learning", and systematically analyses its impact on students' outcomes and teaching modes through the action research method, so as to provide a new method for the theoretical innovation of art education.

1.5.2. Practical Significance

This research provides a new type of teaching mode for teaching photography art, breaking through the limitations of traditional work display through VR exhibition, improving the presentation effect of students' creative achievements, and at the same time enhancing students' learning motivation and creative drive. The findings provide practical references for educators in designing and implementing digital teaching projects while exploring strategies for integrating technology into various fields of art education.

1.5.3. Social Significance

Through the "Yellow River Guardianss" VR photography exhibition, we cultivate students' artistic skills and creative consciousness, while enhancing their concern for local culture and ecological protection, and demonstrating the social responsibility of art education.

2. LITERATURE REVIEW

2.1. Reflection on Past Teaching and Learning Practices

In traditional photography art teaching, the teaching objectives usually focus on the teaching of photography skills and the explanation of aesthetic theories, while the presentation and feedback of students' works are often additional parts of the course. Although this teaching mode can improve the technical level of students to a certain extent, it has obvious deficiencies in stimulating students' creativity, enhancing the expression of their works, and meeting the demand for the display of students' learning achievements.

In traditional teaching, students' photography works are mostly presented in the form of classroom display or printed portfolio. This static, one-way display cannot fully present the creative ideas and emotional expression behind the works, and it is also difficult for students to reflect on their works from a diversified perspective. This lack of attractiveness and depth of the display form, weakening the students' enthusiasm for creativity and learning motivation.

In the past teaching, the evaluation of students' works mainly relied on the teacher's unilateral grading and verbal feedback, and peer evaluation and audience feedback were almost missing. This single feedback channel easily leads to students' one-sided understanding of the direction of work improvement, which limits the development of their artistic expression and critical thinking.

Photography art education emphasises visual expression and emotional transmission, but in teaching practice, the environment in which students' works are presented is often disconnected from the real environment. Traditional classrooms or campus exhibition venues are unable to provide an immersive experience, making it difficult to achieve the educational goal of "situational integration".

Despite the increasing popularity of digital technology in education, photography courses lag behind in the integration of new technologies. Most of the teaching methods are still based on the transmission of technology, and there is a lack of exploration of emerging technologies such as VR, which fails to provide students with a multi-dimensional learning experience, and fails to fully demonstrate the potential of art education.

Students' photography works are often only used for classroom display, without the opportunity to spread and communicate to a wider social group. This limitation not only reduces students' motivation to create, but also makes it difficult for them to truly understand the social

significance of art creation, and unable to establish a deeper sense of social responsibility in the process of creation.

2.2. Constructing Immersive Learning Environments

Zeng (2024) proposes that VR technology offers new perspectives on art education through immersive experiences. In the virtual gallery, students can explore and interact from a first-person perspective, gaining a deeper understanding of the conceptual logic of the artwork, thereby stimulating creativity. Xu (2024) showed that VR technology can help students overcome the limitations of physical exhibitions and improve their art appreciation and creative expression abilities. The virtual art museum has greatly improved students' interest and understanding of art, providing innovative solutions for reforming traditional education (Wang, 2024).

2.3. Facilitating Remote and Interactive Teaching

Research shows that VR technology can significantly improve motivation, cognitive abilities, and reflective abilities, and optimize learning satisfaction (Serna-Mendiburu & Guerra-Tamez, 2024). Zeng (2024) pointed out that VR technology solves the problem of lack of interaction in traditional distance learning by building an immersive digital learning environment. Students can use VR equipment to enter the virtual classroom, interact with teachers and classmates in real time, and complete creative tasks. VR also provides a global art exchange platform where students can discuss their art creations with teachers, display their works in virtual galleries, and receive real-time feedback. By combining art and technology, VR effectively enhances the interactivity and participation of distance learning (Y. Song & Li, 2018).

2.4. Transforming Teaching Strategies

VR-based teaching platforms improve our teaching skills and student engagement, significantly improving instructional design and educational outcomes (Cecotti et al., 2020). Zeng (2024) emphasized that VR technology diversifies art teaching strategies. Students can remotely visit art museums around the world and gain an in-depth understanding of the context and cultural connotations of artworks. Virtual classrooms also break the limitations of physical space, allowing teachers to conduct real-time teaching in virtual scenes, thereby improving creative efficiency. VR technology enhances the visualization of art, allowing students to better understand the three-dimensional dynamics and contextual intent of artworks (P. Liu, 2021).

2.5. Promoting Interdisciplinary Collaboration and Innovation

Zeng (2024) believes that the combination of VR and art can enhance artistic expression, cultivate new art forms, and stimulate innovative thinking. Empirical research shows that virtual museums can promote interdisciplinary learning and interaction by combining interactive games with VR (Riveros Huaman et al., 2019). VR platforms combined with deep learning technology can create immersive multimedia environments that further enhance students' collaboration skills and creativity (H. Song & Zhao, 2024).

2.6. Enabling Personalized Learning and Custom Teaching

Personalized teaching methods based on VR technology can effectively enhance students' creativity and interest in independent learning (Lin et al., 2023). Zeng (2024) proposed that VR technology can personalize the learning experience by designing learning strategies based on students' motivations and optimizing them through instant feedback. A real-time feedback system can track students' creative processes and provide suggestions for improvement to help address deficiencies. Research shows that VR environments can adapt to student needs, improve motivation, enrich teaching outcomes, and reduce physical costs (Du, 2021).

2.7. Challenges in Popularizing VR Technology

Figueroa Jr. et al., (2022) highlight the twin challenges of universal access to VR technology: economic and technical. Although the cost of equipment is declining, high fees remain a barrier for schools with limited resources.VR's reliance on advanced hardware and network infrastructure also poses challenges for under-resourced institutions (Deng et al., 2021). In addition, privacy concerns regarding students' personal information need to be addressed through policy and regulatory measures (F. Liu, 2021).

3. RESEARCH METHODOLOGY

3.1. Research Design

This study explores the application of VR technology in photography teaching through the action research method, taking the "Yellow River Guardians" VR photography exhibition as the core, and dividing it into four phases: planning, action, observation and reflection, so as to solve the actual teaching problems and improve the effect.

3.2. Target Participants

The study involved 100 undergraduate photography students from a university, divided into two classes. The participants have some basic knowledge of photography, but their understanding of VR technology is limited. In this study, the VR exhibition production was done through group creation and collaboration in order to cultivate students' artistic creation skills, technology application skills and teamwork skills.

3.3. Data Collection Methods

Questionnaire survey method: questionnaires are distributed to understand students' learning experience, technology mastery and feedback on VR exhibitions.

3.4. Data Analysis Techniques

Quantitative data analysis: perform statistical analysis on the data questionnaire, and use descriptive statistics and correlation analysis to evaluate students' acceptance of VR technology and its impact on learning outcomes.

3.5. Ethical Considerations

Before the start of this study, the purpose, process and possible impact of this study will be explained in detail to all participants to ensure that they have a full understanding of this study. All participants will be informed of their roles and responsibilities in the study and understand the risks and discomfort they may encounter during the study. Ensure that they participate voluntarily and understand their right to withdraw from the study at any time.

In order to protect the privacy and data security of the participants, strict measures will be taken during the study to ensure that students' personal information and data are fully protected. All personal data collected will be strictly confidential and will only be used for academic research purposes and will not be used for any commercial or non-research related purposes. The data will be stored in an encrypted manner, and access rights will be limited to members of the research team to ensure that unrelated individuals cannot access sensitive information. After the completion of the study, the participants' data will be anonymized to maximize their privacy.

The study protocol has been reviewed by the ethics committee of the host university to ensure that the study complies with relevant ethical standards and ethical norms for educational research. During the course of the study, the researcher will follow all applicable ethical guidelines to ensure ethical and compliant research behaviour. The rights and motivations of the participants will be respected and any negative impact on them will be avoided.

3.6. Research Process

Planning stage: determine the research objectives and research problems, design the framework of teaching activities and exhibition contents based on VR technology, and train students to master the basic knowledge of VR technology.

Action phase: organise students to complete the photography creation with the Yellow River as the theme, and guide them to digitally process the works and produce a VR exhibition.

Observation phase: During the whole teaching and exhibition production process, record students' learning performance and teamwork, and collect relevant data at the same time.

Reflection phase: analyse the data, reflect on the effectiveness and shortcomings of the teaching mode, and put forward suggestions for further improvement to provide guidance for future teaching practice.

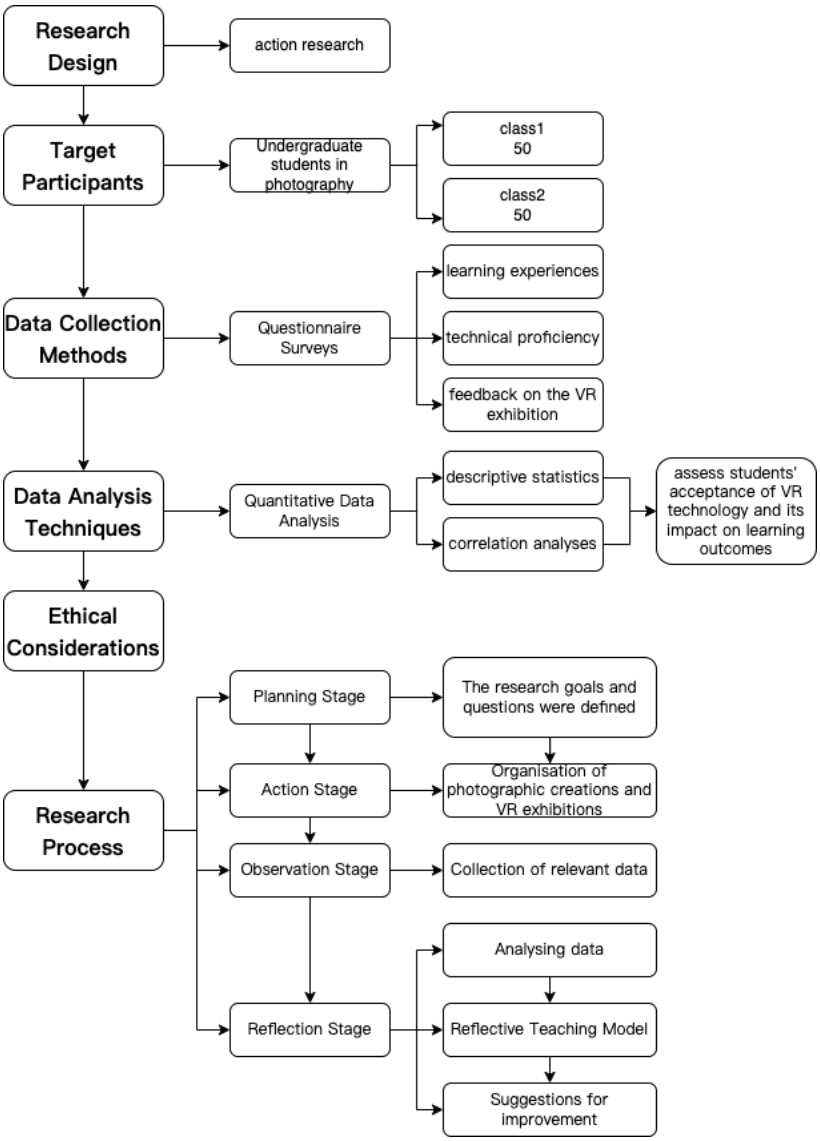

Figure 1: Flow chart of the study

4. IMPLEMENTATION OF ACTION RESEARCH

4.1. Planning Phase

The core objective of this phase is to guide students to create and present photographic works through VR technology. In this process, students will use VR technology to create photographic works and present them as an immersive exhibition around the Yellow River culture and ecological environment. Through this teaching activity, students will not only master the basic operation of VR, but also learn how to combine photographic works with online exhibitions, and then design and plan the structure of the exhibition, display details and interactive experience, so as to enhance their artistic creation and technology application skills.

At the early stage of teaching, in order to ensure that students can smoothly participate in the production of VR photography exhibition, it is necessary to organise basic training on VR

technology for students. The content of the training includes the basic process of VR exhibition, the use of related tools and equipment, the construction of virtual space and interaction design, and the operation of related software. Students will understand the operating principles of VR exhibitions and master how to use VR technology to display photographic works, thus laying a solid technical foundation for subsequent exhibition production.

According to the motivation and interest of the students, they are divided into six groups, each of which is responsible for a sub-theme of the exhibition. The tasks of each group include identification and content design, photo shooting and post-production. In the process, the teacher will guide each group, helping them to formulate programmes and solve technical problems encountered in the actual operation. This grouping ensures that each student can give full play to his/her own strengths and teamwork ability to complete the whole VR exhibition together.

In order to ensure the diversity of the exhibition content and the quality of the creation, regular team discussions and progress reporting meetings will also be arranged during the planning stage. Through mutual communication and feedback among team members, problems will be identified and solved in a timely manner to ensure that the creative direction and exhibition content of each group can be coordinated with the overall theme. Teachers will regularly assess the progress of each group and give specific guidance and suggestions to facilitate students' continuous improvement and enhancement in the creative process.

4.2. Action Phase

The action phase is the core part of the study and involves the actual teaching and learning process. In this phase, students will create, virtually display, and plan exhibitions.

Under the guidance of the teacher, students will take the theme of "Yellow River Guardianss" as the background, and shoot relevant landscapes and portraits. Each group will observe and understand the ecological environment and cultural heritage of the two sides of the Yellow River and create photographs with artistic value and social significance. After the works are completed, students will use professional software to digitise them and convert them into a format suitable for VR display.

Each group will be responsible for designing and constructing the exhibition space, including the layout of the exhibition, the way the works are displayed, and the interactive features. Students will learn how to lay out the works in the virtual space, and how to design the exhibition path and viewing experience to ensure that the audience can smoothly navigate, interact and deeply understand the artistic connotation of each work in the virtual environment.

The completed works will be imported into the online exhibition platform and tested several times to ensure the smoothness and technical feasibility of the exhibition. Each team will repeatedly adjust the content and format of the exhibition to solve problems and optimise the user experience.

4.3. Observation Phase

The observation phase aims to record the effects of the teaching process in real time, and to analyse the students' learning and the interactive feedback of the exhibition.

Teachers observe students' performance throughout the creation and exhibition production process, recording students' technical mastery, teamwork and quality of artistic expression in the creative process. Observations include students' creative attitude, learning commitment, problem-solving skills, etc.

After the completion of the VR exhibition, relevant people are invited to visit the online exhibition. Feedback from the visitors will be collected through questionnaires and interviews, including their evaluation of the exhibition form, content, and interactive experience. Students will also participate in the evaluation of other groups' work and gain ideas for reflection and improvement from the feedback of exhibition viewers.

Students will reflect on the creative process, the effectiveness of the exhibition presentation and the use of technology through self-assessment and discussion within the group. Students will share their experiences and gains, ask questions and explore solutions, and promote mutual learning and growth among team members.

4.4. Reflection Stage

In this stage, the teacher will review and reflect on the teaching activities through a variety of means to ensure that the teaching methods used can maximise students' learning and creativity.

The results of the questionnaire survey and classroom observation records are analysed to assess the effectiveness of using VR technology in teaching photographic art. The questionnaire survey can collect feedback on students' evaluation of the teaching process, their experience of using VR technology, their mastery of the new technology, their motivation to learn and changes in their creative abilities. Classroom observation records can help teachers assess students' participation in teaching activities, their skills in manipulating the technology and their performance in teamwork. By analysing these data, teachers can gain a comprehensive understanding of students' progress in the learning process and assess the specific impact of VR technology on their learning outcomes.

Based on the data analysis and student feedback, teachers and students will review the whole teaching process together. Through group discussion, students can share the difficulties and gains they encountered during their participation in the creative process, and the teacher can obtain suggestions for improvement of the teaching activities from the students' feedback.

The reflection phase will also include in-depth analyses of specific aspects of exhibition design, technology application and student engagement. Teachers and students will discuss possible problems with the design of the exhibition and the implementation of the technology, and suggest improvements so that similar problems can be solved in the next teaching activity and the overall teaching effect can be improved.

Teachers can also apply the results of the reflection phase to their future teaching practice by optimising course design, adjusting teaching methods or improving the use of teaching tools.

5. RESULTS AND DISCUSSION

5.1. Presentation of Data

The data collected in this study came from questionnaires and classroom observations, mainly focusing on students' acceptance of VR technology, learning motivation, creative performance and exhibition interactive experience.

Among them, the average rating of the impact of VR technology on learning motivation is high, indicating that VR technology effectively enhances learning motivation. The contribution of teamwork to the learning experience was generally rated high, indicating that teamwork has a significant positive impact in the learning process. Overall Experience Satisfaction as a measure of end-user experience, this field reflects participants' satisfaction with the entire learning process.

5.1.1. Student Acceptance of VR Technology

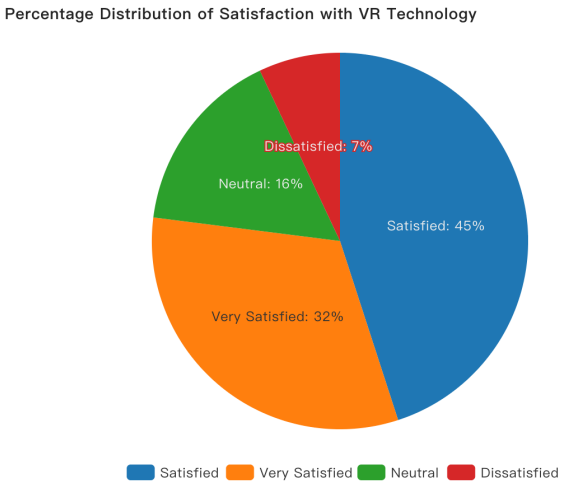

Figure 2: Percentage Distribution of Satisfaction with VR Technology

In the questionnaire survey, 77% of students expressed enthusiasm for the application of VR technology in photography education and were willing to learn more about how to use VR for creation and presentation. 23 per cent of the students indicated that there were some difficulties at the initial stage, but that they gradually overcame them in the course of the course and the training, and that they were eventually able to use the relevant tools in a more proficient way.

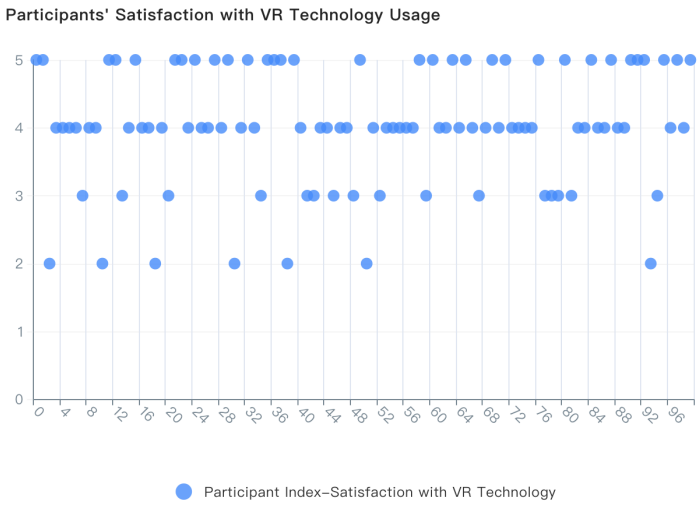

Figure 3: Prrticipants' Satisfaction with VR Technology Usage

This scatterplot shows the distribution of participants' satisfaction with the use of VR technology. The horizontal axis represents the number of the participants and the vertical axis represents their satisfaction ratings (from 1 to 5) with the use of VR technology. It can be observed from the graph that the majority of the participants had high satisfaction ratings, centred on 4 and above, indicating that VR technology was rated favourably overall. The low ratings of a few participants may be related to their personal experience with VR technology, which warrants further investigation and improvement.

5.1.2. Increased Motivation in Learning

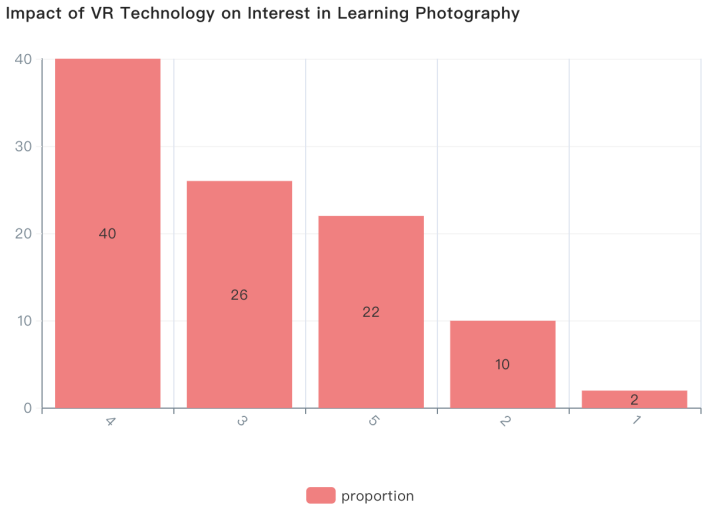

Figure 4: Impact of VR Technology on Interest in Learning Photography

The figure above shows the distribution of ratings on the impact of VR technology on motivation in learning photography. Moderate and above ratings (3, 4 and 5) accounted for 88%, and positive ratings (4 and 5) accounted for 62%, indicating that most of the participants believed that VR technology significantly enhanced their motivation in learning photography, and

especially showed strong motivation in the integration of technology and creativity, and that the monotony of traditional teaching was effectively addressed.

5.1.3. Improvement in Creative Skills

Students demonstrated significantly more innovative thinking during the creative process. Especially in the creation of the theme and the design of the online exhibition space, students not only improved their filming skills, but also learnt how to present the works in a new form, showing the natural landscape on both sides of the Yellow River through VR technology, which gave the works a stronger sense of immersion and emotional transmission.

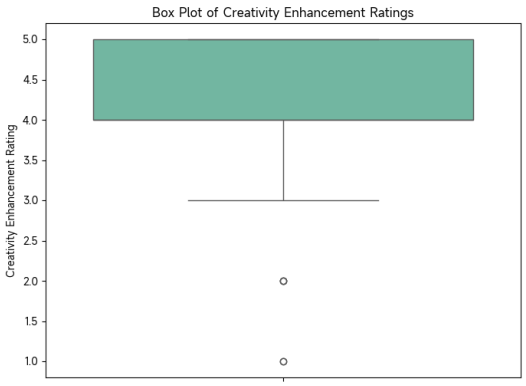

Figure 5: Box Plot of Creativity Enhancement Ratings

This box-and-line plot provides a clear picture of the concentration trend and dispersion of the creative skills improvement ratings. Most of the ratings are concentrated in the higher ranges (4 and 5), indicating that participants generally felt that their creative abilities improved significantly over the course of the exhibition.

5.1.4. Interactive Exhibition Experience

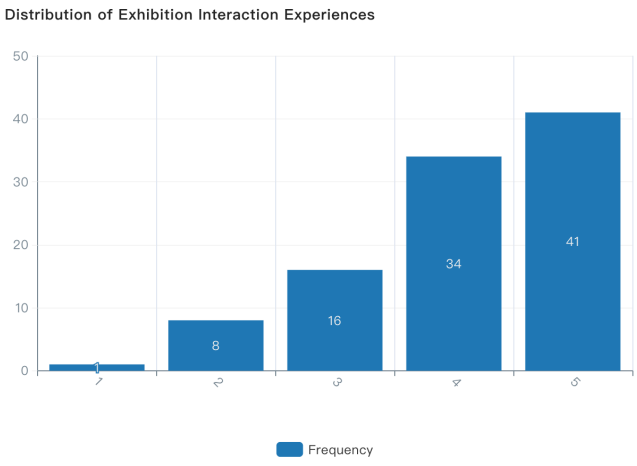

Figure 6: Distribution of Exhibition Interaction Experiences

At the later stage of the exhibition, the interactive feedback from students and visitors became crucial data for assessing the effectiveness of the exhibition. As can be seen from the graph, the ratings were mainly centred between 4 and 5, which means that most of the participants had a positive attitude towards the interactive experience of the exhibition. The low frequency of 1 and 2 indicates that only a few participants were dissatisfied with the interactive experience of the exhibition. The graph shows that participants' feedback on the interactive experience of the exhibition was mostly positive, with only a few giving lower ratings. This suggests that the interactive design of the exhibition was generally successful, but may need to be improved to meet the needs of all participants.

5.2. Analysis and Interpretation

5.2.1. VR Technology Enhances Students' Artistic Expression

Students enhanced their artistic expression and explored new creative possibilities by transforming their photographic works from two-dimensional to interactive three-dimensional displays using VR technology. This finding supports the first question in the study - how VR technology affects students' artistic creation and presentation of their work.

5.2.2. The "Exhibition for Learning" Model Promotes Students' Comprehensive Skills

During the research process, students not only acquired skills in technology and art creation, but also participated in the planning, design, and implementation of the exhibition. This project-based learning approach enhances students' comprehensive skills, especially in teamwork, project management and problem solving. Students took on different roles in the creation and exhibition process, and thus gained more comprehensive skills in practice. This suggests that the "Exhibition for Learning" model can effectively promote the development of students' interdisciplinary skills, especially in the integration of art creation and technology application.

5.2.3. Integration of Technology and Art Stimulates Students' Creative Drive

The students' enthusiasm for VR technology reflects its role in promoting artistic creation; VR technology enables students not only to visualize their works in virtual space, but also to interact with the audience through the network, expanding the scope of dissemination. Students' motivation to create was greatly enhanced, stimulating their enthusiasm for artistic creation. This finding verifies the results expected in the action research and shows that students' motivation in creation can be increased through an innovative teaching model.

5.2.4. Exhibition Feedback Helps Students' Self-assessment and Growth

Through the audience feedback collected after the exhibition, students were able to obtain a more direct and comprehensive evaluation of their works and reflect on their own creations. This two-way feedback mechanism not only allows students to see their own progress, but also helps them to recognise the shortcomings in their creations, thus pushing them to make improvements and enhancements.

5.3. Discussion

5.3.1. The Breakthrough of VR technology to the Traditional Teaching Mode

The research results show that the introduction of VR technology has successfully broken through the limitations of traditional photography art teaching. Traditional teaching focuses on single skill training or theoretical learning, while VR technology not only provides students with the opportunity to combine theory with practice, but also provides students with a more diversified artistic creation display platform, which stimulates students' learning interest. Students' creations are no longer limited to paper portfolios or classroom presentations, but through immersive experience, a deeper emotional connection is established between the work and the audience. This innovative teaching model provides a new direction for the development of future art education.

5.3.2. Practical Effects of the "Exhibition for Learning" Model

This study verifies the effectiveness of the "Exhibition for Learning" model in art education. Through the actual production and display of exhibitions, students can not only gain more creative space, but also exercise comprehensive skills through practice. This model that emphasizes the combination of creation and display not only meets students' needs for artistic creation, but also promotes their growth in teamwork, project management, and technology application. This model has broad application potential in other art disciplines and can provide reference for teaching reforms in other fields.

5.3.3. Future Difficulties and Improvements

Although this study has achieved significant results in terms of teaching innovation and student outcomes, it still faces some difficulties. The application of VR technology still has a certain learning threshold for some students, especially in technical operation and exhibition design. And the high cost of equipment and the need for technical support may limit its application in a wider range of educational scenarios. It is hoped that in the future, the technical threshold can be lowered through more training and resource sharing, and that investment in related projects can be increased so that this technology can be popularised in more educational areas.

6. CONCLUSIONS AND RECOMMENDATIONS

6.1. Conclusion

The incorporation of VR technology has significantly enriched the artistic and technical skills of students in photography education, transforming traditional two-dimensional works into an immersive three-dimensional experience. This innovation not only allows students to master photography skills, but also to learn interdisciplinary skills. The teaching mode of "Exhibition for Learning" further enhances students' comprehensive abilities in artistic creativity, teamwork, project management and technology application. By participating in the planning and

implementation of the exhibition, students were able to demonstrate their learning outcomes, stimulate motivation and increase their confidence, and the interactivity and immersion of VR technology deepened their understanding of the fusion of the art of photography and virtual exhibitions, making learning even more engaging than with traditional methods. Feedback during and after the exhibition provided students with valuable creative evaluations and directions for improvement, while the social participation attributes of the exhibition provided students with real-life application scenarios, effectively promoting their creative growth and learning outcomes.

6.2. Recommendations

In order to promote the application of VR technology in education, it can be used as a regular teaching tool in art education, formulate training courses and teaching guides, lower the technical threshold, and at the same time increase the investment in hardware and software equipment to provide students with more opportunities to learn and use the technology. In terms of teaching mode, deepen the concept of "Exhibition for Learning", expand it to more art disciplines, form an interdisciplinary innovation mode, motivate students through the exhibition results, and enhance the sense of achievement in learning. Through questionnaire surveys and student reflections, we will comprehensively assess the effectiveness of teaching, use data analysis to optimise teaching strategies, and improve students' learning experience and teaching quality. Encourage teachers and students to participate in creative projects such as VR online photography exhibitions, and plan more thematic exhibitions with social impact, thereby fostering students' creative interest and social engagement. To cope with the high cost problem, economic VR solutions can be explored, and through co-operation with local cultural institutions or enterprises, resources can be shared to promote the popularisation of the technology.

CONFLICT STATEMENT

The authors declare no conflict of interest.

COOPERATION STATEMENT

The first author (Yang Hao) was responsible for conceptualization, methodology, investigation, writing—original draft, and data analysis. The second author (Khairul Zahar Bin Jamaludin) provided supervision, guidance, and critical revisions. Both authors reviewed and approved the final manuscript.

REFERENCES

Cecotti, H., Day-Scott, Z., Huisinga, L. A., & Gordo-Peláez, L. J. (2020). *Virtual reality for immersive learning in art history*. 16–23. https://doi.org/10.23919/iLRN47897.2020.9155108

Cross, K. (2014). Training the eye of the photographer: The education of the amateur. *Visual Studies*, *29*(1), 68–79. https://doi.org/10.1080/1472586X.2014.862996

Deng, X., Lei, J., & Chen, M. (2021). Application of VR in the experimental teaching of animation art. *Mobility Information Systems*, 4642850:1-4642850:7. https://doi.org/10.1155/2021/4642850

Du, S. (2021). *Application analysis of virtual reality VR technology in art design teaching*. Journal of Physics: Conference Series. https://doi.org/10.1088/1742-6596/1881/2/022056

Figueroa Jr., R. B., Palma Gil, F. A., Taniguchi, H., & Esguerra, J. R. (2022). Virtual reality photo-based tours for teaching Filipino vocabulary in an online class in Japan: Transitioning into the new normal. *International Journal in Information Technology in Governance, Education and Business*, *4*(1), 29–41. https://doi.org/10.48550/arXiv.2301.01908

Kim, M. (2015). The educational status of college-level photography-related courses. *Education 3-13*, *103*, 186–191. https://doi.org/10.14257/astl.2015.103.40

Liang, Y.-F., Yang, C.-Z., & Li, S.-Y. (2010). *Teaching design on photography course under multimedia environment*. 161–163. https://doi.org/10.1109/MEDIACOM.2010.55

Lin, Y., You, Y., & Zhou, Z. (2023). Application of VR in the field of education. *Highlights in Science, Engineering and Technology*. https://doi.org/10.54097/hset.v68i.11925

Liu, F. (2021). *Construction of contemporary art teaching platform based on virtual reality technology*. 2021 4th International Conference on Information Systems and Computer Aided Education. https://doi.org/10.1145/3482632.3483999

Liu, P. (2021). Application and teaching exploration of virtual reality technology in art appreciation. *International Journal of Learning and Teaching*. https://doi.org/10.18178/ijlt.7.3.187-193

Nam, T.-O. (2016). Photography's educational study: Against practical-based curriculum in photography education. *Journal of Digital Convergence*, *14*(2), 359–367. https://doi.org/10.14400/JDC.2016.14.2.359

Riveros Huaman, E. M., Apaza Aceituno, R. G., & Sharhorodska, O. (2019). Application of virtual reality and gamification in the teaching of art history. *Lecture Notes in Computer Science*, 220–229. https://doi.org/10.1007/978-3-030-21817-1_17

Rubinstein, D. (2009). Towards photographic education. *Photographies*, *2*(2), 135–142. https://doi.org/10.1080/17540760903116598

Serna-Mendiburu, G. M., & Guerra-Tamez, C. R. (2024). Shaping the future of creative education: The transformative power of VR in art and design learning. *Frontiers in Education*. https://doi.org/10.3389/feduc.2024.1388483

Song, H., & Zhao, X. (2024). Immersive multimedia art design based on deep learning intelligent VR technology. *Journal of Electrical Systems*. https://doi.org/10.52783/jes.1703

Song, Y., & Li, L. (2018). *Research on application of VR technology in art design teaching*. 343–345. https://doi.org/10.1109/ESAIC.2018.00086

Stanley, N. (2003). Young people, photography and engagement. *International Journal of Art and Design Education*, *22*(2), 134–144. https://doi.org/10.1111/1468-5949.00349

Wang, S. (2024). Enhancing art education through virtual reality: The impact of virtual art museums on junior high school students. *Research and Advances in Education*. https://doi.org/10.56397/RAE.2024.09.05

Xu, B. (2024). Practice of digital media art education based on virtual reality technology. *Journal of Electrical Systems*. https://doi.org/10.48550/arXiv.2407.09528

Zeng, Q. (2024). Research on innovative paths of art education based on virtual reality technology. *International Journal of Education and Humanities*, *14*(3), 129–133. https://doi.org/10.54097/d3g8xr35

Zhang, Z. (2024). Exploration and Practice of the "One Core and Three Combinations" Teaching

Model in Photography Courses. *International Education Science and Theory*. https://doi.org/10.26789/ijest.v3i7.1958