Study on the Educational Innovation Paths of Qin Opera from the Perspective of Meta-universe

Xin Kang[1,a*], Yuyan Wang[2,b], Ruifan Li[3,b], Ziqi Shen[4,b], Xiaomeng Wang[5,b], Shuming Zhang[6,b]

{kangxin0601@163.com[1], wangyuyan@snnu.edu.cn[2], 18095154633@163.com[3], 245923151@qq.com[4], 2037195523@qq.com[5], Zhshuming@outlook.com[6]}

School of Mathematics and Statistics, Shaanxi Normal University, Xi'an710119, China[a]
School of Computer Science, Shaanxi Normal University, Xi'an710119, China[b]

Abstract. As a national intangible cultural heritage, Qin Opera is one of the oldest operas in China. At present, Constrained by factors such as shallow integration of technology and culture, insufficient digital means of cultural resources, single exhibition methods in museums, poor experience of cultural and tourism projects, and low efficiency of educational services, Qin Opera is gradually fading out of the vision of public. In order to further promote the development of digital education of Qin Opera, first of all, based on the perspective of the meta-universe, this paper proposes six educational innovation paths, namely, reconstructing the way of cultural resources protection, innovating the way of cultural resources exhibition, changing the way of cultural resources production, building a virtual navigation space, creating immersive interactive experience, and building a new social network system. Secondly, relying on database technology to build a Qin Opera resource management system, using Web3D technology to carry out a full range of cultural exhibitions throughout the process, building a virtual Qin Opera museum based on three-dimensional modeling technology, realizing independent tours of Qin Opera town through virtual navigation, and using augmented reality technology to create a Qin Opera face-changing experience project. Based on these, an intelligent body feeling platform of Qin Opera meta-universe has been created to achieve the organic integration of Qin Opera and new multimedia technology. The evaluation results show that the platform can effectively break through the dilemma of traditional culture development and help folk culture education.

Keywords: Qin Opera·Modern educational technology·Virtual navigation·Augmented reality·Three-dimensional modeling

1 Introduction

Since 2021, meta-universe has gradually become a major research hotspot. It is considered to be the "next generation Internet application and social form" that integrates multiple underlying technologies such as augmented reality, mixed reality, and artificial intelligence [1]. The augmented reality and virtual navigation technology promote the innovative development of educational informatization, and also put forward new requirements [2]. As one of the treasures of Chinese culture, Qin Opera has a long history, unique charm and profound mass foundation. However, the slow rhythm and solidified form of opera art do not match the fast-paced lifestyle of modern people, making Qin Opera in a downturn for a period of time. Under the guidance of national strategic planning, based on the perspective of meta-universe,

EIMT 2024, March 29-31, Wuhan, People's Republic of China

DOI 10.4108/eai.29-3-2024.2347692

this paper deeply explores the cultural connotation of Qin Opera, studies the educational innovation paths, and evaluates its effectiveness, so as to provide assistance for breaking through the dilemma of traditional cultural development and promoting folk culture education.

2 Research status

As the latest progress in the development of science and technology, meta-universe is conducive to the digital education of intangible cultural heritage.

2.1 Development status of meta-universe related technology

As a new concept, the realization of meta-universe depends on the comprehensive application of various digital means, mainly including e-learning technology, interactive technology, artificial intelligence, digital twin, multimedia, database technology and so on.

Among them, artificial intelligence technology and video game technology have started earlier and developed more maturely, but they are all hot and still in the rising period.In interactive technology, holographic technology is difficult to achieve due to the support of hardware conditions. Sensory interconnection technology is basically in the theoretical stage of concept research. However, the performance of XR is outstanding. For example, in 2022, the global shipment of XR equipment is 14.382 million [3]. In 2023, Sony, Apple and other companies are expected to sell a new batch of VR/MR equipment. Information and communication technology has made great progress in the field of higher education [4]. The development of digital twin is not yet mature, and it has been initially applied in the field of intelligent manufacturing. Zang Yuhua et al. proposed a virtual workshop based on digital twins [5]. However, there are few applications in China, mainly in the field of smart cities, such as the construction of Guangzhou 'Suizhiguan' urban operation and management center [6], and the application potential in cultural heritage protection and innovation is huge [7]. The meta-universe of great significance to the development of intangible cultural heritage in China, especially for the development of cultural heritage in Shaanxi Province [8].

2.2 Research status of intangible cultural heritage digitization

The reference to 'intangible cultural heritage' around the millennium has been internationally recognized. At present, the above practices have achieved remarkable results, such as the 2018 Unity-based somatosensory interaction museum developed by Greece and France [9], and the emerging interactive paradigm of AR-based World-as-Support proposed by Spain [10].

As far as China is concerned, in the past ten years, the research attention of intangible cultural heritage digitization has been on the rise. Among them, the research focuses on the construction of databases, but there are also new attempts. For example, Dai Meiping proposed the use of AR to protect and inherit traditional opera culture [11], and Chen Feng et al. used VR/AR to build a virtual museum tour system [12]. However, the main means of digitalization of intangible cultural heritage are still pictures, text, video and audio, while the application of emerging technologies such as VR/AR, motion capture, 3D scanning and modeling is relatively insufficient.

2.3 Current situation of the integration of Qin Opera education and technology

The development of Qin Opera has encountered certain problems, and the current situation is not very optimistic [13]. At present, there are few studies on the integration and development of Qin Opera and science and technology, but some practical results have been achieved. In terms of content innovation of Qin Opera, the song "Chang'an Night" sung by the virtual digital person 'Qin Xiaoya' was released in June 2022 [14]. In terms of the innovation of Qin Opera 's communication mode, Shi Xingyue studied the application of action recognition and augmented reality technology to realize the interactive digital virtual performance of traditional opera [15].

Tthe integration of Qin Opera and science and technology is the general trend, and many experts have given solutions. Wu Yue emphasized the need to use Internet technology as the media of Qin Opera [16]. Guo Haijin put forward the proposal of building China's opera meta-universe and combining opera with science and technology [17]. Wang Donglan et al. emphasized that the digital construction of Qin Opera should be done well, such as the establishment of digital museum of Qin Opera [18].

3 Study on the Educational Innovation Paths

3.1 Reconstruct the protection of cultural resources

At present, most of the resources of Qin Opera are preserved in the form of paper materials, and are in the situation of static display. This requires the combination of database and web technology to reconstruct the protection methods of cultural resources. Generally, it needs to go through the following four stages. Firstly, gather resources and use Python-based data collection methods to extract useful information from public sources. Secondly, classify the data, combine recording methods and cultural characteristics, and extract features through neural networks to achieve precise classification. Next, manage the resources, use the database MySQL to build the Qin Opera data management system, and code, save and backup the resources. Finally, presenting cultural resources, using HTML and CSS technologies to build and beautify web page structures, and combining PHP and JavaScript to achieve web page interaction effects, creating an online demonstration system.

3.2 Innovate the ways of cultural resources exhibition

With the support of 3D modeling and human-computer interaction technology, Qin Opera resources exhibit in the following two innovative ways. The first is a comprehensive display of cultural exhibits. With digital twin technology, physical entities can be derived in all directions through digital mapping. Use polygon modeling, curve modeling, and digital 3D engraving techniques to build models of cultural exhibits. Use texture mapping, UV mapping, texture projection and other technologies to improve material accuracy. Arbitrarily enlarge the details of exhibits and display them at 720 degrees through the chamfering and joint push and pull plug-ins in SketchUp.

The second is to enhance the interaction between cultural resources and visitors. First of all, 3D modeling software is used to build a virtual Qin Opera Museum, and then VR/AR technology is combined to achieve interactive functions. Through the operation of the screen

and the mouse, the museum can be immersed in the tour, and the corresponding video and audio can be played automatically by clicking the track script, completing the two-way interaction between cultural resources and visitors.

3.3 Change the mode of production of cultural resources

As users shift from information audiences to the main body, the production mode of media content is shifting from Professionally-generated Content (PGC) to User-generated Content (UGC). There are four specific measures to change the production mode of cultural resources. Firstly, establish a community-based website. Create the structure and style of a website using front-end technologies such as HTML and CSS, and process data and logic using back-end development technologies such as Java and PHP. Users can publish the audio or video of Qin Opera tracks they perform on the website, and disclose the secondary creation achievements related to Qin Opera to other users. Secondly, use collaborative filtering, matrix factorization, and deep learning recommendation algorithms to achieve personalized recommendations based on browsing records. Thirdly, involve users in the decision-making process of cultural resources through voting, likes, and other means, such as developing a website where users vote to determine the content of the homepage. Fourthly, opening up API and SDK can allow users to create new applications and services based on existing platforms.

3.4 Build a virtual navigation space

In order to abandon the disadvantages of time-consuming and laborious offline visits, 3D modeling technology can be used to establish a virtual museum, which goes through the following three stages.

Figure. 1. Qin Opera Town

First of all, as shown in Fig. 1, establish the 3D model of the Qin Opera Museum, which can be composed of multiple experience areas, such as the Qin Opera stage, the knowledge publicity column, the cave dwelling area, the Qin Opera dress experience area, etc. Secondly, the Unity 3D engine is used to write C# functional scripts, so that users can tour in the scene from the first perspective, enter different locations with one click, accompanied by audio guide, and also choose the video of Qin Opera for immersive learning. Finally, low-latency, high-fidelity interaction is achieved through network technologies such as 5G.

3.5 Create an immersive interactive experience

Developing educational AR apps and 3D games about culture is an effective approach. It uses augmented reality, naked-eye 3D technology to create an immersive, low-latency interactive

experience that allows users to interact with virtual cultural images in a real environment with only a camera function.

Figure. 2. Qin Opera face-changing system

As shown in Fig. 2, taking Qin Opera face-changing system as an example, 3DMax modeling software was first used to make Qin Opera face model and import it into Unity 3D, and then function scripts based on C# were written to control camera switch and face switching. The face-changing function was realized through AR Foundation, and facial tracker was used to accurately capture users' actions such as frowning and opening mouths. It makes the Qin Opera facial mask more suitable for the face, and can be released to the Android platform, so that users can experience it only after installation, so as to achieve a more real and convenient experience.

3.6 Build a new social network system

The identity heterogeneity of the universe enables each real person in reality to construct a variety of digital avatars by themselves. Users can conduct social behaviors with a variety of themes by generating corresponding heterogeneous identities in different scenes, which can not only be performed by Qin Opera actors on the stage, but also be used as an exchange of feelings between the audience and actors, breaking through the limitations of offline traditional social time and space. Building such a social network generally requires attention to the following four stages. Firstly, use 3D modeling and physics engines to build a virtual world. The theme and story line are determined by referring to the classic repertoire of Qin Opera, and the virtual world is designed by combining the scenes of villages, stages and caves. Secondly, using AI voice synthesis and 3D animation to create virtual characters to meet the character needs of users in different themes. Next, provide social functions, including personal character settings, adding friends and interest circles, performing dynamic performances, and sharing thoughts with each other. Finally, user privacy is protected through data encryption, access control, and anonymization processing.

4 Effectiveness evaluation

From April to May, 2023, 30 students from Qishan County Third Junior High School, 30 students from Xi'an Jiaotong University Affiliated Middle School, and 40 students from various majors of Shaanxi Normal University conducted platform experiences and received user satisfaction surveys as the data source for this effectiveness evaluation. This survey adopts a questionnaire survey as the main method, supplemented by face-to-face interviews.

For the 98 valid questionnaires collected, reliability analysis was conducted to obtain Cronbach's alpha value is 0.921, indicating good reliability of the questionnaire; In addition, the implementation of validity analysis resulted in a KMO value of 0.833, indicating good validity of the questionnaire. The questionnaire is mainly composed of user satisfaction survey, covering cultural resource integrity, search function experience, Qin Opera town experience, face-changing function experience, and page aesthetics. Data analysis is conducted from the following three aspects.

NPS is an indicator used to measure user loyalty and satisfaction. According to the likelihood of users recommending the product, users are divided into three categories: recommenders (9-10 points), neutralists (7-8 points), and detractors (0-6 points). The calculation formula for NPS is

$$NPS = (N_r / N) \times 100\% - (N_d / N) \times 100\% \quad (1)$$

among them, N represents the total sample size, N_r represents the number of recommenders, and N_d represents the number of detractors. Generally speaking, in the field of cultural education, an NPS score below 0 indicates that the product has many problems. A score between 0 and 30 indicates that the product performs well, while a score above 30 indicates excellent performance and high customer satisfaction. Based on the analysis of the NPS net recommendation value of the questionnaire data, it was found that the NPS scores were all above 38 points, indicating that the overall performance of user satisfaction is excellent.

Regarding interview records and user suggestions, LDA topic model is used for text data mining. Firstly, Chinese word segmentation is performed on the text using Python; Next, TF-IDF is used to weight the words and train the model; Finally, use the LDA model to mine themes and analyze feature words. The obtained feature words have complete functions, abundant resources, and easy operations.

Based on descriptive statistical analysis of research data, the following three conclusions were drawn. The first one is that the platform has effectively broken through the dilemma of traditional culture being neglected. 92.9% of the students said that this platform is different from the traditional two-dimensional static cultural experience project. It not only has rich and vivid Qin Opera resources, but also brings immersive interactive experience. The second conclusion is that the platform has created a new form of traditional culture teaching, with over 90% of students stating that the education model mainly based on knowledge education has caused a lack of time for systematic learning of traditional culture. Integrating emerging multimedia methods into traditional culture education can make up for this deficiency, not only achieving learning anytime and anywhere, but also increasing fun and improving learning efficiency. The third is the strong promotion of digital empowerment of rural education, with 90% of students stating that this firsthand experience enriched their understanding of multimedia technology and also stimulated their enthusiasm for learning folk culture.

5 Conclusion

Qin Opera is the foundation of the development of Chinese opera culture and the spiritual sustenance of the people in the western region. At present, the application prospect of meta-universe to Qin Opera education is very broad. Digging the connotation of characteristic

folk culture, building a digital cultural service platform, and creating an immersive educational research scene play an important role in promoting the digital field of culture and education. Although the meta-universe can bring new changes and upgrades to the field of cultural education, there are still some potential risks and challenges. On the one hand, people's cultural identity is not high. If people's acceptance and recognition of the meta-universe are not high, its application scope in the cultural field will also be constrained. On the other hand, the application of the meta-universe requires processing a large amount of private data and information. Once data leakage occurs, it will cause great losses to users.

Project Fund. Shaanxi Normal University National Undergraduate Innovation and Entrepreneurship Training Program, Project No.: 202210718002.

References

[1] Research Report on the Development of the Universe 2.0[EB/OL]. https：//www.sohu.com/a/546322232_100016406

[2] V. L A .New Imperatives of the Information Approach to Education[J].Scientific and Technical Information Processing,2022,49(1):14-20.

[3] Zheng Xiangqi. Institutions : Global XR equipment shipments are expected to grow by 67 % in 2023(N)(2023-02-09). https://3w.huanqiu.com/a/c36dc8/4BdBeZWt6Ej

[4] Rachana A,Rachna A,Rajesh R,et al. ICT in higher education:learning as usual or a “new normal”?[J].Higher Education,Skills and Work-Based Learning,2023,13(4):846-860.

[5] Zang Yuhua, Liu Hong, Xiong Sijia, Chen Jingyi, Lv Zheqi, Yin Shihao. Research on cost management based on digital twin virtual workshop[J]. Accounting Research,2022,No.555(09):34-40.

[6] Yang Xinyi. Digital twin cities promote the construction of smart cities. (N)(2021-10-11). https://m.gmw.cn/baijia/2021-10/11/1302634958.html

[7] Yang Yifan, Zou Jun, Shi Mingming, Li Yuefeng, Yang Bobo, Wang Hongrong, Shi Chengzhang, Jin Longyue, Lu Xin. Analysis of the research status of digital twin technology[J]. Journal of Applied Technology, 2022,22(02):176-184+188.

[8] Zhang Haoran. Thoughts on Promoting the Development of Shaanxi's Intangible Cultural Heritage with Meta-universe Technology[J]. New Western, 2022(07):64-65.

[9] Koutsabasis P, Vosinakis S. Kinesthetic interactions in museums: conveying cultural heritage by making use of ancient tools and (re-) constructing artworks. Virtual Reality, 2018, 22: 103–118.

[10] Schaper M M, Santos M, Malinverni L, et al. Learning about the past through situatedness, embodied exploration and digital augmentation of cultural heritage sites. Int J Human-Comput Studies, 2018, 114: 36–50.

[11] Dai Meiping. Research on the path of inheritance and protection of traditional opera culture by using AR technology[J]. Research on propagation force, 2020,4(01):9-10+12.

[12] Chen Feng, Wang Feng. Research on the Application of VR/AR Technology in Virtual Museum Tour System -- Taking the Palace Museum as an Example[J]. Popular literature and art,2020(04):61-62.

[13] Liu Xiaoli. On the Protection and Development of Qin Opera Art[J]. Modern and ancient literary creation,2022,No.133(37):83-85.

[14] Qin Yi. Virtual digital person 'Qin Xiaoya' : be a good Qin art recommendation officer[N]. China culture daily,2022-07-25(003).

[15] Shi Xingyue. Research on key technologies of interactive augmented reality and its application in virtual performance of Qin Opera[D]. Northwest China University,2022.
[16] Wu Yue. The spread of Qin Opera under the background of new media[J].Comedy House,2022,No.421(13):49-51.
[17] Guo Haijin. Science and technology make the spread of opera full of vitality[N]. newspaper of cppcc,2022-03-28(009).
[18] Wang Donglan, Lu Xiaoyan. The digital construction and urban-rural communication of Qinqiang Opera art[N]. Chinese Journal of Social Sciences,2022-11-11(012).