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Constructing a Digital Museum of Marine Culture Using 3D Modelling

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Abstract. By utilizing advanced design techniques such as computer-aided design (CAD) and other cutting-edge information technologies, this study delves into the treasure trove of marine cultural resources. Through the extensive collection, meticulous organization, and precise 3D modeling, these resources have been digitized and reshaped. In addition, a highly interactive and educational digital museum interface has been developed, incorporating rich features aimed at providing users with an immersive learning journey of ocean culture. In a series of simulation tests, researchers invited users from different backgrounds to participate in the exploration of digital museums, complete learning tasks, and record their interactive behaviors and feelings in detail. The experimental data shows that the efficiency of digital museums is generally higher in terms of the effectiveness of learning tasks. Its accurate performance in completing tasks is more attractive. At the same time, in terms of platform innovation, the learning efficiency and satisfaction of digital museums can showcase more details in the presentation of visual effects. This can improve the experience of ocean culture in the context of education.

Keywords: CAD Technology; Marine Culture; Visual Teaching; Modeling
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1 INTRODUCTION

Digital replicas allow more people to appreciate and study these collections up close. Botticelli's [1] research delves into digital curation practices in museum archives. However, due to the protection needs of physical collections and restrictions on public visits, many people's understanding of these precious cultural relics is limited to limited text and image descriptions. Through the museum's online collection portal, visitors can now easily access these digital surrogates. These records provide a detailed description of the production process, historical background, cultural connotations, and other information about the collection, providing viewers with a comprehensive window to understand the collection. Catton and Smith [2] conducted an in-depth exploration of the possibility of GLAM organization hosting virtual exhibitions. In the field of cultural heritage protection, virtual exhibitions (VEs) are playing an increasingly important role. Viewers can also access digital versions of cultural relics, allowing them to experience the charm of cultural heritage up close. Effective virtual exhibitions can cleverly utilize technological means to attract the attention of a large audience. This

digital display method not only broadens the audience's perspective but also prompts GLAM institutions and LIS scholars to think deeply. The advantage of the virtual exhibition lies not only in its progressiveness and interactive technology but also in its ability to provide the audience with a deeper understanding and learning experience. Various cultural forms related to the ocean are collectively referred to as ocean culture, which includes various levels, from physical objects to ideas, such as marine material heritage, maritime regulations, and beliefs and arts related to the sea. The openness, diversity, inclusiveness, and exploratory spirit of this cultural system reflect humanity's profound understanding, development, and protection of the ocean and are precious treasures in the cultural treasure trove of all humanity.

Through open databases, these digital models can be applied and promoted on a wider geographical scale. Taking the cultural elements of the Taitung region as an example, the Chang et al. [3] team took the lead in making an innovative attempt. This database not only includes rich cultural materials but also produces 60 detailed digital models and relevant archives. These digital models not only accurately reproduce the unique charm of Taitung culture but also provide valuable materials for subsequent research and application. This model not only breaks the limitations of traditional cultural protection but also injects new vitality into the inheritance and development of cultural elements. With the continuous advancement of digital technology, digital museums, as an emerging form of exhibition, have pushed the concept of traditional museums to a new height. This type of museum uses advanced digital technology to record and reproduce cultural relics and historical sites in detail, allowing people to access these cultural assets anytime and anywhere through the internet, thus obtaining a more convenient and rich cultural experience. In the field of cultural heritage, the application of VR technology brings users an immersive interactive experience. At present, there are still certain limitations in the methods and practices related to the design, implementation, and evaluation of VR applications, making it difficult to meet the needs and requirements of all stakeholders. To achieve this goal, we can draw on the research methods of Fidas and Sylaiou [4]. Their learning methods provide a powerful framework, stimulating their creativity and collaborative spirit.

Gavalas et al. [5] analyzed the transformation of cultural heritage digitization through virtual reality. It simulated the digital environment of cultural relics collection through the exploration of physical space. Through the digital protection of cultural collections, physical space exploration and construction of natural digitization have been carried out. This tourist entertainment provides good physical protection. Simultaneously, it introduces novel ways of interacting with cultural assets to change, enrich, and enhance perceived cultural experiences. Marine culture, as an important component of human culture, urgently needs to be effectively protected and disseminated through modern technology. Therefore, the use of CAD technology to create a digital museum of marine culture and its interactive educational platform has become a key initiative. This not only provides new ways for protection and dissemination through interactive education but also promotes the continuous inheritance and further development of marine culture.

Faced with such challenges, it is urgent to find an effective way to protect these endangered heritage sites. Digitally record and reproduce the original appearance of endangered heritage sites, as well as simulate their changes in the context of the new era. Hajirasouli et al. [6] used a qualitative longitudinal research method to construct this framework. They went deep into the field and collected a large amount of precious data through long-term observation and recording. Through this simulation, it intuitively understands the impact of these changes on heritage sites and thus formulates more targeted protection measures. Based on these data, a narrative-based framework was developed and interactively presented through virtual reality projects.

Traditional museums are often limited to a fixed physical space, and their display methods are mostly static, lacking opportunities for interaction and in-depth exploration with the audience. Based on this background, Hulusic et al. [7] designed the interface of school buildings for the client user interface of virtual museums. Especially at present, digital technology and virtual reality technology are advancing rapidly, providing us with a new perspective on the protection and inheritance of museums and cultural heritage. The research results show that this virtual museum performs well in

both design and development, and the user experience is generally positive. To verify the feasibility and user experience of this virtual museum, Hulusic et al. conducted a user study with a total of 62 participants. Digital strategy is gradually becoming an important force driving social progress and cultural development. In this context, accelerating the launch of digital strategies and preparing for the opening of museums is not only the preparation of a cultural feast but also an important exploration of cultural innovation and development in the new era. The launch of digital strategy aims to utilize modern information technology to promote the digitization, networking, and intelligence of cultural resources, and enhance the competitiveness and innovation of the cultural industry. Through the application of digital technology, we can digitize the preservation and display of precious cultural relics, historical sites, and intangible cultural heritage in museums, allowing more people to transcend the limitations of time and space, and experience the depth of history and the charm of culture up close [8].

Despite such progress, digital pavilions focused on marine culture are still scarce, and most of these pavilions still remain at the level of one-way display, lacking sufficient user engagement and educational significance. Looking ahead to the future, with the continuous evolution, digital museums will place greater emphasis on the immersive experience and interactivity of audiences, providing users with a new way of cultural immersion and learning.

This project aims to develop a visual teaching system for a digital museum of marine culture that integrates display, education, and interactive functions, achieved through the use of advanced CAD technology. The core work of the project involves collecting relevant information on ocean culture, using CAD tools to create precise 3D structures, creating a fully functional and user-friendly digital museum interface, and developing a comprehensive visual teaching platform. Its purpose is to create a vibrant platform for presenting marine culture while providing an interactive learning environment to promote public understanding and interest in marine culture.

The innovation of the research lies in:

(1) The application of CAD technology in the construction of digital museums has improved the accuracy and realism of exhibition details;

(2) A visual teaching system for marine culture digital museums has been formed, which integrates display, education, and interaction, creating a novel learning experience for users;

(3) Through simulation experiments, the functionality and good audience acceptance of the platform have been confirmed.

2 RELATED WORK

With the rapid development of digital technology and the rapid advancement of scientific communication methods, the activities of libraries and information networks have undergone earth-shaking changes. The transition from print culture to digital culture is not only a technological revolution but also a profound cultural transformation. In the era of printing culture, libraries and information networks play a stable role as guardians and disseminators of knowledge through their three-level organizational structure. The forward-looking model of academic library systems or networks demonstrated by Lavrik [9] emerged in this context. It fundamentally changes the ways, forms, and techniques of information transmission in the field of scientific research for universities and academic libraries and also reshapes the products and services they provide. The virtual museum, which was created based on blockchain technology, provides protection against tampering with digital sources. So far, research on virtual museums is still in its early stages, and in-depth research has not been completed. In this study, Lee and Kim [10] focused on the technological advantages of virtual museums and applied them to the entire display content. Especially recently, the attention to virtual museums in the art field has been greater than ever before, but it is not about the characteristics of virtual museums but rather focused on investment and speculative purposes. Virtual museum technology is still in the early stages of marketization, and relevant regulations and supervision are not yet clear. At the same time as conducting preliminary research on virtual

museums, an analysis was conducted on the background technology and blockchain-related preliminary research of virtual museums, which improved the research basis.

Li et al. [11] comprehensively analyzed the VR visitor experience framework of museum exhibitions. Conducting user surveys on immersive museum environment education, emphasizes user experience in emerging markets. By predicting the environmental display of museum visitors, a deep 3D heritage experience of immersive education has been constructed. Digital heritage exhibition, as a cutting-edge cultural dissemination method, is breaking through the limitations of traditional exhibition spaces and the constraints of cultural relics with its unique charm. In order to better achieve the effective dissemination of knowledge and culture, cultural heritage museums have joined the wave of digital construction. This exhibition utilizes advanced technologies such as touch control interaction, augmented reality, virtual reality, simulation, and motion capture to create a digital world full of fantasy and surprise for the audience. Digital construction plays a crucial role in the protection and inheritance of cultural heritage. Viewers can interact with exhibits by touching the screen, experience the three-dimensional effects of cultural relics through AR technology, and immerse themselves in historical scenes through VR technology. The application of these technologies not only improves the technical and artistic level of the exhibition but also allows the audience to deeply understand the connotation and value of cultural heritage through interaction [12].

The birth of this framework actually stems from a profound and urgent practical need - how to more effectively browse and discover complex visual collections. With the advent of the digital age, we are facing an unprecedented flood of information. These scenarios require us to have an efficient and intelligent visual information browsing and discovery ability. Through its unique interface layout and interactive design, it enables users to browse and filter visual information more intuitively. The intelligent algorithms behind it can intelligently recommend relevant content based on the user's browsing history and interests, greatly improving the efficiency of information discovery. In this era, visual information has become an important carrier of information transmission, from dynamic charts to virtual reality scenes, they constitute an indispensable part of our daily lives [13]. When users are immersed in this virtual and realistic environment, they seem to travel through time and space, experiencing the weight and charm of cultural heritage firsthand. By utilizing augmented reality technology, it can present ancient and precious cultural heritage in a completely new way, allowing more people to have the opportunity to appreciate its charm. This immersive experience allows users to have a deeper understanding and recognition of cultural heritage and also stimulates their love and attention to cultural heritage. In this review, Mudička and Kapica [14] delve into the current possibilities and trends of expanding reality, in order to provide more ideas and directions for the digital display of future cultural heritage. Through carefully designed exhibitions and advanced technological means, cultural heritage is presented in a brand-new form to the audience, allowing them to feel the charm of culture through interaction.

The cultural heritage department is constantly exploring innovative technological means to meet the diverse needs of its collection dissemination and interpretation. With the deepening development of related research, the entertainment and learning impacts brought by these technologies are gradually becoming prominent, injecting new vitality into the inheritance and protection of cultural heritage. Augmented reality technology can seamlessly integrate virtual information with the real world, bringing a more immersive experience to the public. Tsita et al. [15] proposed the concept of virtual reality museums in their research. In this virtual environment, visitors can freely choose their visiting routes, interact with exhibits, and even "touch" cultural relics through AR technology to feel their texture and texture. This innovative display method aims to build a virtual museum space, allowing the public to visit, learn, and experience cultural heritage anytime, anywhere. This new display method not only enriches the cultural life of the public but also provides new ideas for the protection and inheritance of cultural heritage. At the same time, museums also provide people with a stage to showcase themselves and realize their value, allowing everyone to find their own position and value within it. In the halls of museums, people can not only appreciate precious cultural heritage but also find resonance and satisfy their emotional needs. It utilizes digital platforms to disseminate cultural heritage that could only be appreciated in physical museums to more people in a more vivid

and intuitive way. More importantly, digital museums have also built a social platform, making cultural dissemination no longer one-way, but two-way and interactive [16].

Participating in museum community education activities is not only an opportunity for middle-aged and elderly people in the community to learn, but also a spiritual exchange and emotional collision. Here, they can travel through time and space, review history, and feel the richness and depth of culture [17]. These memories not only make them feel the flow of time but also help them find their emotional home. In interaction, they learn from each other and inspire each other, not only enriching their knowledge reserves but also enhancing friendship and understanding between each other. The digital exhibition and communication space created by museums, although lacking the touch of physical cultural relics, has opened a window to the past and future for the elderly through the presentation of images. Digital museums should convey their stories to more people through various forms, such as images and text, allowing their spirit to continue [18].

3 THE APPLICATION OF CAD IN DIGITAL MUSEUMS

3.1 The Positive Role of CAD

CAD technology, with its unique advantages, plays an indispensable role in the construction process of digital museums (see Table 1). CAD technology can ensure the accuracy of 3D models of exhibits and scenes, meeting the high requirements of digital museums for the details of exhibits.

Characteristic	*Effect*
Accuracy	By using advanced CAD applications, designers can leverage sophisticated drawing and design capabilities to achieve precise and reliable design results.
Efficiency	Compared to the ancient manual drawing method, CAD tools significantly accelerate the design process and reduce the required time.
Modifiability	These electronic design files are convenient for quick revision and refreshing, allowing designers to respond to changes in real-time.
Visualization	The ability to use three-dimensional modelling enables designers to examine and evaluate their works in a three-dimensional manner.
Compatibility	The compatibility of CAD data allows for easy sharing and collaboration with multiple software, further improving work efficiency.

Table 1: CAD Features and Functions.

CAD technology has shown strong potential for application in the construction of digital museums due to its excellent performance and flexible display methods. CAD technology plays a crucial role in digital museums. This interactive experience not only allows the audience to have a deeper understanding and recognition of cultural relics but also stimulates their interest and enthusiasm for cultural heritage protection. This technology not only improves the display effect of digital museums but also greatly enhances the audience's sense of immersion and participation. Through precise modelling and rendering, cultural relics that cannot be physically displayed can be reproduced in virtual space, allowing tourists to appreciate the unique charm of cultural relics up close. It not only accurately reproduces the form and details of precious cultural relics but also brings an unprecedented visual feast to the audience through diverse display techniques. (see Table 2).

Advantage	*Effect*
	By utilizing the advanced features of CAD technology, precise three-dimensional digital replication of historical relics can be achieved, preserving their original features and intricacies, thereby providing online audiences with a near-physical viewing experience.
Highly	The 3D modeling ability of CAD allows for display from different perspectives and

restored cultural relics	depths, and can even reveal the internal structure of cultural relics, providing the public with a deeper understanding.
	By integrating programming skills, users can interact with these digitized cultural relic models and perform operations such as rotation, scaling, and even disassembly.
Flexible display methods	Due to the flexibility of CAD files, they can quickly adapt to changes in exhibits or revisions to display content, ensuring the timeliness and accuracy of information.
	In the construction and operation of digital museums, the application of CAD technology has significantly reduced costs and improved resource utilization efficiency, providing strong support for the protection and dissemination of cultural heritage.

Table 2: Advantages and Functions of CAD.

3.2 Feasibility of Building Digital Museums with CAD

Digital exhibition halls have gradually expanded globally, becoming a novel platform for showcasing and promoting local history and art in various regions. The application of knowledge visualization in the field of education is becoming increasingly popular, and its positive impact on stimulating learners' enthusiasm and improving learning efficiency has attracted much attention. The design proposal for an online education platform based on visualization technology aims to enhance the interactivity and effectiveness of distance learning. The big data-driven visual teaching evaluation model provides a new tool for objectively and comprehensively evaluating teaching outcomes. The application of CAD technology in the field of 3D modelling and simulation, especially in engineering design and product development, has been widely recognized for its significant contributions. The construction of digital museums for marine culture is still in its early stages, and the current display methods are mostly static, lacking sufficient user participation and educational significance. Table 3 analyzes the feasibility of CAD application.

Advantage dimension	*Concrete content*
Technical maturity	After years of sedimentation and accumulation, CAD technology has entered a mature and stable stage, demonstrating strong capabilities in handling complex modelling tasks.
Resource richness	
Widespread application	By combining these technologies, digital museums can present more realistic scenes and vivid exhibits, bringing visitors a more immersive visiting experience.
Strong adaptability	Both beginners and senior experts can find suitable learning materials and operational skills in these resources, thereby continuously improving the level of digital museum construction.
Cost-effectiveness	In the construction of digital museums, we can confidently use CAD technology to ensure the accuracy and stability of modelling, bringing visitors a more realistic and vivid museum experience.

Table 3: Feasibility of CAD Application.

4 CONSTRUCTION OF A DIGITAL MUSEUM OF MARINE CULTURE

4.1 Using CAD to Reconstruct Marine Cultural Resources

Through 3D modelling, we can present those distant and mysterious marine cultural elements to the world in a completely new way. Light and shadow rendering technology can add light and shadow effects to the model, making it more three-dimensional and realistic visually. The application of CAD technology enables us to construct highly realistic and detailed 3D models based on the data collected by previous systems. These models not only accurately capture the appearance of physical objects, but also restore their unique and refined features. Figure 1 shows the target segmentation process.

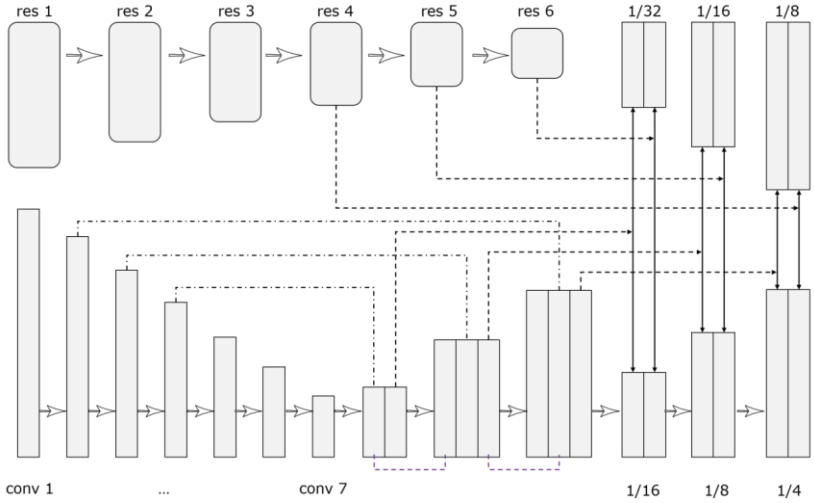

Figure 1: Target segmentation.

The connection between the camera coordinate system and the world coordinate system can be explained in detail through the rotation matrix R and the translation vector T. This relationship reveals how to convert the position of a spatial point in the world coordinate system into its corresponding position in the camera coordinate system. For any point P in space, its coordinate transformation between the world coordinate system and the camera coordinate system depends on the determination of the rotation matrix R and the translation vector T:

$$\begin{bmatrix} X_c \\ Y_c \\ Z_c \\ 1 \end{bmatrix} = \begin{bmatrix} R & T \\ 0^T & 1 \end{bmatrix} \begin{bmatrix} X_w \\ Y_w \\ Z_w \\ 1 \end{bmatrix} \tag{1}$$

Based on this characteristic, a light absorption model can be constructed. In this model, when a beam of light shines on the particle, its intensity is marked as I. Particles absorb a portion of the energy in light, and the absorbed portion is called ΔI. Therefore, in this model, the absorption process of light can be described by the following relationship:

$$\Delta I / I = \rho A \Delta s \tag{2}$$

When exploring the interaction between light and tiny particles, an interesting phenomenon can be observed. When the intensity of the incident light Δs gradually decreases and tends towards 0, the possibility of particles covering each other also decreases and gradually tends towards 0.

$$\frac{dI}{ds} = -\rho\ s\ \cdot A \cdot I\ s\ = -\tau\ s\ I\ s \tag{3}$$

This phenomenon indicates that in extremely weak light conditions, the mutual occlusion between particles becomes minimal. Therefore, it can be concluded that as the intensity of light Δs approaches 0, the probability of mutual coverage between particles also approaches 0.

The above formula s represents the length parameter of the ray casting path, which reflects the distance of ray propagation in space. $I\ s$ represents the light intensity measured at a specific distance s. The attenuation coefficient of light intensity $\tau\ s = \rho\ s \cdot A$ plays a crucial role in determining the absorption ratio of light as it travels along the projection direction S:

$$I\ s = I_0 \exp\left(-\int_0^s \tau\ t\ dt\right) = I_0 T\ s \tag{4}$$

The given formula I_0 represents the initial ray intensity of the light when it first enters the three-dimensional data field while $s = 0$ referring to the ray intensity. $T\ s = \exp\left(-\int_0^s \tau\ t\ dt\right)$ is used to describe the degree of attenuation of light intensity during the transmission of light from the edge of a data field to a specific point s. If defined a as the opacity of the transmission path, we can understand and calculate the intensity change of light passing through the data field based on this formula:

$$\alpha = 1 - T\ s = 1 - \exp\left(-\int_0^s \tau\ t\ dt\right) \tag{5}$$

By utilizing the feature functions f_A and f_B, effective feature extraction can be performed on images to obtain feature vectors u and v. Subsequently, in the pooling stage, the bilinear convolutional neural network model will use bilinear pooling technology to cleverly combine the extracted feature vectors u and v:

$$bilinear\ f_A, f_B = f_A \otimes f_B = u^T v \tag{6}$$

This process is achieved through the pooling function P, which ensures efficient fusion and utilization of features.

In order to obtain the bilinear feature $bilinear\ f_A, f_B$, the feature vector u can be multiplied with the feature vector v. Next, in order to integrate all bilinear features in the image, it is necessary to accumulate and sum the bilinear features at different positions in the image point by point:

$$\phi\ f_A, f_B = \sum_{d=1}^{D} bilinear\ f_A, f_B = \sum_{d=1}^{D} u^T v \tag{7}$$

This process can comprehensively summarize the bilinear feature information of the image, providing rich feature data for subsequent analysis.

This formula D represents the one-dimensional length of the feature map, which reflects the size information of the feature map. $\phi\ f_A, f_B$ refers to the result of converting the accumulated bilinear feature matrix into a column vector. Subsequently, to ensure the stability and comparability of the data, we will normalize the vector $\phi\ f_A, f_B$ to eliminate scale differences between different features. In addition, to enhance the generalization ability of the model, we will also perform L_2 regularization on the vector $\phi\ f_A, f_B$ to reduce the risk of overfitting:

$$y = sign\ \phi\ f_A, f_B\ \sqrt{\left|\phi\ f_A, f_B\right|} \tag{8}$$

$$z = \frac{y}{\|y\|_2} \tag{9}$$

4.2 Interface and Functional Design and Evaluation

User interface design plays a crucial role in the creation of digital museums, deeply influencing the user's operating experience and overall impression of the museum. When designing the interface, it is necessary to fully consider the browsing mode and aesthetic orientation of visitors, as well as their expectations for interaction with exhibition content. Therefore, the designed interface should be concise and clear, allowing users to understand and easily navigate intuitively. At the same time, the visual appeal and practicality of the interface should also be balanced, ensuring that users can easily access information and interact while enjoying beautiful designs. To quantify the aesthetics of the evaluation interface, specific evaluation formulas can be used for calculation:

$$\text{Aesthetic Evaluation} = \text{g}\ \text{Color Scheme, Typography,Layout} \tag{10}$$

$$\text{Panorama View} = f\ \text{Image Stitching Algorithm,UserInput} \tag{11}$$

$$\text{ZoomInView} = \text{g}\ \text{Image Processing Techniques,User Location} \tag{12}$$

In the virtual space of digital museums, the panoramic browsing function is like an open window, allowing users to shuttle through every corner of the exhibition freely. When users browse exhibitions through a digital interface, the algorithm automatically seamlessly concatenates images captured from various angles, generating a continuous and complete exhibition view. The local magnification function is like a magnifying glass in a digital museum, allowing users to explore every detail of the exhibits in depth. By combining image processing technology, this feature can accurately present detailed images of exhibits based on the user's current location and zoom needs. The implementation of this function is inseparable from the perfect combination of advanced image stitching algorithms and user input technology. Whether it's delicate textures or exquisite carvings, they can be presented to users with high-definition image quality, making them feel like they are in a physical museum.

$$\text{Engagement Level} = \text{g}\ \text{Online Questions,Guest Book,Virtual Guide} \tag{13}$$

5 SIMULATION AND ANALYSIS

5.1 Experimental Background and Configuration Overview

The experiment selected elements with distinct marine cultural characteristics, such as vintage ship models, rich and colourful marine creatures, and charming marine geological wonders (Figure 2), and carried out detailed 3D modelling. In addition, in order to simulate the scenarios that users may encounter in actual use more realistically, we have designed diverse interaction links and learning challenges. Intended to deeply explore the knowledge absorption and overall experience of users in different learning environments.

5.2 Experimental Result

In the experimental phase, this study first implemented high-precision modelling work on specific marine cultural elements using CAD technology. Afterward, these carefully constructed models will be seamlessly integrated into the digital museum. For the accuracy of algorithm modelling, please refer to the specific data shown in Figure 3. Figure 4 reflects the time required for algorithm modelling. This study invited multiple participants, including students, educators, and ordinary citizens, to participate in the experiment. They are required to freely explore within the digital museum and complete a series of preset learning and interactive tasks. During the experiment, this study extensively recorded various behaviours of participants, such as their browsing trajectories, duration of stay in various exhibition areas, and number of interactions, while also collecting valuable

feedback from them. Figure 5 clearly shows the accuracy and efficiency of participants in completing learning tasks.

Figure 2: Example of ocean elements.

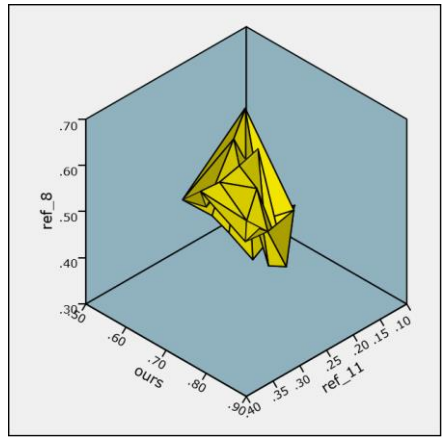

Figure 3: Modeling accuracy.

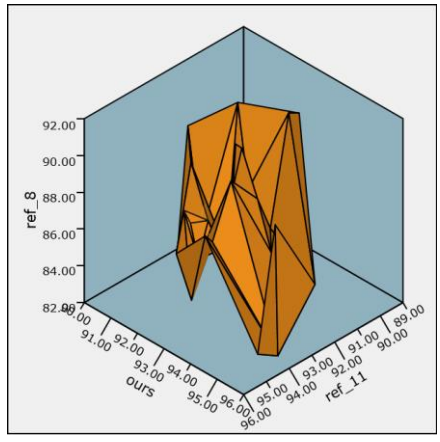

Figure 4: Modeling time.

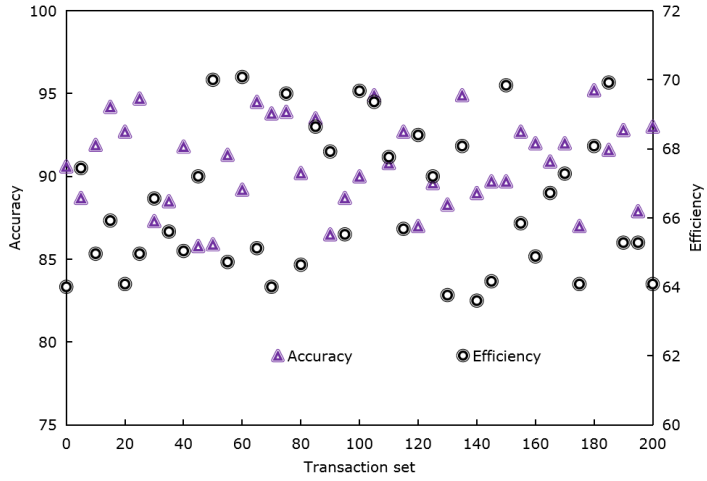

Figure 5: Accuracy and efficiency.

The frequency of interaction and duration of stay of participants in the museum can refer to the detailed data in Figure 6.

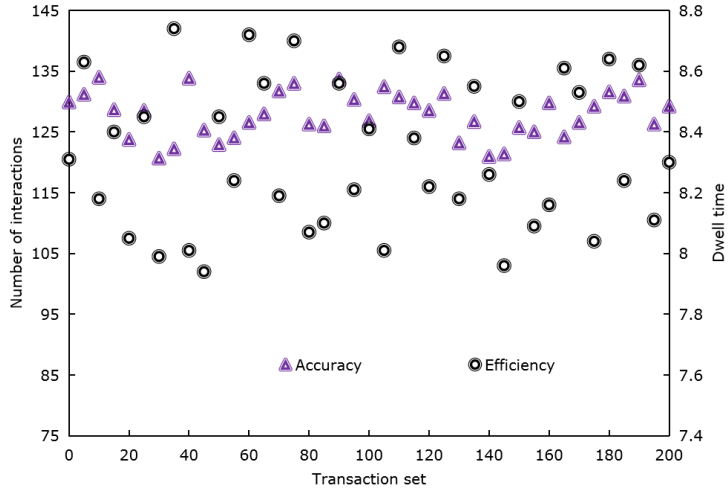

Figure 6: Interaction frequency and stay time.

Figure 7 shows the feedback from participants on the digital museum.

5.3 Result Analysis

After statistical analysis of the data collected from the experiment, the following conclusion can be derived: Firstly, the average duration of stay of the subjects in the digital museum has significantly increased, indicating that the digital museum provides users with deep interaction opportunities and exploration space, successfully attracting their interest and attention. Secondly, the accuracy and efficiency of the subjects in executing learning tasks showed an upward trend, which proves that visual teaching platforms have a positive impact on enhancing users' understanding and grasp of

marine cultural knowledge. Furthermore, from the feedback of the participants, it can be seen that they generally hold a positive attitude towards digital museums, believing that their interface design is friendly and interactive, bringing users a brand new and interesting learning experience.

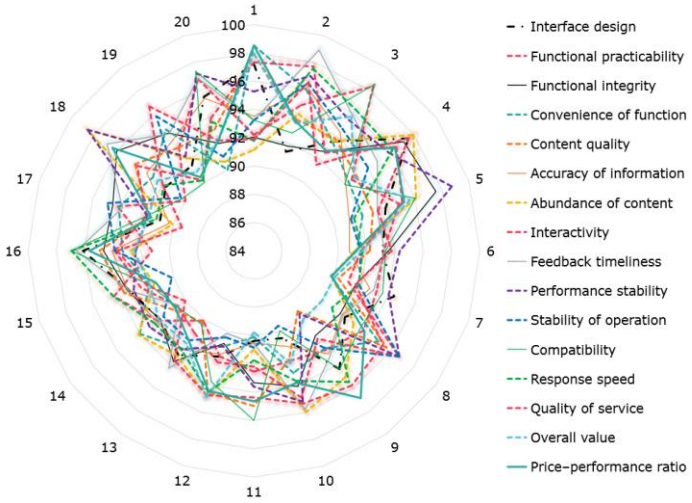

Figure 7: User feedback.

5.4 Conclusions and Insights Obtained from Simulation Experiments

This simulation experiment has confirmed the unique advantages of the Marine Culture Digital Museum and its visual teaching platform. The experimental results clearly demonstrate that this platform can not only enhance users' interest in ocean culture but also effectively improve their learning effectiveness.

Meanwhile, this experiment has also brought profound insights. Firstly, when building a digital museum, we must fully consider and respect the unique needs and existing habits of users and design functions that are more in line with their personalized learning paths and interaction methods. Secondly, in order to maintain the sustained appeal and vitality of digital museums, their content should be constantly updated and expanded, introducing more diverse and interesting marine cultures, and we need to expand their social influence and service coverage through various channels and methods.

6 CONCLUSIONS

This article focuses on the entire process of constructing and implementing a digital museum of marine culture and its visual teaching platform. The opening provides an overview of the core concepts and uniqueness of ocean culture and digital museums and delves into the important role of CAD technology in building digital museums. Next, the article provides a detailed description of the comprehensive collection and organization of marine cultural resources, as well as the innovative ideas and functional implementation of 3D model design and digital museum interface using CAD technology. On this basis, a visual teaching platform has been successfully developed and launched, and its effectiveness and superiority have been fully verified through a series of simulation experiments.

Although significant research results have been achieved in this article, there is still room for improvement. Looking ahead, this study will continue to explore and organize marine cultural resources in depth, to further enrich the collection content of digital museums. At the same time, we

will actively seek and apply advanced technologies and methods to improve the accuracy and realism of 3D models.

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