METAVERSE ENHANCING VOCATIONAL SKILLS OF DIGITAL MEDIA EDUCATION IN CHINESE HIGHER VOCATIONAL INSTITUTIONS

YELAN WANG

A THESIS SUBMITTED IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR THE DEGREE OF
MASTER OF ARTS IN EDUCATION AND SOCIETY
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RAJAMANGALA UNIVERSITY OF TECHNOLOGY KRUNGTHEP
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ABSTRACT

This study examines the impact of metaverse technology on vocational skills training in higher vocational education in my country, focusing on practical experience, professional knowledge, innovation ability, and technical proficiency. It assesses the level of students' use of metaverse technology to enhance their technical and vocational skills. The research subjects are students in the audio-visual language course of the Digital Media Art Design major at Fuzhou Software Vocational and Technical College. A quantitative research method was employed, utilizing teaching plans, pre-tests and post-tests, questionnaires, and other tools. A total of 54 valid questionnaires were collected. The results showed that (1) the impact of metaverse technology on vocational skills training in higher vocational education, focusing on practical experience, professional knowledge, innovation ability, and technical proficiency, was at a high level. (2) Vocational skills acquired through metaverse technology are higher than before learning. (3) Students who learned metaverse technology had a high feedback level. Metaverse technology fosters an interactive learning approach, enhancing vocational skills, transforming educational models, and supporting teaching reform while laying the groundwork for its broader application in vocational education through curriculum innovation.

Keywords: Metaverse Technology, Immersive Learning Environment, Vocational Skills, Chinese Higher Education

ACKNOWLEDGEMENTS

Two years ago, driven by a deep curiosity for global education, I began my transformative journey at Rajamangala University of Technology Krungthep. The Institute of Science Innovation and Culture (ISIC) has been a cornerstone of my academic and personal growth. I am immensely grateful to all my professors, whose dedication to teaching and mentorship has profoundly shaped my thinking. Their encouragement to examine issues from multiple perspectives has fostered in me a critical mindset and an appreciation for lifelong learning.

I extend my deepest gratitude to my supervisor, Asst. Professor Wannaporn Siripala. Her kindness, patience, and guidance have been instrumental in every stage of my thesis. I am equally thankful to Professor Saifon Songsiengchai, whose cultural sensitivity and inclusive teaching created a supportive learning environment. Their balance of academic rigor and compassion has inspired me to pursue excellence with humility and a sense of purpose.

My heartfelt thanks also go to all ISIC faculty members for their generous support, insightful feedback, and access to valuable academic resources. This institution has provided me with countless opportunities that have prepared me for future professional challenges.

To my family, your unwavering support has been my greatest strength. Your love and belief in me gave me the courage to pursue this path. Finally, I thank myself for daring to pursue an international education at 35, for persevering through moments of doubt, and for remaining committed to growth.

I look forward to reuniting with my teachers and peers to celebrate our shared journeys and continued aspirations.

Yelan WANG

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INTRODUCTION

1.1 Background

1.1.1 The Rise of Metaverse Technology in Vocational Education

With the rapid development of science and technology, we are witnessing the emergence of a new digital era: the metaverse era. The metaverse is a combination of the prefix "meta," which implies transcending, and the word "universe," which describes a parallel or virtual environment linked to the physical world (Tlili et al., 2022). Metaverse refers to the next generation of the Internet. It is a universe of a network of virtual environments that provide an immersive online experience. In this universe, users are represented by avatars who can interact with other people and elements in the same environment. It can be said that this new term represents a new construction, an environment that enables digital living (Recker et al., 2021). The Metaverse, which originated from the 1992 science fiction novel by the Hugo Award-winning Author, is now widely regarded as the next stage of the Internet's evolution, integrating the real and virtual worlds more deeply. In 2021, after the term "Metaverse" gained popularity, various companies explained the concept of the Metaverse from their own perspectives and development directions. Facebook founder Zuckerberg defined the Metaverse as a social platform with a strong sense of immersion.

Roblox Baszucki, CEO of Baidu, believes that the Metaverse is a persistent, shared three-dimensional (3D) virtual space in a virtual universe. Baidu Vice President Ma Jie believes that the Metaverse is essentially a process of virtualizing and digitizing the real world. The Metaverse serves as a crucial guide for various companies to transition their operations from the physical world to the virtual world. The academic community's understanding of the metaverse has become consistent, and it is generally believed that the metaverse is a world that seamlessly integrates the virtual and real worlds (Zhang, 2023). With the proposal of the metaverse concept and the rapid development of related technologies, the metaverse concept has received widespread attention and is hailed as the future of virtual reality (Lee et al., 2021). Due to its potential to create immersive and interactive digital environments, the Metaverse has

entered various industries, including entertainment and social networking (Gastón et al., 2022). In the metaverse space, people can participate in various social activities, such as discussing problems, collaborating on projects, playing games, engaging in educational experiences, or solving challenges (Bourlakis et al., 2009; Jovanovi'c & Milosavljevi'c, 2022; Park & Kim, 2022). This would be an alternative reality in which one can perform all one's daily tasks without moving (e.g., interacting with colleagues in the office without experiencing traffic jams or taking the train during rush hour) (Gastón et al., 2022).

In recent years, with the continuous development of technology, Metaverse technology has gradually penetrated the education industry. Metaverse technology has gradually become one of the important application scenarios in the field of vocational education. Metaverse technology, with its unique interactivity, immersive experience, and highly realistic virtual reality environment, provides a new perspective and method for modern teaching. It can significantly enrich the teaching content and form in vocational education, creating virtual simulation scenes. Provide students with an immersive practical training and internship environment (Tlili et al., 2022).

In recent years, some vocational schools have begun to utilize VR/AR and other technologies to develop virtual simulation training platforms and establish virtual classrooms based on the Metaverse, thereby enhancing the quality of teaching (Moolenar & Sleegers, 2015; Niemi & Isopahkala, 2015). At the same time, technological advancements such as mobile Internet and 5G networks have also provided support for the application of metaverse technology in vocational education (Gastón et al., 2022). The development of Yuanverse is expected to profoundly transform the teaching and learning model of vocational education, promoting the advancement of digital, intelligent, and personalized education. At Nanjing University of Information Science and Technology, the application of metaverse technology has become a significant research focus. The rise and application of Metaverse technology in vocational education provide students with a more realistic and vivid learning experience, promoting (Moolenar & Sleegers, 2015; Niemi & Isopahkala, 2015).

1.1.2 Overview of the Application of Metaverse Technology in Vocational Education

The traditional teaching model is gradually lagging in the face of modern

professional needs. Traditional teaching methods are limited by physical space, are difficult to provide sufficient practical experience, and cannot fully meet students' personalized learning needs. The complexity and diversity of career fields require students to possess a broader range of knowledge and skills, and traditional models of subject isolation often fail to meet this demand (Lam et al., 2020). The problems existing in traditional vocational education have become increasingly prominent, and there is an urgent need for more practical and innovative educational methods. In the field of vocational education, the application of metaverse technology is increasingly showing its unique advantages. Metaverse technology presents new opportunities for vocational education thanks to its immersive and interactive features. The application of Metaverse technology in vocational education primarily involves the comprehensive integration of emerging technologies, including Virtual Reality (VR), Augmented Reality (AR), and Artificial Intelligence (AI), to create an immersive and personalized learning environment for teaching activities. Enabling students to participate deeply and interact improves learning effects and teaching quality.

By employing teaching methods such as virtual simulation experiments and simulating actual operations, Metaverse technology can enable students to practice practical operations in a simulated environment, thereby improving their practical operation skills (Heim, 1998; Bostoen, 2021). At the same time, Yuanverse technology can also facilitate distance education and online learning, enabling students to study at any time and from anywhere, thereby improving learning efficiency and flexibility. In our country, many schools have begun to incorporate metaverse technology into their daily teaching. For example, the Communication University of China established the Metaverse Cultural Laboratory in 2020, aiming to research the cultural communication of the Metaverse, immersive business formats, and virtual-reality interaction. Additionally, students majoring in architecture at many colleges and universities in China can simulate the entire process of architectural design and construction using Metaverse technology to understand the actual working environment and the required skills. Students majoring in tourism can utilize Metaverse technology to simulate tourist attractions and tour guide work, thereby gaining an understanding of the tour guide's work process and identifying matters that require attention. Relying on the Metaverse platform, a realistic three-dimensional virtual working environment is created, allowing

students to learn work processes and operating specifications in the digital space.

For example, virtual factories and virtual hotels can be established to allow students to learn vocational skills in an immersive environment. This can compensate for the shortcomings of the real work environment (Sanglier, 2021). At the same time, the EngEd Metaverse platform can also create a virtual teamwork environment using metaverse technology, enabling students to participate in team interactions through virtual avatars and complete tasks such as division of labor, cooperation, and problem-solving. This approach can help students better understand the importance of teamwork and develop their skills in role positioning and collaboration within the team. Metaverse technology enables real-time voice, text, image, and other forms of communication, allowing students to communicate at any time and from anywhere. This convenient communication method can enhance students' communication efficiency and help them make informed decisions in their academic pursuits and professional endeavors. Metaverse technology can simulate various scenarios that students may encounter in real-world work, allowing them to immerse themselves in complex and ever-changing workplace environments. The TEAMS tool, for example, which allows us to interact live with students and teachers, will enable us to accomplish a lot and make it more enriching for all students. All students can exercise their judgment, analytical skills, and adaptability in the process of solving problems and making decisions (Furht， 2008). These abilities are critical for future career development.

Additionally, some universities are actively exploring the application of Metaverse technology in experimental training, online education, and other fields to enhance teaching quality and improve student learning outcomes. In online vocational education, Yuanverse technology can construct various virtual vocational scenarios, such as medical simulation surgery and engineering simulation construction, allowing students to conduct actual operations in a safe and controlled environment, thereby improving their vocational skills (Touraine, 2005). Metaverse technology can enable real-time voice, text, image, and other forms of communication, facilitating effective communication and collaboration between students and helping to cultivate teamwork and communication skills. Metaverse technology can simulate situations that may be encountered in real-world work, allowing students to conduct simulation training and enhance their adaptability and problem-solving skills. The application of metaverse

technology is of great significance to vocational education and teaching. First of all, Metaverse technology can provide a more realistic learning environment, stimulating students' interest in learning and motivation. Secondly, Yuanverse technology can help students better master vocational skills and improve professional quality. Ultimately, Yuanverse technology can offer students a more convenient communication and collaboration platform, thereby enhancing learning efficiency and productivity at work. Therefore, this study aims to use Fuzhou Software Vocational and Technical College in China as an example to thoroughly explore the application of Metaverse technology in higher education, providing a reference for the future development of Metaverse technology in this field.

1.2 Research Questions

In the field of vocational education, traditional teaching methods and technologies already have some problems, such as a lack of sufficient interactivity and practicality, which makes it difficult for students to apply theoretical knowledge to real-world work. In addition, the traditional vocational education model may not be able to meet the changing and developing industry needs, resulting in students being mismatched with actual work scenarios after graduation and lacking the required vocational skills and practical experience.

With the development and application of metaverse technology, new educational technologies and methods have emerged, offering fresh possibilities for vocational education. Metaverse technology can create a highly immersive virtual environment, providing students with a more realistic and challenging learning experience. This virtual environment can simulate various real-world work scenarios, enabling students to practice and apply their skills in a safe and controlled environment, thereby enhancing their vocational skills and problem-solving abilities. However, there are still some problems and challenges in the current application of metaverse technology in vocational education. For example, the popularization and application of Metaverse technology are still in their infancy, and the technology's cost is relatively high. The content and teaching design of Metaverse education technology also require continuous improvement. The educational impact and practical application value of

Metaverse technology have not yet been fully verified, highlighting that schools and educational institutions generally face challenges in securing both financial and technical support. The cost and complexity of technology may limit the use of Metaverse technology in some educational institutions and among students, preventing its widespread adoption and popularization. How do we integrate Metaverse technology with modern technology? The effective integration of teaching content and methods to improve students' learning outcomes and cultivate vocational skills is a question that warrants research and exploration.

This article, therefore, aims to address the following issues：

1.2.1 How can metaverse technology improve the vocational skills of students in higher vocational education in China?

1.2.3 To what extent does the implementation of Metaverse Technology improve students' vocational skills, such as practical experience, professional knowledge, and innovative ability, in Chinese Higher Education compared to before its implementation?

1.2.3 What are the students' opinions on the use of metaverse technology in Chinese higher vocational education to enhance students' technological vocational skills?

1.3 Research Objectives

By delving deeper into the use of Metaverse technology in vocational education, we can gain a better understanding of its impact on student learning outcomes and career skill development. This will help address the limitations of the traditional vocational education model, enhance students' learning experience and vocational skills, foster connections between vocational education and actual work needs, and promote the development and progress of vocational education. Therefore, the main objectives of this study are as follows:

1.3.1 To analyze the impact of metaverse technology on improving the vocational skills of students in higher vocational education in China.

1.3.2 Based on the differences before and after implementing metaverse technology, investigate the extent to which the implementation of Metaverse

Technology improves students' vocational skills, such as practical experience, professional knowledge, and innovative ability, in Chinese Higher Education.

1.3.3. To assess the students' quality level in terms of using metaverse technology to enhance technological and vocational skills in Chinese higher vocational education.

1.4 Research Hypotheses

1.4.1. Vocational skills acquired through metaverse technology are higher than those acquired before the introduction of metaverse technology.

1.4.2. Students who learn metaverse technology receive highly qualified feedback.

1.5 Significance of the Study

1.5.1 Theoretical Significance

Metaverse technology is a virtual reality technology that provides students with an immersive and interactive learning experience by simulating real scenes and situations. This study examines the impact of metaverse technology on Chinese students' learning outcomes and vocational skill development from three perspectives: immersive learning theory and situational teaching theory, which hold significant theoretical implications.

Firstly, through Metaverse technology, students can be highly immersed in the virtual learning environment, interact with content, communicate with other students and teachers in real-time, and enhance their perception and participation in learning, which helps to create a more engaging and guiding learning experience. By analyzing the application cases of Metaverse technology in the field of higher education, we can gain a deeper understanding of the impact of immersive learning environments on students' learning effects and help explore how to design and implement immersive Metaverse educational experiences to improve students' learning interests. Moreover, participation can improve learning effects and quality, and provide theoretical guidance for designing and optimizing immersive learning environments.

Finally, situational teaching theory emphasizes the importance of meeting

individual student differences and needs. Metaverse technology can customize learning paths and content according to students' interests, abilities, and learning styles. They can also independently choose the content and methods of learning, explore and practice independently, and provide personalized learning experiences, thereby enhancing their practical and innovative abilities. By exploring the help of Metaverse technology in cultivating students' vocational skills and analyzing the application cases of Metaverse technology in different disciplines and fields, we can understand the reactions and needs of different student groups towards Metaverse technology and further verify the application of situational teaching theory in education. The application effect provides a reference for developing a personalized teaching model.

This study makes a theoretical contribution to a deeper understanding of immersion theory and situational teaching theory in metaverse education, offering a new theoretical perspective and methodology for vocational education. It is important in improving students' learning experiences and outcomes. The theoretical significance also promotes the innovation and development of education and teaching models.

1.5.2 Practical Significance

With the rapid development of information technology, Metaverse technology, as an emerging virtual reality technology, has attracted widespread attention. Its application in entertainment, social networking, and other fields has achieved remarkable results. However, there is still less research on the application of Metaverse technology in vocational education, especially its potential impact on personalized learning and autonomous development.

During the pandemic, online teaching revealed several issues, including the use of single teaching methods, limited forms of interaction, insufficient teaching resources, challenging practical operations, and a lack of scenario-based teaching (Hu, 2020). With the help of metaverse-related technologies, we can build a highly immersive, safe, and reliable metaverse platform for courses, which will incur lower trial-and-error costs. This platform can effectively enrich interaction methods, generate innovative teaching resources, and enhance the immersive experience (Yang, 2022). Metaverse is revolutionizing teaching and learning in vocational education. Metaverse technology can create a more immersive and interactive learning environment, stimulate students' interest and motivation in learning, improve teaching effects and

learning outcomes, and improve the quality of education and teaching.

Therefore, this study aims to explore how Metaverse technology promotes students' learning in vocational education, using Fuzhou Software Vocational and Technical College as a case study to conduct a specific analysis of the effect of Metaverse technology on student learning and vocational skills training in higher education. Benefit. This will provide us with a reference for further optimizing vocational education teaching methods and improving the quality of talent training. By analyzing the benefits and potential impacts of metaverse technology on student learning, we hope to provide references and suggestions for the development of vocational education and teaching in our country. It is of great significance to promote the construction of educational informatization, realize the transformation of educational modernization, and implement educational reform and innovation to break the time and space constraints of traditional education. This will create a more open, independent, and flexible learning environment, promoting the development and progress of vocational education. At the same time, by discovering the application effect of Yuanverse technology in vocational education, it can provide a basis for improving the quality of education and teaching, promote the process of reengineering online teaching and upgrading student experience, and help cultivate innovative, high-skilled talents that meet the needs of future social development.

1.6 Scope and Limitations

1.6.1 Study Subjects

This study focuses on the practical application of Metaverse technology in the Digital Media Art Design major of Fuzhou Software Vocational and Technical College. The researcher randomly selected one class of students from three first-year classes in the Digital Media Art Design major at the college to participate in this study, exploring the impact of the Metaverse course on students' learning outcomes and vocational skills.

1.6.2 Research Limitations

Although this study strives to be comprehensive and in-depth, it still has the following limitations:

1.6.2.1 Sample Representativeness

The issue of sample representativeness is a crucial consideration in any study, as it determines the extent to which the findings can be generalized to a broader population. In this study, the sample size is limited, which fundamentally limits the representativeness of the results. When the sample size is small, the variability within the sample may not be sufficient to fully capture the diversity that exists in the larger group, which can lead to biased research results and an inaccurate reflection of the actual impact of metaverse technology on vocational skills.

In addition, the participants in this study are from the same college and major, specifically Digital Media, at Fuzhou Software Vocational and Technical College. Although convenient and practical, this sampling also introduces significant limitations. The educational environment, institutional policies, faculty, and available resources of this college may differ significantly from those of other vocational colleges in China. Therefore, the experiences and results of students at Fuzhou Software Vocational and Technical College may not be representative of the situation in other colleges. For example, colleges with more advanced technological infrastructure and better-trained teachers may produce different results than colleges with fewer resources.

To address this limitation, future research may consider including larger and more diverse samples covering vocational colleges in different regions of China. This will help ensure that the research results are more representative of the overall population. In addition, the use of stratified sampling techniques can more effectively capture the variability within the group. By dividing the population into distinct strata (e.g., based on geographic location, institutional resources, or student demographics) and sampling from each stratum, researchers can gain a more comprehensive understanding of the impact of metaverse technologies on career skills.

1.6.2.2 Limitations of the Research Method

The research methods and analysis tools used in this paper have specific limitations, and these methods may not be able to comprehensively and objectively evaluate students' vocational skills. Different methods and tools may lead to different conclusions. A common problem in questionnaire-based research is self-report bias, primarily when data collection relies on participants' self-assessment of their skills and experiences. In this study, questionnaires were used to collect students' views on their

vocational skills and the impact of metaverse technology, which introduces potential self-report bias. Social desirability bias, in particular, can cause participants to provide answers that they believe are more socially acceptable or favorable rather than their true thoughts. For example, students may exaggerate their proficiency in metaverse technology to appear more technically proficient.

Recall bias is another type of self-report bias that can affect the accuracy of the data. Students may struggle to accurately remember and report their experiences with metaverse technology, particularly if these experiences span a prolonged period. This can lead to inconsistencies and inaccuracies in the data, which can affect the validity of research findings.

To mitigate the impact of self-report bias, researchers can employ multiple data collection methods to triangulate their research findings. For example, combining self-report data with objective measures of student performance (such as grades or skill assessments) can provide a more accurate picture of the impact of metaverse technology. Furthermore, ensuring the anonymity of questionnaire responses may reduce social desirability bias, as students may be more willing to provide truthful answers, knowing that their responses will not be traced back to them.

1.6.2.3 Limitations of Vocational Skills

The development of vocational skills is a complex and multifaceted process that often requires sustained practice and reinforcement over an extended period of time. In the context of this study, the relatively short duration may not be sufficient to capture the long-term effects of metaverse technology on vocational skills. Skills such as problem-solving, teamwork, and communication typically develop over time through repeated practice and real-world application, and a brief intervention may only yield limited improvements.

Furthermore, the assessment standards and measurement methods for vocational skills may not be comprehensive enough to cover all relevant aspects of these.

1.6.2.4 Time Constraints

The time constraints of the study present another significant limitation. Conducting research over a short period may not allow for the observation of the long-term impacts of metaverse technology on vocational skills. Skills development,

particularly in the context of vocational education, often requires sustained practice and reinforcement over an extended period of time. A short-term study may capture initial improvements in skills but may not provide insights into whether these improvements are maintained over time.

Furthermore, the time interval between pre- and post-tests is crucial. If the interval is too short, students may not have sufficient time to engage fully and benefit from the metaverse technology, resulting in minimal observable changes in their skills. On the other hand, if the interval is too long, other external factors could influence the results, making it difficult to attribute changes in skills solely to the use of metaverse technology.

To address these time-related limitations, future research could adopt a longitudinal design, tracking students' skill development over a more extended period. This approach would allow researchers to observe not only immediate effects but also long-term impacts and retention of skills. Additionally, conducting multiple assessments at different time points can help identify the trajectory of skills development and the sustainability of the observed improvements.

1.6.2.5 Research Design

The research design, which involves pre- and post-tests, may not control for all potentially confounding variables. Without a control group, it is difficult to rule out the influence of other factors that might affect the observed changes in students' skills. For example, students might be simultaneously exposed to other educational interventions, changes in their circumstances, or variations in teaching quality, all of which could influence the results.

To strengthen the research design, future studies could include a control group of students who do not receive the metaverse technology intervention. This would allow for a more accurate comparison of the impact of metaverse technology versus traditional teaching methods. Additionally, employing a randomized controlled trial (RCT) design, where participants are randomly assigned to either the intervention or control group, can help minimize selection bias and ensure that any observed differences are attributable to the intervention.

Nonetheless, we will strive to adopt appropriate methods and strategies, utilizing scientific methods and in-depth analysis, to ensure the reliability and validity

of the research results.

1.7 Research Framework

This study examines the impact of integrating Metaverse Technology and educational practices on students' vocational skills. The independent variable, Metaverse Technology, includes the use of various learning resources, an immersive learning environment, and enhanced student interaction. The dependent variable, Technical Skills, is further subdivided into professional knowledge, practical experience, and innovation ability. By sorting and analyzing books, literature, and related reports, this study explores the application of Metaverse Technology in education, the exploration and research of digital education scenarios, the construction of a modern vocational education system, and other related content. A combination of pre-test, post-test, and questionnaire surveys is used to quantitatively evaluate the changes in students' vocational skills before and after the implementation of Metaverse Technology, transitioning from theory to practice.

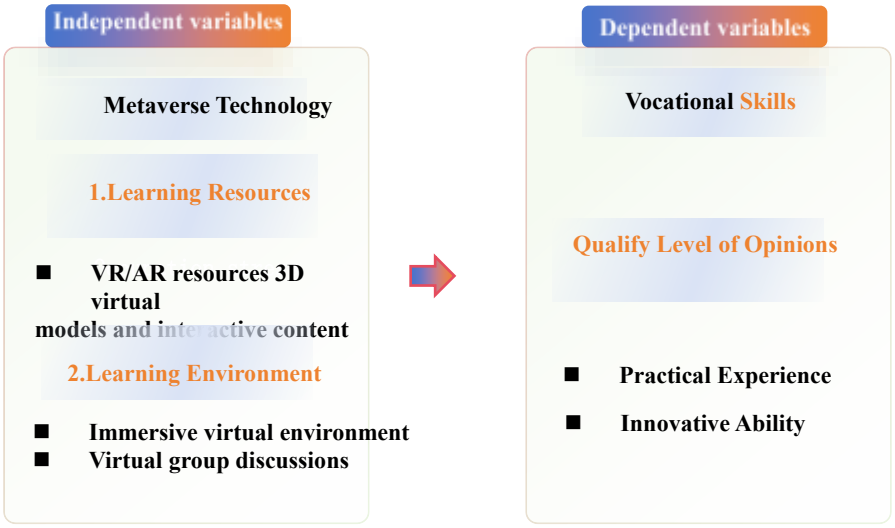

Figure 1.1 Research Framework

1.8 Definition of Terms

1.8.1 Metaverse Technology

Metaverse Technology refers to a new digital platform that integrates multiple cutting-edge technologies, including virtual reality (VR), augmented reality (AR), artificial intelligence (AI), and blockchain. Through these technologies, the Metaverse creates a highly immersive virtual environment that seamlessly combines the virtual world and the real world, providing innovative application scenarios across multiple fields, including education, entertainment, and social interaction. Users can fully immerse themselves in various activities and interact in these virtual experiences. It provides users with a brand-new digital space, expands people's interaction methods and experience methods, and has broad application prospects and far-reaching impacts. The application of Metaverse technology in education is particularly noteworthy because it offers rich learning resources, innovative learning environments, and interactive methods for student engagement in the teaching process. It encompasses a wide array of technologies and concepts, such as:

1.8.2 Learning Resources

1.8.2.1 VR/AR Resources and Three-dimensional Virtual Models

Virtual reality (VR) and augmented reality (AR) are important components of Metaverse technology. VR technology creates an entirely virtual environment that enables students to immerse themselves in a three-dimensional space for deep learning. For example, students can use VR devices to conduct virtual internships, simulate real working environments, and gain practical experience. Augmented reality (AR) superimposes virtual information in the real world to provide an interactive learning experience. For example, students can use AR devices to watch the display of three-dimensional models in the classroom, interact in real-time, and enhance their understanding of abstract concepts.

1.8.2.2 Interactive Content

Metaverse technology offers rich, interactive content, making the learning process more engaging and interesting. These interactive contents include simulated experiments, virtual scene exploration, and real-time feedback.

1.8.3 Learning Environment

1.8.3.1 Immersive Virtual Environment

Metaverse technology creates an immersive environment that gives users a sense of being in the world. Through virtual reality headsets, tactile feedback technology, and other means, users can engage in various activities within the Metaverse and interact with other users or virtual entities in real time. For example, in engineering courses, students can perform experimental operations in virtual laboratories to gain an understanding of the equipment and experimental steps involved. This immersive learning environment not only enhances students' interest in learning but also improves their practical operational capabilities.

1.8.3.2 Virtual Group Discussion

With the support of Metaverse technology, students can engage in group discussions, exchange views, and collaborate on solving problems through virtual platforms.

1.8.3.3 Immersive Learning Environment

An immersive learning environment is one of the important applications of Metaverse technology. It is a method that utilizes virtual reality (VR) technology to immerse students in a virtual environment for learning and experience, simulating real-life scenes and situations. Teaching method. Students can experience various learning scenarios immersively, such as conducting simulation experiments and simulating practical operations in a virtual environment, which enhances realism and participation in learning, improving practical ability and innovation skills. This, in turn, promotes students' learning outcomes and professional skill development.

In an Immersive learning environment, simulation experiments and simulation practices are standard teaching methods. A simulation experiment refers to using a virtual environment to simulate the real experimental process, allowing students to perform experimental operations in a virtual laboratory, observe experimental phenomena, and collect experimental data. Simulation practice involves simulating real-world or life situations through virtual scenes, allowing students to perform actual operations in a virtual environment and cultivate practical application skills. These two teaching methods can effectively provide real and safe learning experiences, help students master professional knowledge and skills, and improve practical and

innovative abilities.

In an Immersive learning environment, visual, auditory, and three-dimensional experiences are all crucial.

Vision: An immersive learning environment utilizes high-resolution head-mounted displays to provide students with a realistic visual experience. Students can feel the reality of the surrounding environment. For example, they can observe chemical reactions in virtual laboratories and experience historical events in virtual historical scenes. This visual immersion helps enhance students' understanding and retention of learning content.

Hearing: An immersive learning environment provides surround sound effects through stereo headphones or a surround sound system, allowing students to feel the sounds in real scenes. For example, in the virtual laboratory, students can hear the sounds of experimental equipment and instructions on experimental operations, thereby gaining a better understanding of the experimental process.

Three-dimensional experience: An immersive learning environment also allows students to have a three-dimensional experience in a virtual environment. Students can interact with the virtual environment through handles or gesture controllers, for example, by operating chemical instruments in virtual laboratories or role-playing in virtual scenes. This three-dimensional experience can enhance students' sense of participation and concentration, promoting improved learning outcomes.

1.8.4 Vocational Skills

Vocational skills refer to the specific skills and abilities required in specific occupational fields or jobs. They are abilities that students must possess in their careers and are necessary for individuals to develop in the workplace and achieve career goals successfully. They directly impact an individual's performance and achievement at work. Vocational skills cover the following aspects:

1.8.5 Professional Knowledge

Professional knowledge refers to the understanding and mastery of theories, principles, concepts, and facts in a specific field. In the profession, possessing solid professional knowledge enables individuals to understand and apply relevant theories more effectively, thereby improving work efficiency and quality.

1.8.6 Innovation Ability

Innovation ability refers to an individual's ability to generate new perspectives, ideas, or methods in the workplace. In a highly competitive workplace, innovative abilities can help individuals stand out at work and bring new development opportunities to teams and organizations.

1.8.7 Practical Experience

Practical experience refers to the skills and knowledge that students acquire through hands-on practice and task execution in real-world work environments or simulated scenarios. This experience is not just the application of theoretical knowledge; it also involves the process of encountering, solving, and continually improving problems in real-world situations. Through practical experience, students can directly apply and master the knowledge they have learned in the classroom, develop problem-solving skills, understand and manage work processes, gain teamwork experience, enhance professional attitudes and work ethics, and foster innovation and creativity. Practical experience enables students to integrate theoretical knowledge with actual practice, improving their vocational skills and increasing their competitiveness in the job market. This experience is particularly crucial in vocational education as it directly impacts students' employability and career development prospects.

1.8.7 Chinese Higher Education

The Chinese higher education system is one of the largest in the world. In recent years, with the rapid development of the Chinese economy and society, higher education has also undergone significant transformation and expansion. The Chinese higher education system is a diverse, comprehensive, and large-scale education system. It encompasses nearly all subject areas, combining degree education and non-degree education, and establishes a multi-level and multi-form education structure.

Types of Higher Education

Chinese higher education institutions are mainly divided into the following categories:

General Higher Education Institutions

Undergraduate colleges: These institutions offer four-year undergraduate education, and some majors (such as medicine) may take five years or more. General undergraduate colleges encompass a broad range of subject areas, including humanities,

science, engineering, agriculture, medicine, economics, management, law, education, and the arts.

Higher vocational colleges and junior colleges: These institutions offer two to three years of junior college (college) education and focus on cultivating applied technical talents. Higher vocational education emphasizes practical teaching, works closely with enterprises and industries, and provides students with internships and hands-on opportunities.

Postgraduate Education

Master's and doctoral postgraduate education: A master's degree generally takes two to three years to complete, while a doctoral degree takes three to five years. Postgraduate education focuses on cultivating scientific research capabilities and encourages students to participate in various research projects.

Adult Higher Education

Continuing education: academic degree improvement and vocational skills training for employed personnel, mainly through night schools, correspondence courses, and self-study examinations.

The Fuzhou Software Vocational and Technical College, where the researcher is currently studying, is a higher vocational college and junior college. In 2012, NetDragon Websoft Holdings Limited (Hong Kong Stock Exchange: 777), a leading company in the domestic Internet field, officially moved into the school. In 2021, the school's virtual reality technology application major group was identified by the Fujian Provincial Department of Education and the Department of Finance as a high-level professional group A-level project in the "Fujian Provincial High-level Vocational College and Professional Construction Plan". In 2017, the Fujian Provincial Department of Education identified it as a training base for professional teachers in virtual reality technology (VR). The Metaverse pilot was launched in 2022.

CHAPTER II
LITERATURE REVIEW

2.1 Theoretical Framework

Over the past few years, the application of Metaverse technology in education has garnered increasing attention. Research shows that Metaverse technology can significantly improve students' learning outcomes and career skill development. This article will review the role of constructivism theory, immersion theory, skill acquisition theory, and contextualized teaching theory in this study.

2.1.1 Immersive Learning Theory

Immersive learning theory, as proposed by Schott and Marshall (2018), is an advanced educational methodology that integrates multidisciplinary theories, including cognitive psychology, educational technology, and user experience design. It is a method that creates comprehensive sensory stimulation through an educational approach, providing a vivid and realistic learning environment to enhance learner participation and learning effectiveness. This learning method emphasizes simulating real-world situations or creating a virtual environment with a strong sense of reality to engage learners. The learning experience of simulating the real environment can deepen students' learning impressions and promote the transfer and application of knowledge, creating an environment in which learners are fully immersed to enhance learning effectiveness (Mikropoulos & Natsis, 2011). According to research by Dede (2009), immersive learning environments can increase learners' emotional and cognitive investment through synthetic experiences, thereby improving problem-solving abilities and on-the-spot reactions. Ability. Immersive learning theory is often complementary to multiple learning theories, including constructivism, situated cognition theory, and multimodal learning theory.

One of the most important features of an immersive learning environment is the increased motivation of learners. Csikszentmihalyi's Flow Theory explains the high degree of concentration and enjoyment experienced when an individual is completely immersed in an activity. This state is precisely the goal of immersive learning, as described by Csikszentmihalyi (1990). Immersive learning theory further

emphasizes the critical role of technology in creating immersive learning environments. The emergence of technologies such as Virtual Reality (VR), Augmented Reality (AR), and Mixed Reality (MR) and their application in education provide technical support and possibilities for realizing fully immersive learning. With the continuous advancement of immersive technology, learners are increasingly able to deepen their understanding and retention of knowledge through multisensory experiences that engage multiple senses, including vision, hearing, and touch. Research by Allison et al. (2012) proposed that multisensory learning can enhance memory formation and knowledge comprehension.

In educational practice, immersive learning experiences usually focus on creating realistic learning environments through technological means, such as virtual reality (VR), augmented reality (AR), or mixed reality (MR). These technologies can create an atmosphere that encourages active exploration and learning by simulating real-life situations or participating in entirely constructed virtual worlds. A study was conducted by Ibanez et al.(2014), who designed an AR-based system to teach circuit theory to college students. This research demonstrates that the use of AR technology has the potential to enhance student motivation and learning outcomes.

Contextual awareness in immersive learning theory is considered a key factor in improving motivation and depth of learning. According to Gee (2003), learners can better understand and master knowledge points when they are placed in specific situations related to the learning content. Gee emphasized that game-based learning environments can promote the development of problem-solving skills and critical thinking. The key is to provide a challenging, interactive learning environment with an immediate feedback system.

Among immersion learning theories, immersion learning is also supported by sociocultural theory (Vygotsky, 1978), which views learning as a process of social interaction and cultural participation. In an immersive learning environment, learners do not passively receive knowledge; instead, they develop knowledge, skills, and attitudes through interaction, cooperation, and communication with others.

In recent years, with the advancement of technology, particularly the development of virtual reality (VR) and augmented reality (AR) technologies, the application of immersive learning theory in education has become increasingly

widespread. Slater and Wilbur (1997) conducted research on immersion in virtual reality. They believed that immersion is the key to experiencing the environment and can be achieved through the sense of envelopment, inclusiveness, interactivity, and fidelity of the VR environment. Dewey's practical learning theory (Dewey, 1938) also provides a theoretical basis for the application of the metaverse in vocational education, emphasizing the importance of practical activities in the learning process and the important impact of the learning environment on learning outcomes. In the application of Metaverse technology, immersive teaching offers an immersive learning experience, enhancing students' sense of participation and engagement through visual, auditory, and other sensory stimulations. Research indicates that immersive learning environments can enhance students' learning outcomes and experiences and help cultivate their innovation and teamwork skills (Slater & Sanchez-Vives, 2016; Sheridan, 2016).

The metaverse, as the latest development trend in immersive technology, provides an ideal platform for vocational education. Specifically, in training and education scenarios, the Metaverse can simulate real-life work environments, providing learners with a risk-free practice space. For example, Freina and Ott (2015) explored the application of immersive virtual environments in the learning process in their study. They proposed that realistic work environments created through simulations have a positive impact on improving learning outcomes.

At the same time, based on these technologies, scholars have begun to study the unique educational potential of the Metaverse. Research by Pasfield-Neofitou and Huang2 (This experience is unique to traditional electronics.) Learning cannot be provided.

To achieve the educational benefits of immersive learning theory, educators must design engaging educational content and interactive activities that foster meaningful learning experiences. In their study, Bricken and Byrne (1992) discussed the importance of educational content design to improve the effectiveness of immersive learning, including elements such as task design, role-playing, and storytelling.

In summary, the immersive learning theory as a theoretical basis can not only provide a solid scientific foundation for studying the application of metaverse technology in the development of Chinese students' vocational skills but also help understand and design practical learning activities to promote students' Vocational skill

learning and development in virtual environments.

2.1.2 Situational Teaching Theory

Contextualized teaching theory posits that the acquisition of knowledge and skills occurs within specific social and cultural contexts and is closely tied to the context in which they are applied (Lave & Wenger, 1991). Traditional vocational education often emphasizes teaching methods that separate theory from practice, which can sometimes make it challenging for students to apply theoretical knowledge to real-world situations. With the development of technology, the Metaverse, as an emerging teaching platform, brings innovative teaching and learning methods to vocational education. The virtual environment of the Metaverse breaks through the limitations of traditional classrooms, creating rich visual and interactive experiences that can significantly enhance students' interest in learning (Dede, 2009). For example, the application of virtual reality technology in tourism and hotel management education can place students in a highly simulated hotel environment, thereby improving their professional interests and career awareness (Guttentag, 2010). The Metaverse offers learners an immersive experience, which helps students better understand complex concepts and processes (Dalgarno & Lee, 2010). This, in turn, potentially improves learning outcomes and enhances students' professional and technical skills (Wang & Dunston, 2007; Hamilton et al., 2009). For example, a car repair simulation in the Metaverse enables students to experiment with various repair techniques in a risk-free environment. Dewey's "learning by doing" teaching guidance has a natural affinity with situational teaching.

This study can draw theoretical support from Situated Cognition Theory, which posits that cognitive development is not the processing of information abstracted from the external environment but rather the process of people interacting with others in a specific environment and acquiring applications that are closely linked to the specific context in which they occur. Brown and Duguid 1 proposed this theory. In their paper "Situated Cognition and the Culture of Learning", they explained that learners should combine learning situations with actual practice situations in order to integrate theoretical knowledge and practical skills better (Brown et al., 1989). This guides building learning environments in the metaverse, emphasizing the importance of task-oriented learning activities in the real world. It is emphasized that the learning

environment should be similar to the actual application situation. Situated cognition theory posits that learning is a cognitive process grounded in a specific situation. In the application of metaverse technology, situational cognition theory emphasizes that students construct knowledge and understand concepts by engaging in real-world activities within a specific situation. It utilizes the characteristics of metaverse virtual reproduction and simulation to create a situational teaching scene that blends virtual and real elements, thereby triggering students' practical experience and enhancing their knowledge, understanding, and application abilities. Metaverse technology offers rich virtual environments, enabling students to learn and practice in these settings, thereby promoting the development of their professional and vocational skills. In a real-world case study, Dede proposed in his 2009 article, "Immersive Interfaces for Engagement and Learning," that the dynamics of interaction between the virtual world and the real world can support the establishment of more complex and realistic learning situations (Dede, 2009). In addition, he found that immersive environments not only increase students' interest in learning but also increase their engagement and motivation. Through the case of this interactive virtual environment, we can see the considerable potential for vocational skills training in the Metaverse.

Applying these research results and theories to the practice of Yuanverse technology in Chinese vocational education enables us to create simulated work environments that closely resemble reality. In these environments, students can experience and solve real problems in the industry through practical operations. Challenges and problems faced. Such simulated scenarios not only help students better understand theoretical knowledge but also enhance their ability to apply knowledge to actual work environments. Therefore, the educational application of Metaverse technology, especially in helping students acquire vocational skills, has enormous development potential and practical value.

Therefore, situational cognition theory provides a solid theoretical foundation for the application of metaverse technology in education. By referring to studies similar to those of Brown and Dugui (2009) and Ded (2009), it can be observed that simulating real work scenarios in a metaverse environment can significantly enhance students' learning and the development of vocational skills. Therefore, Chinese educators should consider integrating these theories with Metaverse technology to

create a more engaging and effective educational model.

2.2 Related Research

2.2.1 Current Status of International Research

2.2.1.1 Foreign Research on the Metaverse Mainly Focuses on the Following Aspects

(1) Education field

Foreign researchers are paying attention to the application of the metaverse in education, especially in the fields of higher education and vocational education. They study how Metaverse technologies are transforming teaching and learning experiences, as well as the impact on student learning outcomes and career skill development. Research indicates that the Metaverse can offer a more immersive and personalized learning environment, thereby enhancing students' interest and enthusiasm for learning. Helps improve students' learning motivation and effectiveness (Jiang & Wang, 2020; Smith & Brown, 2019). For example, virtual reality technology enables students to learn and practice in simulated environments, thereby enhancing their understanding and application of knowledge (Chen et al., 2018).

Additionally, Metaverse technology can offer a more diverse range of learning resources and teaching methods, enabling students to acquire professional knowledge and skills more effectively (Smith & Brown, 2019). Dahanna used the electronic learning environment as an example to study the virtual learning environment and demonstrated a virtual learning environment based on the metaverse by constructing a metaverse framework (Dahanna et al., 2022). Parks believes that Yuanverse can innovate the educational environment and help learners obtain equal educational opportunities. Therefore, the virtual world is expected to turn imagination into reality through the integration of multiple technologies (Parks,2022).

(2) Virtual Reality

Virtual reality is a crucial component of the metaverse. It can provide simulated reality scenes. Foreign researchers have conducted in-depth research on the application of virtual reality. They discussed the application of virtual reality in education, medical care, construction, and other fields, as well as its impact on user

experience and behavior (Chen et al., 2018; Lee & Lee, 2020). Ge Jiajia studied the impact of intelligent technology on college students' online behavior in the metaverse era. It found that in the metaverse era, students can use VR, AR, MR, and other media technologies to watch online videos, listen to online radio, receive online education, enjoy special functions such as virtual reality and naked-eye 3D, and realize the combination of the virtual world and the real world, opening up a new human-computer interaction mode. However, at the same time, this has also harmed the behavioral habits of college students, and it is necessary to strengthen the education and guidance provided to them.

(3) Social interaction

The metaverse emphasizes social interaction and the creation of virtual communities. Students from different regions and cultural backgrounds interact and cooperate in real-time, expanding their horizons and social circles (Johnson & Smith, 2018). Metaverse technology can not only promote cross-cultural communication and understanding but also provide a more diverse social environment and activities, such as virtual exhibitions and conferences. Foreign researchers pay attention to the social interaction model and community construction in the metaverse. They studied the impact of virtual communities on users' social behaviors and psychological states, as well as the design of practical social interaction functions (Jones & Smith, 2017; Wang & Liu, 2021). Akul and others said that the metaverse is a world full of imagination, and immersive digital spaces continue to expand into educational environments, providing users with a more interactive environment where they can share various digital experiences.

(4) Commercial applications

Foreign researchers are also paying attention to the application of the Metaverse in the commercial field. Metaverse technology also has broad application prospects in commercial applications. They studied how Metaverse technology changes business models and marketing strategies, as well as the impact on consumer behavior and brand building (Brown & Johnson, 2018; Taylor & Anderson, 2020). Research indicates that through the Metaverse platform, companies can create more immersive and interactive product displays and marketing methods to attract the attention of a

broader consumer base (Wang & Liu, 2019). At the same time, Yuanverse technology can also provide enterprises with a more efficient and convenient remote office and collaboration platform, thereby reducing operating costs and enhancing employee work efficiency.

(5) Technological development

Finally, foreign researchers are also paying attention to the development of metaverse technology itself, which is another important direction in metaverse technology research. With the continuous development and advancement of science and technology, Metaverse technology is also constantly innovating and improving. They studied the latest advances and trends in metaverse technology, as well as prospects for future development (Zhang et al., 2021; Smith et al., 2022). Research indicates that future Metaverse technology will prioritize user experience and interactivity, becoming more intelligent and personalized, thereby offering a higher-quality and more personalized user experience (Li et al., 2020). In addition, as Metaverse technology continues to mature and gain popularity, it will also be combined with other emerging technologies, such as artificial intelligence and blockchain, to produce more powerful and diverse application scenarios.

2.2.1.2 Research on the Application of Metaverse in Vocational Education

On an international scale, research on the application of the Metaverse in vocational education has gradually increased. In the field of vocational education, international research is exploring the potential applications of metaverse technology and actively seeking to integrate it into educational models. To review the application of Metaverse technology in education, we used the search term' Metaverse technology in education' and searched in Google Scholar, classifying the relevant documents retrieved. It was found that relevant Metaverse education research involves many aspects, including the conception of the application scenarios of Metaverse in education and the exploration of teaching effects, such as sustainable learning, digital transformation of education, and the exploration of teaching effects in language teaching, medical education, football teaching, and other disciplines; Metaverse The impact on learning methods, such as immersive teaching and game-based learning; the

impact of Metaverse on the environment, such as Metaverse classrooms and educational ecosystems; Metaverse technology's impact on improving students' learning interest and participation, and promoting students' professional Study the depth and breadth of learning. For example, Smith et al. (2021) found that using Metaverse technology to conduct chemical experiments in a virtual laboratory environment can improve students' learning motivation and experimental skills, as well as explore the potential of Metaverse education to enhance Jones and Wang (2020) have demonstrated that team projects conducted in a metaverse environment can effectively cultivate students' teamwork and innovation skills.

(1) Learning experience and interests

The application of metaverse technology has a significant promotional effect on students' learning experiences and interests. Through Metaverse technology, students can participate in a more realistic and engaging learning environment that is more immersive and interesting than traditional classrooms (Smith et al., 2019; Brown & Johnson, 2020). In this virtual environment, students can explore and learn more freely, thereby enhancing their learning interests and initiative. For example, students can visit scenic spots and participate in virtual experiments and other activities through metaverse technology. These activities can stimulate students' curiosity and desire to explore, thereby enhancing their understanding and acceptance of knowledge (Johnson et al., 2017; Lee & Brown, 2019). Therefore, Metaverse technology offers students a richer and more diverse learning experience, thereby enhancing their learning motivation and effectiveness.

(2) Cultivation of professional and technical skills

Many vocational education institutions internationally have begun to use VR/AR technology for skills training. Traditional vocational education primarily relies on theoretical instruction and practical training to develop students' vocational skills; however, it faces challenges, including a limited practical environment and inadequate resources. Metaverse technology can create a highly simulated virtual experimental environment. Through the application of virtual reality technology, students can perform practical operations in a fictional but highly realistic environment, thereby gaining richer and in-depth practical experience (Chen et al., 2018; Wang & Li, 2020).

Hampton and Keys (2017) studied the application of virtual reality in nursing education. Nursing students can utilize virtual reality technology to conduct simulation training of operating room procedures in a risk-free environment, thereby enhancing their operational skills, proficiency, and clinical decision-making. (Radianti et al., 2020) conducted a study on firefighter training, utilizing VR technology to simulate emergencies such as fires and enhance operational skills, as well as improve emergency response capabilities. Design schools can utilize VR technology to create a virtual studio where students can design and sculpt 3D objects within this virtual space. Jing and Wei's (2020) research explores the application of VR technology in art design education, offering a new, interactive learning method that enables students to learn and practice art design in an immersive environment. In their article, Piovesan et al. (2012) examine how immersive environments can foster learner creativity, particularly in computer graphics learning. With the development of social media and digital platforms, live broadcast operations have become an important vocational education direction (Greenfield & Bevan, 2023). Research from the University of the Arts London in the UK examines how the Metaverse can facilitate students' learning of live broadcast operations. Through the virtual live broadcast room module training, students can experiment with different sets, lighting, and photography techniques without risk. Students can also role-play as directors, photographers, and hosts to understand the various responsibilities involved in the entire live broadcast operation, helping learners gain practical operational and management experience in a simulated environment in advance. Pasqualotto and Freitas(2019) explored the application of virtual reality in engineering education. Researchers at Harvard University School of Design developed virtual reality tools to enable students to "walk" into their buildings in a virtual environment. Design to better understand the impact of spatial layout and structural design (Schnabel & Kvan, 2021). Research indicates that the use of virtual reality (VR) technology can enable students and professionals to experience the actual architectural environment and the actual situation of construction engineering projects, thereby providing an intuitive understanding of architectural design concepts and construction processes. Help students better understand the connection between theoretical knowledge and practical engineering practice. In this way, students can more comprehensively master professional technical knowledge and skills and improve their

coping and practical abilities in actual work. Yung D. Khoo (2019) conducted a systematic literature review on virtual reality and augmented reality in tourism research, summarizing applications.

(3) Cultivation of innovative capabilities

The application of Metaverse technology helps cultivate students' innovative abilities. In the Metaverse environment, students can continue to think critically and explore by participating in virtual practices and solving practical problems, thereby cultivating their innovative thinking and problem-solving abilities (Johnson & Smith, 2018; Li & Zhang, 2021). Compared to traditional education, Metaverse technology offers a more open and flexible learning environment, stimulating students' creativity and imagination, and enabling them to address future challenges and problems better.

(4) Current Status of Domestic Research in China

In 2022, the Ministry of Industry and Information Technology proposed cultivating a group of innovative small and medium-sized enterprises that will enter emerging fields, such as the Yuanverse and blockchain. At the same time, it is clearly stated in the "Key Points of Work of the Ministry of Education in 2022": Implement strategic actions for educational digitalization, strengthen demand traction, innovate and empower, and accelerate the digital transformation and intelligent upgrading of education. The current status of research on vocational education is based on the Yuanverse. With the successive introduction of Yuanverse-related policies and reports, the innovative development of higher vocational education in my country has ushered in new opportunities. Domestic experts and scholars have conducted in-depth research on the integration of the Metaverse and vocational education, discussing how the Metaverse can play a role in promoting educational reform and talent cultivation in the field of vocational education. Domestic-related research involves four levels: technology, concept, educational structure, and educational application. The research characteristics indicate that the technical level primarily focuses on understanding and describing basic technology and architecture; the conceptual level exhibits two types of positive acceptance and a cautious view. Attitude: The educational structure layer forms a "dual-core" radiation research structure; the educational application layer primarily

conducts educational and teaching research guided by the principle of embodied learning (Xufeng et al., 2023).

2.2.1.3 Research on the Technical Direction of Metaverse Education

China's research in Metaverse education technology is developing rapidly, with a primary focus on constructing the Metaverse platform, integrating virtual reality (VR) and augmented reality (AR) technologies, and applying artificial intelligence (AI) in education. Chinese scholars have discovered that the Metaverse platform, built by integrating VR/AR technology, can provide a richer and more realistic learning environment. They not only enhance students' learning experience but also improve students' practical operational capabilities by simulating real situations. For example, a study by Zhejiang University explored the application of VR technology in engineering education, finding that it helped students understand and remember complex engineering concepts (Chen, 2022). Students' interaction in the virtual environment and their intuitive responses to operations can effectively improve their learning investment and skill mastery. At the same time, artificial intelligence plays a crucial role in understanding student behavior, creating personalized teaching plans, and automatically evaluating student work. Research from Beijing Normal University shows that AI can not only provide personalized learning paths but also adjust learning difficulty and content according to student performance, significantly improving the effectiveness and efficiency of teaching (Wang et al., 2023). The integration and application of these technologies are gradually promoting the digital transformation of the education industry, which is of great significance to improving China's competitiveness in the global education technology field. However, the continued development and application of technology are also accompanied by challenges, such as data security and privacy protection, which necessitate collaboration among researchers, technology providers, and educators to explore corresponding solutions and strategies.

2.2.1.4 Research on the Direction of Education Concepts in the Yuanverse:

In terms of philosophy, China's research on metaverse education emerged from exploring the potential value of the metaverse as a new educational field and the innovation of educational concepts. Researchers have explored how the combination of

the metaverse and education can enhance the learning experience, as well as its impact on and promotion of teaching concepts. A paper by researchers from the Central University of Finance and Economics (Zhang et al., 2022) highlights that Yuanverse education fosters a shift from teacher-centered to student-centered approaches, emphasizing the initiative and autonomy of individual learners. This study positions the development of the Metaverse education concept in the experiential, immersive, and interactive learning stages. Through the Yuanverse platform, students can learn in an immersive environment, breaking the space and time constraints of traditional classrooms and promoting cross-border cooperation and the cultivation of innovation capabilities. More importantly, such a learning concept respects student diversity and supports multiple intelligences, as well as differentiated teaching.

Nonetheless, conceptual innovations in the metaverse also pose challenges, including the repositioning of teachers' roles and changes in learning assessment standards. In a study by East China Normal University, scholars emphasized that the implementation of Yuanshi education requires the establishment of a new teaching evaluation system, which not only involves the evaluation of knowledge and skills but also includes the comprehensive evaluation of the learning process, innovation ability, and collaborative attitude (Zhou, 2023). These research results demonstrate that, despite the challenges, the innovation of the metaverse educational concept holds great potential and positive significance in promoting educational reform.

2.2.1.5 Research on the Educational Structure Direction of Metaverse Education

In the realm of educational structure, Chinese research primarily focuses on the impact and reshaping of traditional education structures by metaverse education. The researchers discussed how metaverse education can promote the development of school education structures in a more flexible and open direction. A study by the School of Education at Peking University highlighted that the Metaverse not only alters the distribution of learning spaces and resources but also facilitates the open sharing of course content and educational materials (Zhao et al., 2023).

Researchers propose that in the metaverse education structure, courses are no longer fixed and standardized products but experiences that can be flexibly adjusted according to students' needs and interests. Teaching is no longer limited to a single

teacher but rather encompasses a learning ecosystem co-created by many participants. The Northeast Normal University paper highlights how this structural change promotes the concepts of learners' independent inquiry and lifelong learning (W.J., 2022). However, changes in the educational structure also necessitate new management models and policy support. For example, research from Tsinghua University proposed that to adapt to the development of Yuanverse education, a management mechanism for cross-departmental cooperation must be established, education regulations should be adjusted, and teaching quality, as well as student rights and interests, must be ensured (Chen, 2023).

2.2.1.6 Research on the Application of Metaverse Technology in Chinese Education

Chinese researchers have conducted extensive discussions on the application of metaverse technology in education. Chinese researchers are focusing on how metaverse technology is integrated into the teaching process and its effectiveness in different teaching scenarios. The research report by Zhang Jingwei and others from Shanghai Jiao Tong University presents an application case of the Metaverse in medical education. Constructing a virtual medical practice scene provides a risk-free environment for surgical practice, allowing medical students to practice without pressure. Repeatedly practice surgical skills and learn from them (Jingwei et al., 2023). In addition, a study by Tsinghua University on the Metaverse's support for language learning found that by simulating immersive scenes of different cultural backgrounds, students can gain a deeper understanding and mastery of foreign languages while also developing cross-cultural communication skills (Haitao, 2022）) In the field of primary school education, the Metaverse has also been utilized to create an engaging learning environment and stimulate students' interest in learning. Research from Nanjing University found that through the Yuanverse platform, children can acquire mathematical and scientific knowledge through games. This method not only improves learning efficiency but also enhances children's problem-solving abilities (Yueming et al., 2022). Therefore, Metaverse technology can bring revolutionary changes to traditional education, enhance learners' learning interests and experiences, and promote the transfer and sharing of knowledge (Wang et al., 2020).

Through Metaverse technology, education can become more personalized

and interactive, helping to stimulate students' learning motivation and creativity and improve learning results. The exploration of the Metaverse's application in China's education presents both opportunities and challenges. From promoting learners' active and in-depth learning to facilitating the sharing and optimization of educational resources, the Metaverse has demonstrated significant potential. Zhang Ye and others used emerging information technologies such as VR/AR/MR, digital twins, 5G, artificial intelligence, and blockchain to explore the "Metaverse + Vocational Education" and found that it can improve the effectiveness of vocational education and will become a professional The new trend of educational development provides support for our in-depth study of "Yuan Universe + Higher Vocational Education"（Zhang & Cai,2023）. Liao analyzed the structural elements, key technologies, and application prospects of the vocational education metaverse, arguing that the educational metaverse is not merely the application of metaverse technology to education but rather a profound reconstruction of the educational ecosystem (Jingqian & Sun, 2023). Research by Lu and Zhang (2023) also verified the effectiveness of procedural knowledge acquisition and aesthetic ability improvement in the Metaverse learning environment through experiments, proving that the Metaverse learning environment has the potential to achieve various educational goals. Li and others combined the requirements of the times with the existing foundation for promoting the digitalization of education in higher vocational colleges to construct an overall idea of integrating higher vocational teaching with the Metaverse, exploring the practical path of metaverse-enabled course teaching (Jin et al., 2023). This provides important theoretical guidance and practical reference for building a comprehensive and spatially integrated digital education management model for higher vocational colleges, cultivating talents with digital concepts and technologies. To sum up, at this stage, domestic research on higher vocational education in the metaverse field, although relatively extensive, has yet to be refined. At the same time, the current research status at home and abroad also reminds us that we should actively pay attention to and study the application of emerging information technologies such as VR/AR/MR, digital twins, 5G, artificial intelligence, and blockchain in the metaverse field in future research, and accelerate key Breakthroughs in technological breakthroughs; attention should be paid to students' experience in the Metaverse learning environment, immersive computing technology, perceptual interaction

technology, etc. should be optimized; data security and privacy protection issues should be paid attention to.

In the field of research that combines the Metaverse and education, international research focuses on the potential of Metaverse technology to improve the quality of education, enhance teaching methods, and enrich learning resources. There is a lack of systematic research on the applicability and effects of Metaverse technology on students across different disciplines and age groups. There is a lack of long-term follow-up research, and it is impossible to comprehensively evaluate the long-term impact of Metaverse technology on students' learning outcomes and vocational skill development.

Most of the domestic research in China is still in the preliminary exploration stage and lacks systematicness and depth. The lack of interdisciplinary research makes it impossible to comprehensively evaluate the comprehensive effect of Metaverse technology in the field of education. This study is based on the innovative value of Yuanshi technology in the field of education and the need for modernizing China's vocational education. It is not only a helpful supplement to the existing literature at home and abroad, but also a practical promotion of vocational education reform and development.

CHAPTER III
RESEARCH METHODOLOGY

3.1 Research Design

This study employed a pre-test and post-test design within a quasi-experimental framework, complemented by a quantitative research method that involved a questionnaire survey. This research design can effectively evaluate the impact of metaverse technology on the vocational skills of students majoring in digital media art design. The researcher chose the audio-visual language course as the pre-test and post-test quasi-experimental course. By testing before and after the implementation of metaverse technology teaching, the changes in students' vocational skills can be compared. The quasi-experimental design is suitable for educational environments and can be studied without disrupting the existing class structure. This design method enables us to evaluate the impact of metaverse technology in a real educational setting while maintaining a certain degree of experimental control. The researcher chose the chapter on light and shadow as the course for applying metaverse technology. The effect of using the metaverse before and after its implementation was evaluated by conducting situational teaching tests. The quantitative research component included pre-tests, post-tests, and questionnaire surveys to collect quantifiable data, such as students' views on metaverse technology and its potential to improve their vocational skills. Quantitative research enabled researchers to obtain statistical data, which were used for statistical analysis, testing hypotheses, analyzing the relationship between variables, and making broad inferences on the results to objectively evaluate how metaverse technology affects learning experiences, practical abilities, innovation abilities, and other dimensions in vocational education.

The research was divided into the following stages:

1. Pre-test stage: Before introducing Metaverse technology, students in the digital media art design major use traditional teaching methods to learn the content of the light and shadow chapter in the audio-visual language course and conduct vocational skills tests on students

2. Implementation stage: A new course design is implemented in the audio-visual language course of the digital media art design major, and Metaverse technology is introduced to further explain the content of the light and shadow chapter.

3. Post-test stage: After completing this chapter, students are retested on vocational skills, and a questionnaire survey is conducted.

4. Data analysis stage: Statistical and qualitative analysis of the collected data.

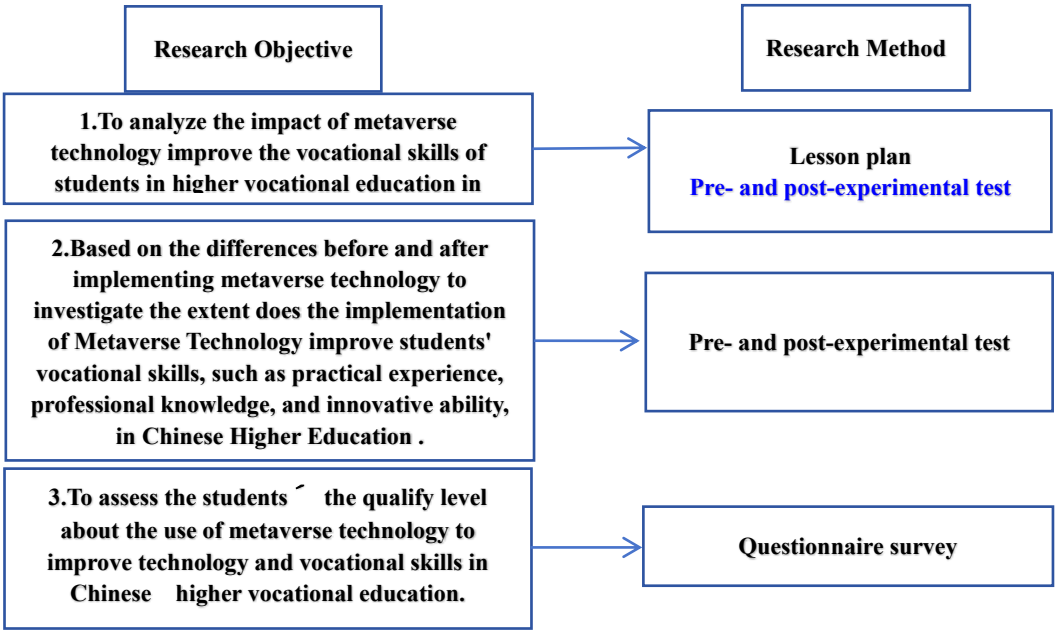

Figure 3.1 Relation between Research Objective and Research Instrument

This quantitative research design can comprehensively evaluate the impact of Metaverse technology on students' vocational skills, providing both objective statistical data and an in-depth understanding of students' subjective experiences and views. By comparing the pre-and post-test results, we can quantify the effect of Metaverse technology on the improvement of students' vocational skills. At the same time, the questionnaire data can help us understand the personal views of students behind these changes.

3.2 Research Population

The research population of this study consists of students enrolled in the audio-visual language course of the Digital Media Art Design major at Fuzhou Software Vocational and Technical College. The reason for choosing this group is that the audiovisual language course is a professional introductory course in the second semester of the freshman year. After one semester of study, students in this major usually possess high digital technology literacy, which is conducive to the application of metaverse technology.

3.2.1 Population

This study primarily examines the practical application of Yuan inverse technology in the digital media art design program at Fuzhou Software Vocational and Technical College. There are 157 first-year students majoring in digital media art and design, randomly assigned to three classrooms.

Classroom no.1 = 54 students

Classroom no.2 =54 students

Classroom no.3 =49 students

3.2.1.1.Ensure the Effectiveness of the Study and Take Measures

Random selection: Participants were randomly selected based on meeting the above conditions to minimize selection bias.

Consent to participate: Ensure that all participants voluntarily participate in the study and sign the informed consent form.

Confidentiality: Protect the privacy of participants and ensure the anonymity and confidentiality of data.

The representativeness of the research sample is crucial to the generalizability of the research results. By carefully selecting and balancing the sample, we can ensure that the research results accurately reflect the overall situation of students majoring in digital media art design at Fuzhou Software Vocational and Technical College, providing a valuable reference for other similar institutions.

3.2.1.2.Characteristics of the Survey Subjects

Age: mainly college students aged 20-22. Students in this age group usually have a high degree of acceptance and learning ability for new technologies.

Educational background: All survey subjects are students majoring in digital media art design and have relevant professional basic knowledge.

Technical literacy: As students majoring in digital media, they usually have high digital technology literacy, which is conducive to the application of metaverse technology.

3.2.2 Sample Group

To ensure the diversity and representativeness of the data and make the findings more generalizable, the researcher used cluster random sampling to select the sample group. Therefore, the researcher randomly selected the classroom numbers, and Classroom 1 was chosen as the sample group.

3.2.2.1 Specific Sample Information

- Number of students: 54
- Gender ratio: 21 male, 33 female

Academic background: All students are first-year majors in digital media art design.

Major	**Population**		**Sample**	
Digital media art design major	Male	Female	Male	Female
	53	104	21	33
Total	157		54	

3.2.2.2.Information to be Collected

In order to fully understand the survey subjects, the following information were collected:

1. Basic information: including demographic data such as age and gender.

2. Learning background: including high-education students.

3. Technology usage: including familiarity and frequency of use of various digital technologies.

By deeply understanding and respecting the respondents, we can ensure the

authenticity and reliability of the research data while also providing valuable feedback for students' learning and development.

3.3 Sampling Methods

Cluster random sampling selects individuals from a population. Each individual has an equal chance of being selected, and each possible sample has an equal chance of being selected. The specific method involves randomly dividing 157 students into three groups according to the standard classes. Find 3 small balls and write down the numbers 1, 2, and 3, respectively. Each number corresponds to the class of the corresponding number. Then, randomly select 1 small ball, and the corresponding class is the class participating in this experiment. For example, the number of drawn balls is 3, which means that 3 participants were included in this study.

By adopting a cluster random sampling method, we can ensure that the research sample can accurately reflect the overall situation of students majoring in digital media art design at Fuzhou Software Vocational and Technical College. This sampling method can not only improve the reliability and universality of the research results but also provide a solid foundation for subsequent data analysis.

3.4 Data Collection

Data collection techniques include tests, lesson plans, and questionnaires.

Step 1: Study theories and articles to find ideas for the title and to inform your research approach.

Step 2: Write chapters 1-3

Step 3: Design research instruments, including tests, lesson plans, and questionnaires.

To compare the impact of Metaverse Technology teaching and traditional teaching on students' vocational skills, this study employs lesson plans and pre- and post-experimental tests. The lesson plans and pre- and post-experimental tests were developed around the theme of "The impact of metaverse technology on improving the vocational skills of students in higher vocational education in China. This flexible design enables participants to complete tasks at their own pace, potentially providing

new insights.

Objective 3 is to assess the students' qualification level for utilizing metaverse technology to enhance technology and vocational skills in Chinese higher vocational education. I made a questionnaire. Students completed a questionnaire to share their experiences and provide feedback on the use of Metaverse technology.

Step 4: Test students with a pre-test

Before implementing Metaverse Technology, students received traditional teaching and complete vocational skills tests to assess their existing professional knowledge, technical ability, and innovation ability.

Step 5: Teach by lesson plan and metaverse technology.

By building a highly simulated virtual learning environment, students can participate in audio-visual language courses in an immersive way, learn and simulate operations according to the course plan, enhance students' learning interest and participation, and help students understand and master complex knowledge concepts more deeply by simulating real scenes and interactive experiences.

Step 6: Test students with a post-test

After implementing Metaverse Technology teaching, students took the same test to evaluate the effectiveness of this teaching method.

The test has right or wrong answers and also serves as an examination of students' learning outcomes during this period.

Step 7: Survey by questionnaire

After the post-test, students completed a questionnaire to provide feedback on their experience and the use of Metaverse technology. Data collection was conducted through an online questionnaire. The questionnaire was distributed to the target sample by email, social media, and academic forums, with a particular response deadline. The content of the questionnaire included the following aspects:

1. Professional knowledge(5)
2. Practical experience(5)
3. Innovation ability(5).
4. Opinion about the use of metaverse technology(3)

Step 8: Collect data and analyze

Organize numbers and enter relevant data. Data were checked for missing

values, outliers, and errors and processed and corrected as necessary. Calculate basic statistics such as the mean, standard deviation, and frequency of data to understand the distribution characteristics of the data.

Using a class of students from the Digital Media Design major at Fuzhou Software Vocational and Technical College to conduct a before-and-after control test ensures the scientific validity and reliability of the collected data. It is essential to fully understand The Impact of metaverse technology on improving students' vocational skills in Chinese higher education.

For pre-and post-test data, a paired-sample t-test were conducted to determine whether the experiment produces a statistically significant effect.

Step 9: Write chapters 4-5

Based on the analysis results, explain the phenomena and relationships reflected by the data, verify the research hypotheses, and draw meaningful conclusions.

3.5.Research Instruments

The research tools used in this study include vocational skills tests, lesson plans, and questionnaires.

3.5.1 Lesson Plan

To analyze the impact of metaverse technology on improving the vocational skills of students in higher vocational education in China. The researcher used a lesson plan to complete the course design of operating metaverse technology.

The lesson plan helps address specific research questions about vocational skills development. There are 5 lesson plans in total; each lesson plan is 45 minutes long, and the total teaching time for each lesson is also 45 minutes.

Lesson Plan 1: Shadows and their classification and role

(1) Purpose:

1) Students understand professional knowledge

2) Students have a learning experience

3) Students have innovative ability

(2) Content: Understand the role of light and shadow in film and television works, as well as how to effectively light a subject.

(3) Key points:

Shadows and their classification and role

(4) Teaching methods

1) Teaching introduction (corresponding purpose: professional knowledge, learning experience)

Methods: Learning resources

a. Playing two-dimensional pictures and two-dimensional classic movie clips to show the light and shadow effects, attract students' attention, and use Traditional textbooks to introduce the theme of this lesson.

b. Then, utilize VR/AR resources, 3D virtual models, and interactive content to guide students into immersive virtual movie scenes, allowing them to experience different light and shadow effects firsthand. (Through intuitive visual effects and immersive experience, students can initially feel the importance of light and shadow and stimulate their interest in learning.)

2) Knowledge transfer (corresponding purpose: professional knowledge)

Method: Learning Environment

a. Immersive virtual environment

Teachers explain the basic knowledge and application of light and shadow in an immersive virtual environment, including shadow classification, light quality, and guidance functions for light and shadow. Using 3D virtual models, students can intuitively observe the changes of light and shadow in three-dimensional space. (Through systematic explanations and virtual demonstrations, students can master the basic concepts and theoretical knowledge of light and shadow.)

3) Interactive discussion (corresponding purpose: learning experience, innovation ability)

Method: Student Interaction

a. In-class discussions and group activities

Organize students' in-class discussions and group activities, analyze the application of light and shadow in different movie scenes, and explore its effects and creativity.

b. Virtual group discussions

Using the Metaverse platform, students organize virtual group discussions

to display and discuss their plans for arranging light and shadow in virtual groups. (Through discussion, stimulate students' thinking and communication, promote a deep understanding of knowledge and the cultivation of innovative thinking.)

4) Feedback and evaluation

Method: Teachers evaluate and give feedback on students' filming work, organize students to conduct self-evaluation and evaluation, and conduct comprehensive evaluation in combination with examinations. Using the Metaverse platform, students can display their works in a virtual space and receive real-time feedback.

After class, a detailed evaluation is conducted through a test of knowledge points, which comprehensively assesses students' innovation ability, professional knowledge, and practical ability. This test can effectively reflect students' learning outcomes and comprehensive qualities in the light and shadow chapter. The test results provided valuable feedback for further teaching and help students continuously improve and perfect their skills in future learning. （Through multi-party feedback and evaluation, help students recognize their strengths and weaknesses and improve vocational skills and learning effects.）

Lesson Plan 2: The nature of light

Lesson Plan 3: The internal and external guiding role of light and shadow

Lesson Plan 4: The direction of five kinds of light

Lesson Plan 5: Three-point lighting

Lessons 2 through 5 follow the same purpose and steps as Lesson 1 but have different content.

3.5.1.1. The Development Process of Lesson Plan

(1) Understand students' basic knowledge level and learning needs and formulate appropriate teaching objectives and content.

(2) According to the teaching objectives, design diversified teaching methods and activities that meet the teaching content.

(3) Review the teaching plan formulated by the teacher.

(4) Modify the teaching plan according to suggestions.

(5) Resource preparation: Prepare the necessary resources for teaching, such as movie clips, handouts, and equipment, to ensure the smooth progress of

teaching activities.

(6) The validity of the teaching plan was verified by three experts, all of whom were from China, and the test consistency index ranged from 0.50 to 1.00.

(7) Implement teaching activities according to the plan, adjust teaching methods flexibly, and pay attention to students' feedback and participation.

(8) Effect evaluation: Through testing, feedback, and evaluation, analyze teaching effects, summarize experience, and provide a basis for subsequent course improvements.

3.5.2 Pre- and post-experimental test

Pre- and post-experimental tests were conducted to assess the extent to which implementing Metaverse technology enhances students' practical experience, professional knowledge, innovation abilities, and other vocational skills in higher education in China. The test helps address specific research questions about vocational skills development. The researcher selected Classroom No. 1 of the Digital Media Art Design program at Fuzhou Software Vocational and Technical College as the sample group. Before implementing Metaverse Technology, students were given a baseline test to assess their existing professional knowledge, technical skills, and innovation capabilities.

After implementing Metaverse Technology teaching, students were given the same test to evaluate the effectiveness of this teaching method.

The test is multiple choice, with 30 questions covering the following five knowledge points, and takes 30 minutes to complete:

1) Shadows and their classification and role（6）

2) The nature of light（6）

3) The internal and external guiding role of light and shadow（6）

4) The direction of five kinds of light（6）

5) Three-point lighting（6）

3.5.2.1 How to Develop the Process of the Test

1) Determine the test objectives and content

Steps: Clarify the specific objectives of the test and determine the test content and evaluation criteria.

Activity: Discuss with the teaching team and industry experts to ensure that the test content covers light and shadow theory, application, and innovation capabilities.

2) Design test questions and forms

Steps: Design test questions with relevant content, including Shadows and their classification and role, the nature of light, the internal and external guiding role of light and shadow, the direction of five kinds of light, three-point lighting, and other relevant topics to assess professional knowledge and vocational skills.

Activity:

Choice questions: Test students' understanding of light and shadow theory and concepts.

Practical operation questions: Perform light and shadow arrangement and actual operation in the metaverse environment.

3) Develop test tools

Steps: Select and develop appropriate test tools and platforms.

Activity: Prepare the hardware and software resources required for the test.

4) Implement the test

Steps: Implement the test in the pre-test and post-test stages of the course.

Pre-test: Before introducing the metaverse technology, test students' vocational skills under traditional teaching methods.

Post-test: After the metaverse technology is applied, test students' vocational skills with duplicate content.

5) Data collection and analysis

Steps: Collect test results and related data and conduct a statistical analysis.

Statistical analysis: Compare pre-test and post-test data to evaluate the impact of Metaverse technology on students' professional knowledge and innovation ability.

3.5.2.2 Data Collection

The researchers conducted the test and implemented the teaching plan during the selected students' class time. The researcher provided the test paper and guided the students to complete the test steps. Data were collected from 30 items and scored based on the standard answers.

3.5.2.3 Data Analysis

Quantitative data analysis assigned a score to each student based on their test scores.

3.5.3 The Questionnaire

Objective 3: To assess the students' quality level in using metaverse technology to improve technology and vocational skills in Chinese higher vocational education.

The questionnaire helps to assess students' perceptions of Metaverse technology and its effects on their learning. Design a detailed questionnaire that incorporates questions from multiple dimensions, carefully crafted by the research objectives of the article and relevant literature. Before using the questionnaire, the researcher consulted with relevant experts and tested it to ensure its effectiveness.

The questionnaire survey content mainly includes the following 3 aspects：(See Table 3.1)

1. Practical experience (5 items)
2. Professional knowledge (5 items)
3. Innovation ability (5 items)
4. Opinion about the use of metaverse technology（3 items）

The questionnaire was scored using the Likert scale to qualify the students' feedback.

Table 3.1 Questionnaire Structure

	Subject	**Item**	**References**
Practical experience	1-5	5	（Mystakidis, 2022; Wang et al., 2022）
Professional knowledge	6-10	5	(Wu et al., 2021)
Innovation ability.	11-15	5	(Wu et al., 2021)
Opinion about the use of metaverse technology	16-18	3	

3.5.3.1 Data Collection

The researcher designed a questionnaire based on the research framework. All questions are in the form of declarative sentences, allowing the sampled students to

choose answers based on their ideas. The questionnaire was scored using the Likert scale to qualify the students' feedback. The questionnaire has 18 questions divided into three dimensions, each measuring a different number of questions, as follows:

5 points for "strongly agree"

4 points for "agree"

3 points for "uncertain"

2 points for "disagree"

1 point for "strongly disagree"

3.5.3.2 Data Analysis

The quantitative data were analyzed using frequency, percentage, and mean. The average of the expert opinion suitability ratings was calculated and compared to the following scale:

A mean score of 1.00-1.50 means “strongly disagree,” interpreted as “very low.”

A mean score of 1.51-2.50 means “disagree,” interpreted as = “low.”

A mean score of 2.51-3.50 means “uncertain,” interpreted as = “moderate.”

A mean score of 3.51-4.50 means “agree,” interpreted as = “high.”

A mean score of 4.51-5.00 means “strongly agree,” interpreted as = “very high.”

3.6 Reliability and Validity Tests

In order to ensure the reliability and validity of the research tools, this study conducted the following tests:

3.6.1 Part 1. Lesson Plan

To ensure the effectiveness of the lesson plan, it was reviewed by a team of educational research experts.

The development process of the effectiveness evaluation form for teaching plans for teachers at Fuzhou Software Vocational and Technical College.

1) The concept and development process of teaching plan validity evaluation and testing were studied.

2) The teaching plan effectiveness evaluation form for Fuzhou Software

Vocational and Technical College was drafted, and the consideration levels were as follows:

The score was +1. There was an opinion that it “conforms to the content.”

The score was 0. There was an opinion that “is not sure whether it conforms to the content”.

The score was -1. There was an opinion that “does not conform to the content”.

At the end of each section, there is space for experts to provide suggestions for improvement.

3) Verification of the effectiveness evaluation form for the teaching plan and the tutor test results.

4) The teaching plan effectiveness evaluation form and test were modified following the suggestions.

Requires IOC (Index of Item Objective Congruence). The content consistency standard index should be greater than or equal to 0.50 to be considered suitable for research. The IOC analysis result of the audio-visual language teaching program of Fuzhou Software Vocational and Technical College is 1.00.

3.6.2 Part 2. The Test

To ensure the validity of the test content, it was reviewed by a team of education research experts.

The test content included 30 items:

1) Shadows and their classification and role（6）

2) The nature of light（6）

3) The internal and external guiding role of light and shadow（6）

4) The direction of five kinds of light（6）

5) Three-point lighting（6）

The development process of the light and shadow test of the audio-visual language course of the digital media design major of Fuzhou Software Vocational and Technical College

1) The concept and development process of the test validity evaluation form were studied.

2) The validity evaluation form of the audio-visual language light and shadow knowledge test was developed, and the consideration levels are as follows:

The score is +1. There is an opinion that “conforms to the content”.

The score is 0 points, and there is an opinion that “is not sure whether it conforms to the content”.

The score is -1. There is an opinion that “does not conform to the content”.

At the end of each section, there is an expert opinion column to allow experts to provide suggestions for improvement.

3) The instructor verified the test validity evaluation form.

4) Modify the test validity evaluation form according to the suggestions.

Requires an IOC (Index of Item Objective Congruence). The content consistency standard index should be greater than or equal to 0.50 to be suitable for research. The IOC analysis result of the audio-visual language and light and shadow knowledge test for freshmen at Fuzhou Software Vocational and Technical College was 1.00.

3.6.3 Part 3. Questionnaire

To ensure the validity of the student questionnaire’s content, it was reviewed by a team of education research experts.

The process of compiling the questionnaire evaluation form for the Impact of metaverse technology on improving students’ technology skills in vocational education in Chinese higher education.

1) The concept and development process of the questionnaire validity evaluation form

2) The validity evaluation form for the “Impact of Metaverse Technology on Improving Students’ Technology Skills in Chinese Higher Education” questionnaire was compiled. The consideration levels are as follows:

The score is +1. There is an opinion that “conforms to the content”.

The score is 0. There is an opinion that “is not sure whether it conforms to the content”.

The score is -1. There is an opinion that “does not conform to the content”.

At the end of each section, there is space for experts to provide suggestions for improvement.

3) The consultant verifies the validity of the evaluation questionnaire.

4) According to the suggestions, the questionnaire validity evaluation form was modified.

Request the IOC (Objective Consistency Index). The content consistency standard index should be greater than or equal to 0.5 to be considered suitable for research.

When the IOC was finished, the researcher used Cronbach´s alpha to assess reliability. The criteria of Cronbach´s alpha should be greater than or equal to 0.8 to be considered suitable for research.

3.7 Statistical Data Analysis

Data analysis adopted quantitative analysis methods, mainly including the following steps:

3.7.1 Descriptive Statistics

The questionnaire used frequency, average, and standard deviation

3.7.2 Inferential Statistics

Pre-test and Post-Test used t-tests for dependent samples.

CHAPTER IV
ANALYSIS RESULT

Based on the research content from Chapters 1 to 3, this chapter collects and analyzes data to validate the hypotheses. This chapter utilizes SPSS software to verify each research hypothesis, employing descriptive statistical analysis (frequency, percentage, mean, and standard deviation), as well as independent-sample T-tests, to analyze the sample distribution of students at Fuzhou Software Vocational and Technical College and the differences before and after the implementation of metadata technology. This study collects and analyzes data using questionnaires, learning plans, and tests. The questionnaire covers basic student information and students' recognition of using metadata technology to enhance technical and vocational skills in higher vocational education in China, divided into practical experience, professional knowledge, innovative ability, and recognition of metadata technology. A total of 54 pre-experiment questionnaires and 54 post-experiment questionnaires were collected.

4.1 Descriptive Characteristics

A total of 54 students majoring in Digital Media Art and Design at Fuzhou Software Vocational and Technical College were selected to participate in the study. The data presents the basic information of these students who participated in the research from the Digital Media Art and Design program at Fuzhou Software Vocational and Technical College. The study population consists of 54 students, including 21 males and 33 females. The number of female students in this major is significantly higher than that of male students, accounting for approximately 61%, while male students account for about 39%. This gender distribution reflects the characteristics or trends in gender selection for this and provides data support for subsequent research.

Table 4.1 Descriptive Characteristics

Major	Frequency	
Digital media art design major	Male	Female
	21	33
Total	54	

4.2 The Impact of Metadata Technology On Students' Vocational Skills Improvement

The research subjects of this study are students enrolled in the Audiovisual Language course within the Digital Media Art and Design at Fuzhou Software Vocational and Technical College. Before the introduction of Metaverse technology, students in Digital Media Art and Design used traditional teaching methods to learn the content of the lighting chapter in the Audiovisual Language course, and they underwent vocational skills tests. After exposure to metadata technology, the students were tested again, and the test data were collected. A new course design was implemented in the Audiovisual Language course of the Digital Media Art and Design major, introducing Metaverse technology to continue explaining the content of the lighting chapter. At the end of this chapter, the students were once again tested on their vocational skills and surveyed through questionnaires.

Before the introduction of Metaverse technology, students were tested, and 54 valid test papers were collected. Following the introduction of Metaverse technology, students were retested, and an additional 54 valid test papers were collected. An independent-sample t-test was conducted on the students' scores. The data showed that before the introduction of Metaverse technology, the average score of the 54 students was 12.76, with a standard deviation of 2.835, indicating that the overall performance level of the students was relatively low and concentrated. However, after the introduction of Metaverse technology, the average score of the 54 students significantly increased to 23.57, with a standard deviation of 3.424. Although there was a slight increase in score fluctuation, the performance was significant in the pre-test phase. See Table 4-2 for details.

These data indicate that after students engaged in learning supported by Metaverse technology, the average score of the post-test group was significantly higher

than that of the pre-test group (23.57 > 12.76), demonstrating a notable improvement in student performance following the introduction of Metaverse technology. The research results reflect that this technology may have a positive effect on students' learning outcomes. This result provides preliminary evidence for the study, suggesting that Metaverse technology can effectively enhance students' learning performance and deserves further exploration and promotion.

Table 4.2 Pre-Test and Pro-Test Group Statistics

Group Statistics					
	Group	**N**	**Mean**	**Std. Deviation**	**Std. Error Mean**
Score	1	54	12.76	2.835	0.386
	2	54	23.57	3.424	0.466

The research data presents the results of an independent-sample t-test conducted on students' performance before and after the introduction of Metaverse technology. The results of Levene's test for equality of variances showed an F-value of 2.635 with a corresponding significance level (Sig.) of 0.107, which is greater than 0.05. This indicates that the variance difference between the two sets of data is not significant; the assumption of equal variances for the two sets of performance data can be accepted. Consequently, the results under the "Equal variances assumed" condition were used for analysis. Under the assumption of equal variances, the t-test results showed a t-value of -17.880 with 106 degrees and a corresponding two-tailed significance level (Sig. (2-tailed)) of 0.000, which is much smaller than 0.05. This suggests that the difference in students' performance before and after the introduction of metaverse technology is statistically highly significant. The 95% confidence interval, ranging from [-12.014, -9.616], indicates the range of the average score difference between the pre-test and post-test, supporting the reliability of the results. Based on these analyses, the introduction of metaverse technology has led to a significant improvement in students' performance. The statistical test results provide support for the research, demonstrating that metaverse technology plays a role in enhancing students' learning outcomes.

Table 4.3 Independent Samples Test

	Levene's Test for Equality of Variances		t-test for Equality of Means				
						95% Confidence Interval of the Difference	
	F	Sig.	t	df	Sig. (2-tailed)	Lower	Upper
Equal variances assumed	2.635	0.107	-17.880	106	0.000	-12.014	-9.616
Equal variances are not assumed			-17.880	102.435	0.000	-12.014	-9.615

4.3 Evaluation of Students' Opinions About the Use of Metaverse Technology

Reliability analysis is a statistical process that reflects the degree of consistency or stability of test instrument results concerning the measured characteristic. The more uniform the test results, the better the data represents the situation and the higher the reliability. Through reliability analysis, researchers can assess whether the questionnaire design is reasonable and make corrections to avoid categorization errors. Cronbach's Alpha is used to evaluate the internal consistency of test items. A higher Cronbach's alpha value indicates a high degree of consistency. When the reliability coefficient of a subscale is above 0.7, the reliability of the scale or questionnaire is considered good; when it is between 0.6 and 0.7, it is acceptable; and when the reliability coefficient of the overall scale needs to reach above 0.8, it indicates good overall reliability.

The reliability of the survey data was evaluated using the Cronbach's Alpha index. According to the research, Cronbach's Alpha for professional knowledge was 0.939, for practical experience was 0.937, for innovative ability was 0.902, and for opinion about metaverse technology was 0.841, as shown in Table 4-4. The research data showed that all Cronbach's Alpha values exceeded 0.8, indicating good reliability of the survey questionnaire.

Table 4.4 Reliability Statistics

Dimension	Cronbach's Alpha	N of Items
Professional Knowledge	0.939	5
Practical Experience	0.937	5
Innovative Ability	0.902	5
Opinion About the Use of Metaverse Technology	0.817	3

The validity of the survey questionnaire is assessed based on the KMO value (Kaiser-Meyer-Olkin value). A KMO value greater than 0.7 indicates that the survey data is suitable for factor analysis. The survey data revealed an overall KMO value of 0.968, with a significance level of 0.000, which is less than 0.05 and meets the significance threshold, indicating that factor analysis can be conducted. According to the factor analysis results of each variable, the cumulative explanatory rates for practical experience, professional knowledge, and innovative ability were 70.402%, exceeding 0.5, indicating their suitability for factor analysis. Three factors were obtained through the factor analysis.

Table 4.5 KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		**0.968**
Bartlett's Test of Sphericity	**Approx. Chi-Square**	**1948.277**
	df	153
	Sig.	0.000

The numerical results display the statistical outcomes of a questionnaire survey on students' professional knowledge, practical experience, innovative ability, and attitudes toward the use of metaverse technology before and after its introduction. According to the data, in terms of professional knowledge, the mean of the pre-test was 1.45 with a standard deviation (Std. Deviation) of 0.33. In contrast, the mean of the post-test significantly increased to 3.88 with a standard deviation of 0.54. For practical experience, the pre-test mean was 1.59 with a standard deviation of 0.29, and the post-test mean rose to 4.07 with a standard deviation of 0.53. For innovative ability, the pre-test mean was 1.78 with a standard deviation of 0.36, and the post-test mean increased to 3.99 with a standard deviation of 0.56.

Regarding attitudes towards the use of metaverse technology, the pre-test

mean was 1.91 with a standard deviation of 0.56, while the post-test mean reached 4.01 with a standard deviation of 0.54. The data indicate that after the introduction of metaverse technology, students' scores in these vocational skills and attitudes have shown significant improvement. The slightly higher standard deviations in the post-tests suggest slight individual differences in students' adaptation to and feedback on metaverse technology, but the overall effect is remarkable. See Table 4.6.

These data reveal that the introduction of metaverse technology has a significant impact on enhancing students' vocational skills. The substantial increase in professional knowledge and practical experience demonstrates that metaverse technology can effectively enhance students' mastery of key concepts and their practical application skills, particularly in vocational colleges. The notable improvement in innovative ability reflects the positive role of metaverse technology in stimulating students' creative thinking, which may benefit from its immersive and interactive learning environment. The significant change in attitudes towards its use further indicates that students have a high level of acceptance of metaverse technology and recognize its value in education. The metaverse technology offers new ideas for vocational education, contributing to students' comprehensive progress in knowledge acquisition, skill development, and innovative growth.

Table 4.6 Pre-Test and Pro-Test Questionnaire Statistics

Group		N	Mean	Std. Deviation	Std. Error Mean
Professional Knowledge	1	54	1.45	0.33	0.05
	2	54	3.88	0.54	0.07
Practical Experience	1	54	1.59	0.29	0.04
	2	54	4.07	0.53	0.07
Innovative Ability	1	54	1.78	0.36	0.05
	2	54	3.99	0.56	0.08
Opinion About the Use of Metaverse Technology	1	54	1.91	0.56	0.08
	2	54	4.01	0.54	0.07

The data were analyzed through independent sample t-tests to explore whether there were significant changes in students' scores across different dimensions before and after the introduction of metaverse technology. Levene's test for equality of variances indicated that the assumption of equal variances was not met for the variables

"professional knowledge," "practical experience," and "innovative ability." In contrast, they were met for "attitude towards the use of metaverse technology." Therefore, the t-test results for "unequal variances" were referenced, and for the latter, the results for "equal variances" were adopted.

For professional knowledge, the significance level (Sig.) of Levene's test was 0.001, which is less than 0.05, indicating unequal variances and necessitating the reference to the t-test results for "unequal variances." The t-value was 28.049, with 87.950 degrees of freedom, and the two-tailed significance level (Sig. (2-tailed)) was 0.000, indicating a significant difference in professional knowledge scores before and after the introduction of metaverse technology. The 95% confidence interval was [2.254, 2.598], suggesting a stable and significant average increase.

In terms of practical experience, the Sig. of Levene's test was 0.000, failing to meet the assumption of equal variances. Again, referring to the results for "unequal variances," the t-value was 30.172, with 82.968 degrees of freedom. The value was 0.000. The 95% confidence interval was [2.321, 2.649], indicating a statistically significant and substantial increase in students' practical experience scores after the introduction of metaverse technology.

For innovative ability, the Sig. of Levene's test was 0.002, failing to meet the assumption of equal variances. According to the results for "unequal variances," the t-value was 24.387, with 91.220 degrees of freedom, and the significance level (p-value) was 0.000. The value was 0.000. The 95% confidence interval was [2.024, 2.383], showing that the introduction of metaverse technology also had a significant effect on enhancing students' innovative ability, with a relatively narrow range of score improvement and a clear trend.

Regarding attitudes towards the use of metaverse technology, the Sig. of Levene's test was 0.697, which is greater than 0.05, indicating that the assumption of equal variances was met. Therefore, the t-test results for "equal variances" were adopted, with a t-value of 19.882, 106 degrees of freedom, and a Sig. of 0.000. The 95% confidence interval was [1.884, 2.301], indicating a statistically significant and substantial increase in students' scores on attitudes towards the use of metaverse technology.

The data results demonstrate that the introduction of metaverse technology

has a significant effect on enhancing students' vocational skills, particularly in mastering professional knowledge, accumulating practical experience, and developing innovative abilities. Additionally, students' attitudes towards the use of this technology have improved significantly, reflecting its high applicability and potential in the teaching context. The study validates the effectiveness of metaverse technology in vocational college education, providing empirical support for its further promotion and application.

Table 4.7 Questionnaire Independent Samples Test

		Levene's Test for Equality of Variances		**t-test for Equality of Means**				
							95% Confidence Interval of the Difference	
		F	**Sig.**	**t**	**df**	**Sig. (2-tailed)**	**Lower**	**Upper**
Professional Knowledge	Equal variances assumed	12.384	0.001	28.049	106.000	0.000	2.254	2.597
	Equal variances are not assumed			28.049	87.950	0.000	2.254	2.598
Practical Experience	Equal variances assumed	19.833	0.000	30.172	106.000	0.000	2.322	2.648
	Equal variances are not assumed			30.172	82.968	0.000	2.321	2.649
Innovative Ability	Equal variances assumed	10.191	0.002	24.387	106.000	0.000	2.025	2.383
	Equal variances are not assumed			24.387	91.220	0.000	2.024	2.383
Opinion About the Use of	Equal variances assumed	0.152	0.697	19.882	106.000	0.000	1.884	2.301

		Levene's Test for Equality of Variances		t-test for Equality of Means				
							95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Lower	Upper
Metaverse Technology	Equal variances are not assumed			19.882	105.831	0.000	1.884	2.301

CHAPTER V
CONCLUSION AND DISCUSSION

5.1 Conclusion

Part 1 for Answering Research Question 1

The research results indicate that the introduction of Metaverse technology has a significant effect on enhancing the vocational skills of students in China's higher vocational education. Through a comparative analysis of students' scores, the average score of the post-test group was 23.57, significantly higher than the 12.76 of the pre-test group, with a notable difference. The results of the independent sample t-test showed a t-value of -17.880, with 106 degrees of freedom, and the corresponding two-tailed significance level (Sig. (2-tailed)) was 0.000, far less than 0.05. This suggests that the improvement in students' scores after engaging in learning supported by Metaverse technology is statistically highly significant.

Metaverse technology offers students a novel learning experience through immersive virtual reality environments and highly interactive teaching methods. The multidimensional learning support of Metaverse technology enhances students' mastery of professional knowledge and strengthens their development of vocational skills, including practical experience and innovative abilities. Research data indicate that students' post-test scores were significantly higher than pre-test scores across key dimensions of vocational skills, including professional knowledge, practical experience, and innovative ability. The results of the independent sample t-test further validate that the introduction of Metaverse technology has a statistically significant positive impact on these dimensions. By innovating teaching methods, Metaverse technology breaks the limitations of traditional teaching modes, improves students' academic performance, and provides technical support for the development of higher vocational education.

Part 2 for Answering Research Question 2

Research has shown that Metaverse technology has a significant impact on enhancing the practical experience, professional knowledge, and innovative abilities of students in China's higher vocational education. Through a comparative analysis of pre- and post-test data, students' scores on core dimensions, such as professional knowledge,

practical experience, and innovative ability, have all increased significantly, and the results of various t-tests are statistically highly significant. This suggests that the introduction of Metaverse technology can effectively address the shortcomings of traditional teaching methods, enhancing students' mastery of knowledge and practical operational skills and fostering innovative thinking through immersive and interactive learning environments.

Students' professional knowledge increased from 1.45 to 3.88, practical experience from 1.59 to 4.07, and innovative ability from 1.78 to 3.99, with significant and stable growth in all scores. The reliability of these improvements has been verified through independent sample t-tests. The application of Metaverse technology has introduced innovative elements into vocational education, providing students with more opportunities to engage with real-world scenarios and significantly improving learning outcomes and vocational competence. Metaverse technology offers valuable insights for reforming higher vocational education and demonstrates broad application prospects in enhancing students' core skills and fostering professional competitiveness.

Part 3 for Answering Research Question 3

The research results indicate a significant improvement in the attitudes of Chinese higher vocational education students towards using Metaverse technology to enhance their vocational skills. In the pre-test, students' average score for their attitude towards using Metaverse technology was 1.91, with a standard deviation of 0.56. After the introduction of Metaverse technology, the post-test score increased significantly to 4.01, with a standard deviation of 0.54. This notable change suggests a substantial increase in students' recognition and acceptance of the technology after experiencing the learning mode supported by Metaverse technology. The significance of Levene's Test for Equality of Variances is 0.697, which is greater than 0.05, indicating that the data satisfy the assumption of equal variances. Therefore, the t-test results, assuming equal variances, were adopted, with a t-value of 19.882, 106 degrees of freedom, and a significance level of 0.000, indicating that the increase in scores is statistically highly significant. Students exhibited positive attitudes towards the application of Metaverse technology in teaching and acknowledged its practical effects in enhancing vocational skills. Metaverse technology enhances students' interest in and engagement with learning through immersive and interactive learning environments, thereby

transforming the traditional passive mode of knowledge acquisition and encouraging students to participate in the learning and practice of vocational skills.

5.2 Discussion

Part 1 To Answer Research Question No. 1

4. How can metaverse technology improve the vocational skills of students in higher vocational education in China?

Metaverse technology offers immersive and interactive learning environments, addressing the limitations of traditional teaching modes. Through technological means such as Virtual Reality (VR) and Augmented Reality (AR), students can directly engage in practical operations within virtual scenarios, enhancing their understanding and application of knowledge. For instance, in higher vocational education, many skills require training in real-world settings. Metaverse technology simulates real environments through virtual simulations, enabling students to familiarize themselves with processes and practice while reducing the constraints of equipment, venue, and safety associated with traditional teaching. The introduction of Metaverse technology has changed students' attitudes and approaches to learning. In traditional teaching modes, students often serve as passive recipients of knowledge, whereas Metaverse technology encourages students to engage in active and exploratory learning. The fun and immersive nature of virtual learning environments significantly boosts students' interest in learning, making them willing to invest more time in in-depth study. This transformation in learning mode may be one of the primary reasons for the significant improvement in students' academic performance.

This research conclusion aligns with the findings of Slater & Sanchez-Vives (2016) and Sheridan (2016). Some scholars have noted that teaching modes based on Metaverse technology can enhance students' practical skills, team collaboration abilities, and innovative thinking capabilities (Jiang & Wang, 2020; Smith & Brown, 2019). These research results collectively demonstrate that Metaverse technology is a technological innovation and an educational tool that effectively promotes the development of vocational skills. Especially in the highly practice-oriented field of higher vocational education, Metaverse technology provides students with more

opportunities for hands-on practice, better meeting the needs of vocational skill training.

Potential challenges in the application of Metaverse technology include, for example, the equipment costs and technical requirements that may limit its promotion and application in some higher vocational colleges. Additionally, designing teaching content that suits the needs of different majors and skills and fully integrates with Metaverse technology is an issue that requires further research. Only through coordinated development in technology, resources, and instructional design can the enhancing effects of Metaverse technology on higher vocational education be maximized.

Part 2 To Answer Research Question No. 2

2. To what extent does the implementation of Metaverse Technology improve students' vocational skills, such as practical experience, professional knowledge, and innovative ability, in Chinese Higher Education compared to before its implementation?

The research findings highlight the effectiveness of metaverse technology in teaching and reveal its unique advantages in higher vocational education. By offering immersive and interactive learning environments, metaverse technology provides students with intuitive and vivid learning experiences. This research conclusion aligns with the findings of Dahanna et al. (2022) and Parks (2022). Traditional teaching relies heavily on classroom lectures, where students comprehend knowledge through textbooks and teachers' explanations. In contrast, metaverse technology employs virtual simulations and visualization techniques to materialize abstract knowledge (Chen et al., 2018; Lee & Lee, 2020). This immersive learning approach enables students to grasp complex theoretical knowledge more quickly, thus significantly improving their scores in professional knowledge.

Higher vocational education emphasizes the cultivation of practical abilities, and one of the advantages of metaverse technology is its provision of near-real practice scenarios. In traditional teaching, students often lack sufficient practical opportunities due to constraints on venue, equipment, and safety. Metaverse technology simulates real work scenarios for students through virtual simulations, enabling them to practice repeatedly in a safe and low-cost environment (Jones & Smith, 2017; Wang & Liu, 2021). This research conclusion is consistent with the findings of Taylor and

Anderson (2020). The increase in practice opportunities directly promotes the students' practical abilities and helps them better adapt to professional requirements in real-world scenarios.

Innovative capabilities are a goal in vocational education; however, traditional teaching modes, which lack interactivity and flexibility, struggle to stimulate students' creative thinking. The introduction of metaverse technology provides students with innovative spaces that offer rich, interactive functions and diverse learning scenarios. For example, within the metaverse environment, students can independently explore problems, design solutions, and even try different experiments and models. This student-centered learning mode greatly encourages their initiative and creativity, thereby significantly improving their scores in innovative capabilities (Zhang et al., 2021; Smith et al., 2022).

The application of metaverse technology enhances students' vocational skills and provides insights for the teaching reform of higher vocational education. Technology-enabled education is a crucial direction for future development. By introducing advanced technology, traditional classrooms can break the limitations of time and space, enabling students to participate in learning more flexibly. The successful application of metaverse technology demonstrates that education needs to closely align with the development needs of society and industry, cultivating competitive professional talents through the introduction of cutting-edge technology. By enhancing students' professional knowledge, practical experience, and innovative capabilities, metaverse technology injects innovative elements into higher vocational education, significantly boosting students' professional competitiveness.

Part 3 To Answer Research Question No. 3

5. What are the students' opinions about the use of metaverse technology in Chinese higher vocational education to enhance students' vocational technology skills?

The research results indicate that the introduction of Metaverse technology has significantly improved students' attitudes in China's higher vocational education toward enhancing their vocational skills. This reflects the successful application of technology in teaching reform and a marked increase in student acceptance. This research conclusion aligns with the findings of Wang (2020) and Radianti et al. (2020). In traditional teaching modes, students may lack interest and motivation in one-way,

didactic learning methods. Metaverse technology transforms dull knowledge transmission into interactive learning that is both fun and engaging (Li et al., 2020). Through virtual reality scenarios, students can "personally" participate in simulated operations or problem-solving, enhancing their learning interest and improving learning efficiency. This technology-driven learning environment fosters higher recognition and trust in Metaverse technology among students.

The significant improvement in students' attitudes holds great significance for reforming vocational education teaching. Students' positive attitudes towards technology can further stimulate their enthusiasm and participation in learning, indirectly enhancing their learning outcomes and skill levels. This attitudinal improvement also contributes to the widespread application and promotion of Metaverse technology in vocational education. When students have positive attitudes towards technology, they are more willing to try novel learning methods and actively explore the possibilities that technology offers. This initiative enhances students' personal and professional competitiveness, creating educational value through technology applications. The successful application of Metaverse technology demonstrates that education needs to adapt to students' learning needs by enhancing the fun and practicality of teaching through technological means. The improvement in attitudes indicates that students are more adaptable to digital and technological learning environments, which aligns well with the needs of future society and career development. The significant improvement in students' attitudes towards Metaverse technology reflects the technology's immense potential and broad prospects in vocational education. Technology enriches students' learning experiences and changes their perceptions of learning and technology, injecting innovative momentum into the modernization reform of vocational education.

5.3 Implication for Practice

The research findings reveal that Metaverse technology has had a significant impact on enhancing vocational skills, improving learning attitudes, and enhancing teaching practices among students in China's higher vocational education.

(1) Practical Effects on Vocational Skill Enhancement

The study indicates that the introduction of Metaverse technology has significantly improved students' vocational skills. Through virtual simulation and immersive learning, students can acquire core vocational skills, including professional knowledge, practical experience, and innovation abilities, in realistic environments. The direct application of technology in the classroom also reflects students' active learning and hands-on practice in virtual scenarios. This provides an innovative path for vocational education, transforming traditional teacher-centered learning into a more interactive and participatory learning approach, enhancing students' comprehensive vocational abilities in practice.

(2) Promotion of Practice through Improved Learning Attitudes

The significant improvement in students' attitudes towards the use of Metaverse technology has also had a positive impact on practice. In pre-tests, students scored low in their attitudes towards Metaverse technology, but in post-tests, their attitudes towards this technology significantly improved, with scores rising from 1.91 to 4.01. This attitudinal shift suggests that after experiencing Metaverse-supported instruction, students have developed higher recognition and acceptance of the technology. Positive learning attitudes have a direct influence on students' learning motivation and participation, promoting higher-quality learning practices. When students have a positive attitude towards Metaverse technology, they are more inclined to actively participate in classroom activities and interact with the virtual environment, improving the efficiency and quality of practical operations. This improvement in attitudes has laid a solid foundation for the future popularization and application of Metaverse technology in vocational education.

(3) Innovative Applications in Teaching Reform

From the perspective of teaching practice, the introduction of Metaverse technology offers an innovative direction for reforming teaching in China's higher vocational education. Metaverse technology, through virtual reality and immersive learning environments, breaks the limitations of traditional teaching and transcends spatial and temporal constraints, providing students with more practical opportunities and interactive spaces. This technology-enabled learning approach enhances students' vocational skills and promotes the transformation of educational models, providing strong support for teaching reform.

(4) Impact on Teachers and Course Design

The application of Metaverse technology also poses challenges and opportunities for teachers' teaching methods. Teachers should master and apply this emerging technology to design courses and teaching activities, placing higher demands on their technological application abilities. By providing technical training and support, teachers can effectively utilize Metaverse technology to create highly interactive teaching environments, thereby enhancing students' sense of participation and practical skills. Additionally, course design should be adjusted to accommodate Metaverse technology, devising teaching content suitable for virtual learning environments. This change promotes innovation in education and teaching, making vocational education more aligned with social development and industry demands.

Despite the enormous potential of Metaverse technology in enhancing students' vocational skills, its widespread application in higher vocational education still faces challenges, including equipment costs, technological limitations, and variations in teachers' skills. In future practice, these issues should be addressed to ensure that the technology can benefit more students and institutions. Meanwhile, educational departments and higher vocational colleges should strengthen technology research and development, as well as curriculum innovation, to promote the diversified application of Metaverse technology across various disciplines and majors. Only through continuous technological innovation and optimization of teaching resources can the potential of Metaverse technology for enhancing students' vocational skills be maximized.

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APPENDICES

Appendix I. Audio-visual Language Light and Shadow Lesson Plan

Lesson Plan 1: Shadows and their classification and role

1. Purpose:
1) Students understand professional knowledge
2) Students have a learning experience
3) Students have innovative ability

2. Content: Understand the role of light and shadow in film and television works, as well as how to light the subject effectively.

3. Key points:
Shadows and their classification and role

4. Teaching methods
(1) Teaching introduction (corresponding purpose: professional knowledge, learning experience)
Methods: Learning resources
1) Playing two-dimensional pictures and two-dimensional classic movie clips to show the light and shadow effects, attract students' attention, and use Traditional textbooks to introduce the theme of this lesson.
2) Then, utilize VR/AR resources, 3D virtual models, and interactive content to guide students into immersive virtual movie scenes, allowing them to experience different light and shadow effects firsthand. (Through intuitive visual effects and immersive experience, students can initially feel the importance of light and shadow and stimulate their interest in learning.)

(2) Knowledge transfer (corresponding purpose: professional knowledge)
Method: Learning Environment
1) Immersive virtual environment
Teachers explain the basic knowledge and application of light and shadow in an immersive virtual environment, including shadow classification, light quality, and guidance functions for light and shadow. Using 3D virtual models, students can intuitively observe the changes of light and shadow in three-dimensional space. (Through systematic explanations and virtual demonstrations, students can master the basic concepts and theoretical knowledge of light and shadow.)

(3) Interactive discussion (corresponding purpose: learning experience, innovation ability)
Method: Student Interaction
1) In-class discussions and group activities
Organize students' in-class discussions and group activities, analyze the application of light and shadow in different movie scenes, and explore their effects and

the creativity they inspire.

2) Virtual group discussions

Using the Metaverse platform, students organize virtual group discussions to display and discuss their plans for arranging light and shadow in virtual groups. (Through discussion, stimulate students' thinking and communication, promote a deep understanding of knowledge, and cultivate innovative thinking.)

(4) Feedback and evaluation

Method: Teachers evaluate and give feedback on students' filming work, organize students to conduct self-evaluation and evaluation, and conduct a comprehensive evaluation in combination with examinations. Using the Metaverse platform, students can display their works in a virtual space and receive real-time feedback.

After class, a detailed evaluation is conducted through a test of knowledge points, which comprehensively assesses students' innovation ability, professional knowledge, and practical ability. This test can effectively reflect students' learning outcomes and comprehensive qualities in the light and shadow chapter. The test results will provide valuable feedback for further teaching and help students continuously improve and perfect their skills in future learning. （Through multi-party feedback and evaluation, help students recognize their strengths and weaknesses and improve vocational skills and learning effects.）

Lesson Plan 2: The nature of light

Lesson Plan 3: The internal and external guiding role of light and shadow

Lesson Plan 4. The direction of the five kinds of light

Lesson Plan 5. Three-point lighting

Appendix II. Lesson Plan Validity Checking

Name……..Surname…….
Workplace……..Position……..

Directions: Please put the / in the table according to your opinion.

Meaning: Rated +1. There is a view that "fits the definition".
The rating is 0. One comment was, "Not sure it meets the definition".
The rating is -1. There is a view that is "inconsistent with the definition".

No.	**Question**	**+1**	**0**	**-1**
1	Purpose			
2	Content			
3	Key points			
4	Teaching methods			
5	Feedback and evaluation			

Appendix III. Audio-visual Language Light and Shadow Chapter Test

This test paper will help evaluate students' knowledge, innovation, and practical abilities in the five courses before and after the test.

Shadows and Their Classification and Role

1. What is the primary role of shadows in cinematography?
   a) To enhance the color of the scene
   b) To create depth and dimension
   c) To increase the brightness of the scene
   d) To reduce the contrast

2. Which type of shadow is created by a small, focused light source?
   a) Soft shadow
   b) Hard shadow
   c) Ambient shadow
   d) Diffuse shadow

3. What classification of shadow can be used to evoke a sense of mystery or suspense in a scene?
   a) Soft shadow
   b) Hard shadow
   c) Ambient shadow
   d) Shadowless lighting

4. In terms of storytelling, how can shadows be used effectively?
   a) By eliminating all shadows to focus on the characters
   b) By creating patterns that distract from the main action
   c) By emphasizing important elements and guiding the viewer's eye
   d) By making the scene look overly bright

5. Which of the following is not a classification of shadow?
   a) Core shadow
   b) Cast a shadow
   c) Reflected shadow
   d) Transparent shadow

6. Which role do cast shadows play in visual composition?
   a) They diffuse light evenly across the scene
   b) They highlight the main subject
   c) They provide context by indicating the position and shape of objects
   d) They eliminate the need for additional lighting

The Nature of Light

7. What property of light affects its ability to create sharp or diffuse shadows?
   a) Color temperature
   b) Intensity
   c) Direction
   d) Quality

8. Which type of light source is most likely to produce soft shadows?
   a) A small spotlight
   b) A significant, diffused light source
   c) A flashlight
   d) A laser pointer

9. What is the term for light that spreads out and illuminates a large area evenly?
   a) Direct light
   b) Ambient light
   c) Specular light
   d) Focused light

10. How does the color temperature of a light source affect the mood of a scene?
   a) It changes the speed of movement in the scene
   b) It alters the emotional tone by shifting colors toward warm or cool hues
   c) It determines the sharpness of shadows
   d) It impacts the spatial composition

11. What characteristic of light describes its brightness?
   a) Intensity
   b) Color temperature
   c) Diffusion
   d) Quality

12. Which term refers to light that is reflected from surfaces within the scene?
   a) Key light
   b) Fill light
   c) Bounce light
   d) Backlight

The Internal and External Guiding Role of Light and Shadow

13. How can light be used to guide the viewers' attention to a specific area of the frame?
   a) By evenly lighting the entire scene
   b) By placing the brightest light on the background
   c) By using highlights and shadows to create contrast around the focal point
   d) By diffusing light evenly across all objects

14. What is the internal guiding role of light in a scene?
    a) To illuminate external landscapes
    b) To create natural lighting conditions
    c) To enhance the emotional context within the scene
    d) To make actors' faces appear brighter

15. Which technique uses light to create a visual path for the viewer's eyes to follow?
    a) Hard lighting
    b) Leading lines
    c) Diffusion
    d) Silhouetting

16. In what way can shadows provide external guidance in a visual composition?
    a) By obscuring important details
    b) By reducing depth and making the scene appear flat
    c) By framing the subject and creating context
    d) By brightening the background

17. How does backlighting contribute to the guiding role of light?
    a) It creates a silhouette effect that highlights the subject's outline
    b) It eliminates all shadows in the scene
    c) It focuses light on the foreground objects
    d) It softens the overall lighting

18. What is the effect of using high-key lighting in a scene?
    a) It creates deep shadows and high contrast
    b) It produces a soft, even light with minimal shadows
    c) It directs attention to dark areas
    d) It highlights the edges of objects

The Direction of Five Kinds of Light

19. Which type of light comes from directly above the subject?
    a) Front light
    b) Sidelight
    c) Top light
    d) Backlight

20. How does side lighting affect the appearance of a subject?
    a) It flattens the features and reduces the depth
    b) It creates strong shadows and enhances texture
    c) It evenly illuminates the subject
    d) It obscures the subject details

21. Which direction of light is commonly used to create a silhouette effect?
    a) Front light
    b) Backlight
    c) Top light
    d) Sidelight

22. What is the purpose of using front lighting in a scene?
    a) To create dramatic shadows
    b) To highlight the subject evenly and reduce shadows
    c) To obscure the subject
    d) To add depth to the background

23. What effect does underlighting have on a subject's appearance?
    a) It creates a natural and flattering look
    b) It casts eerie and dramatic shadows
    c) It softens the subjects' features
    d) It highlights the background

24. In portrait lighting, which direction of light is used to create the classic Rembrandt lighting effect?
    a) Front light
    b) Sidelight
    c) Top light
    d) Backlight

Three-Point Lighting

25. What are the three components of three-point lighting?
    a) Key light, fill light, backlight
    b) Front light, top light, side light
    c) Key light, under light, overhead light
    d) Fill light, side light, backlight

26. What is the primary role of the key light in three-point lighting?
    a) To soften shadows
    b) To provide the primary source of illumination and define the subject
    c) To illuminate the background
    d) To add color to the scene

27. What function does the fill light serve in three-point lighting?
    a) To create strong shadows
    b) To add highlights to the subject
    c) To reduce shadows created by the key light
    d) To enhance the background

28. In three-point lighting, what is the purpose of the backlight?
    a) To create a silhouette effect
    b) To evenly light the subject from the front
    c) To separate the subject from the background
    d) To increase overall scene brightness

29. Which component of three-point lighting is positioned opposite the key light?
    a) Fill light
    b) Backlight
    c) Top light
    d) Sidelight

30. How does three-point lighting enhance a scene?
    a) By creating flat and even illumination with no depth
    b) By providing dynamic lighting with depth, dimension, and texture
    c) By focusing all the light on the background
    d) By using a single light source to create a strong contrast

Student Mastery List

Student Mastery	**Content of Examination**
	Shadows and their classification and role
	The nature of light
	The internal and external guiding role of light and shadow
	The direction of the five kinds of light
	Three-point lighting

Appendix IV. Paper Test Validity Checking

Name……..Surname…….
Workplace……..Position……..

Direction: Please put the / in the table according to your opinion.

Meaning: Rated +1. There is a view that "fits the definition".
The rating is 0. One comment was, "Not sure it meets the definition".
The rating is -1. There is a view that is "inconsistent with the definition".

Content of Examination	Question	+1	0	-1
Shadows and Their Classification and Role	1. What is the primary role of shadows in cinematography? a) To enhance the color of the scene b) To create depth and dimension c) To increase the brightness of the scene d) To reduce the contrast			
	2. Which type of shadow is created by a small, focused light source? a) Soft shadow b) Hard shadow c) Ambient shadow d) Diffuse shadow			
	3. What classification of shadow can be used to evoke a sense of mystery or suspense in a scene? a) Soft shadow b) Hard shadow c) Ambient shadow d) Shadowless lighting			
	4. In terms of storytelling, how can shadows be used effectively? a) By eliminating all shadows to focus on the characters b) By creating patterns that distract from the main action c) By emphasizing important elements and guiding the viewer's eye d) By making the scene look overly bright			
	5. Which of the following is not a classification of shadow? a) Core shadow b) Cast a shadow c) Reflected shadow d) Transparent shadow			

Content of Examination	Question	+1	0	-1
	6. Which role do cast shadows play in visual composition? a) They diffuse light evenly across the scene b) They highlight the main subject c) They provide context by indicating the position and shape of objects d) They eliminate the need for additional lighting			
The Nature of Light	7. What property of light affects its ability to create sharp or diffuse shadows? a) Color temperature b) Intensity c) Direction d) Quality			
	8. Which type of light source is most likely to produce soft shadows? a) A small spotlight b) A significant, diffused light source c) A flashlight d) A laser pointer			
	9. What is the term for light that spreads out and illuminates a large area evenly? a) Direct light b) Ambient light c) Specular light d) Focused light			
	10. How does the color temperature of a light source affect the mood of a scene? a) It changes the speed of movement in the scene b) It alters the emotional tone by shifting colors toward warm or cool hues c) It determines the sharpness of shadows d) It impacts the spatial composition			
	11. What characteristic of light describes its brightness? a) Intensity b) Color temperature c) Diffusion d) Quality			
	12. Which term refers to light that is reflected from surfaces within the scene? a) Key light b) Fill light c) Bounce light d) Backlight			

Content of Examination	Question	+1	0	-1
The Internal and External Guiding Role of Light and Shadow	13. How can light be used to guide the viewer's attention to a specific area of the frame? a) By evenly lighting the entire scene b) By placing the brightest light on the background c) By using highlights and shadows to create contrast around the focal point d) By diffusing light evenly across all objects			
	14. What is the internal guiding role of light in a scene? a) To illuminate external landscapes b) To create natural lighting conditions c) To enhance the emotional context within the scene d) To make actors' faces appear brighter			
	15. Which technique uses light to create a visual path for the viewer's eyes to follow? a) Hard lighting b) Leading lines c) Diffusion d) Silhouetting			
	16. In what way can shadows provide external guidance in a visual composition? a) By obscuring important details b) By reducing depth and making the scene appear flat c) By framing the subject and creating context d) By brightening the background			
	17. How does backlighting contribute to the guiding role of light? a) It creates a silhouette effect that highlights the subject's outline b) It eliminates all shadows in the scene c)It focuses light on the foreground objects d) It softens the overall lighting			
	18. What is the effect of using high-key lighting in a scene? a) It creates deep shadows and high contrast b) It produces a soft, even light with minimal shadows c) It directs attention to dark areas d) It highlights the edges of objects			
The Direction of Five Kinds of Light	19. Which type of light comes from directly above the subject? a) Front light b) Sidelight c) Top light d) Backlight			

Content of Examination	Question	+1	0	-1
	How does side lighting affect the appearance of a subject? a) It flattens the features and reduces the depth b) It creates strong shadows and enhances texture c) It evenly illuminates the subject d) It obscures the details of the subject			
	21. Which direction of light is commonly used to create a silhouette effect? a) Front light b) Backlight c) Top light d) Sidelight			
	22. What is the purpose of using front lighting in a scene? a) To create dramatic shadows b) To highlight the subject evenly and reduce shadows c) To obscure the subject -d) To add depth to the background			
	23. What effect does underlighting have on a subject's appearance? a) It creates a natural and flattering look b) It casts eerie and dramatic shadows c) It softens the subjects' features d) It highlights the background 24. In portrait lighting, which direction of light is used to create the classic Rembrandt lighting effect? a) Front light b) Sidelight c) Top light d) Backlight			
Three-Point Lighting	25. What are the three components of three-point lighting? a) Key light, fill light, backlight b) Front light, top light, side light c) Key light, under light, overhead light d) Fill light, side light, backlight			
	26. What is the primary role of the key light in three-point lighting? a) To soften shadows b) To provide the primary source of illumination and define the subject c) To illuminate the background d) To add color to the scene			

Content of Examination	Question	+1	0	-1
	27. What function does the fill light serve in three-point lighting? a) To create strong shadows b) To add highlights to the subject c) To reduce shadows created by the key light d) To enhance the background			
	28. In three-point lighting, what is the purpose of the backlight? a) To create a silhouette effect b) To evenly light the subject from the front c) To separate the subject from the background d) To increase overall scene brightness			
	29. Which component of three-point lighting is positioned opposite the key light? a) Fill light b) Backlight c) Top light d) Sidelight			
	30. How does three-point lighting enhance a scene? a) By creating flat and even illumination with no depth b) By providing dynamic lighting with depth, dimension, and texture c) By focusing all the light on the background d) By using a single light source to create a strong contrast			

Appendix V. Questionnaire

This questionnaire is used to explore students' opinions about the use of metaverse technology to enhance technological and vocational skills in Chinese higher vocational education.

1. This questionnaire is divided into two parts.
Part 1 Respondents' basic personal information
Part 2 The students' opinions about the use of metaverse technology

2. Please complete this questionnaire, as your answers are important for the analysis of the data in the study. Please answer all questions truthfully in order to make the study accurate and valuable.
3. The information you provide in the questionnaire is confidential, and the presentation of the study results will be presented in summary form only. To all those who sacrificed their valuable time to answer this questionnaire. Our deepest gratitude is extended

Part 1: Respondents' basic personal information
Please tick ✓ the box that matches your criteria.

1. Gender:
(1) Male (2) Female

Part 2 The students' opinions about the use of metaverse technology
Strongly agree: 5, Generally agree: 4, Sometimes: 3, Disagree: 2, Never: 1

The full score is 90. Choose 5 for 5 points, choose 4 for 4 points, choose 3 for 3 points, choose 2 for 2 points, and choose 1 for 1 point. There are 18 questions in total. Use this to study Q3.

Figure 3. Student Questionnaire

	Question	**1**	**2**	**3**	**4**	**5**
Professional knowledge	1. The projects or tasks implemented in this course have greatly helped me improve and master professional knowledge					
	2. The projects or tasks implemented in this course enabled me better to grasp the core concepts in my professional field and greatly helped me understand the technical and theoretical knowledge					

	Question	1	2	3	4	5
	3. Through the Metaverse platform, I can more easily acquire and learn cutting-edge industry knowledge					
	4. The virtual experiments and simulations in the Metaverse can enhance my ability to apply professional theories in practice					
	5. In the Metaverse environment, I can more intuitively master the operating skills of professional equipment					
Practical experience	6. Metaverse technology provides me with more opportunities for practical operations and enhances my hands-on ability.					
	7. Through the Metaverse platform, I can simulate the real working environment and improve my practical skills.					
	8. The virtual training projects in the Metaverse help me better understand and apply vocational skills.					
	9. Metaverse technology enables me to collaborate remotely with classmates and enhances my teamwork abilities.					
	10. In the Metaverse environment, I can practice operations repeatedly, which enhances my practical confidence.					
Innovative ability	11. The interactive and exploratory activities in this course enabled me to think more freely and creatively, making it easier for me to generate innovative ideas.					
	12. I was able to design and implement innovative solutions in this course, which stimulated my creativity					
	13. On the Metaverse platform, I have more opportunities to participate in innovative projects and practical activities					

	Question	1	2	3	4	5
	14. The Metaverse platform provides me with a new channel to showcase and share my innovative achievements					
	15. The study of this course encouraged me to explore and learn professional knowledge and think critically					
Opinion about the use of metaverse technology	16. The use of metaverse technology makes me more engaged in course learning.					
	17. I am satisfied with the metaverse technology used in the course.					
	18. I hope to use metaverse technology in more courses.					

Appendix VI. Questionnaire Validity Checking

Name……..Surname…….
Workplace……..Position……..

Direction: Please put the / in the table according to your opinion.

Meaning: Rated +1. There is a view that "fits the definition".
The rating is 0. One comment was, "Not sure it meets the definition".
The rating is -1. There is a view that is "inconsistent with the definition".

	Question	+1	0	-1
Professional knowledge	1. The projects or tasks implemented in this course have greatly helped me improve and master professional knowledge			
	2. The projects or tasks implemented in this course enabled me better to grasp the core concepts in my professional field and greatly helped me understand the technical theoretical knowledge			
	3. Through the Metaverse platform, I can more easily acquire and learn cutting-edge industry knowledge			
	4. The virtual experiments and simulations in the Metaverse can enhance my ability to apply professional theories in practice			
	5. In the Metaverse environment, I can more intuitively master the operating skills of professional equipment			
Practical experience	6. Metaverse technology provides me with more opportunities for practical operations and enhances my hands-on ability.			
	7. Through the Metaverse platform, I can simulate the real working environment and improve my practical skills.			

	Question	+1	0	-1
	8. The virtual training projects in the Metaverse help me better understand and apply vocational skills.			
	9. Metaverse technology enables me to collaborate remotely with classmates and enhances my teamwork abilities.			
	10. In the Metaverse environment, I can practice operations repeatedly, which enhances my practical confidence.			
Innovative ability	11. The interactive and exploratory activities in this course enabled me to think more freely and creatively, making it easier for me to generate innovative ideas.			
	12. I was able to design and implement innovative solutions in this course, which stimulated my creativity			
	13. On the Metaverse platform, I have more opportunities to participate in innovative projects and practical activities			
	14. The Metaverse platform provides me with a new channel to showcase and share my innovative achievements			
	15. The study of this course encouraged me to explore and learn professional knowledge and think critically			
Opinion about the use of metaverse technology	16. The use of metaverse technology makes me more engaged in course learning.			
	17. I am satisfied with the metaverse technology used in the course.			
	18. I hope to use metaverse technology in more courses.			

BIOGRAPHY

NAME: WANG YELAN

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WORK EXPERIENCE

Yelan Wang is a dedicated educator and a seasoned professional in the fields of art, design, media, and education. I hold a bachelor's degree in Art Design from Xi'an Polytechnic University and am currently pursuing a Master's degree in Education at the Rajamangala University of Technology Krungthep. With professional certifications as a Senior Omnimedia Operator and a Level 2 Technician in Internet Marketing, she has established herself as a versatile expert in her domain.

Since 2010, Yelan has accumulated extensive experience in brand design, visual design, and new media operations. Her professional journey has been marked by a profound understanding of corporate and brand dynamics, with a specialization in visual identity (VI) design, web design, promotional video production, and new media operations for various brands. In 2020, she transitioned into the field of education, leveraging her rich corporate experience to bridge the gap between academic learning and professional practice. Her innovative approach focuses on integrating degree education with vocational training, aiming to cultivate industry-ready talents that meet the evolving needs of the digital age.

Currently serving as a full-time teacher at Fuzhou Software Vocational and Technical College, Yelan imparts her knowledge and skills across a wide range of courses, including 3ds Max, Maya, animation video composition and packaging, digital audio technology, audio-visual language in film and animation, animation motion laws, web design, new media operations, community culture marketing, creative writing for new media, visual layout, and Photoshop. Her commitment to educational innovation is further evidenced by her published research paper, "Exploring Strategies for Digital Media Teaching Reform Oriented by Social Needs," which appeared in the second issue of *Electronics Technology* (ISSN: 31-1323/TN) in 2023. This paper reflects her ongoing efforts to adapt educational strategies to the changing demands of the digital media industry, making significant contributions to the field of education.