Research on a User-Centered Evaluation Model for Audience Experience and Display Narrative of Digital Museums

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Abstract: As culture becomes a value dimension of economic and social development worldwide, museums as a social medium are given more missions and expectations. Mobile Internet technology is empowering digital museums in the epidemic context, bringing new public cultural service content to the public. In this paper, we focus on the website quality of user experience in the current construction of digital museums. By analyzing the components of 20 digital museums, three models with different tendencies are abstracted. Then the three models are implemented as prototype websites, and their user experience was evaluated by experiment. Result shows that website content and user identity differences affect website quality, user attitudes, and user intentions. Rich contextual information contributes to the experience, and the “professional group” generally agrees less with the digital museum experience than the “non-professional group”. This research has implications for the study of digital museum user groups, experience analysis, and content construction.

Keywords: digital museum; experience design; user-centered design; human-computer interaction

1. Introduction

Culture has become a value dimension of economic and social development worldwide in today’s society. The development of information technology, modern communication, virtual reality, artificial intelligence, and other digital technologies in this century provides an opportunity to upgrade the development of cultural display media. As the frontier of cultural preservation and dissemination, museums have been given additional missions and expectations with the trend of global growth. However, COVID-19 has profoundly impacted the global production, exchange, and dissemination of culture. For this reason, museums, as social media, should make full use of digital platforms. Constructing strategies compatible with contemporary cultural and intelligent contexts and in harmony with modern social and epidemic contexts can meet people’s information needs for search, recommendation, and communication.

COVID-19 has directly affected the social service efficiency of museums. The National Museum of China, for example, received 7.39 million visitors in 2019, but in 2020, due to the epidemic, only 1.6 million visitors entered the museum, down 78.35% year-on-year [1,2]. As one of the important ways to digitize museums in the epidemic context, digital museums are best able meet people’s spiritual and cultural life needs in special times and highlight the value of museums in the public sphere and social construction. Google Arts & Culture and Europeana bring together museum information from around the world in a digital space, allowing people to enjoy the rich diversity of cultural heritage resources from around the world via the web [3]. As a fully online art museum, VOMA (Virtual Online Museum of Art) uses virtual roaming technology to collaborate with museums and artists worldwide to normalize online curation and virtual exhibition viewing.

On the other hand, the National Palace Museum is at the forefront of digitalization in China’s comprehensive museums. With applications such as the Digital Repository...
of Cultural Relics, the Forbidden City’s Famous Paintings, and V Forbidden City, which enable online access to cultural relics, narrative display content, and virtual panoramic tours, respectively, to build a rich user experience channel. At the same time, the research field of digital museums against the background of the epidemic has widely discussed value realization in education, community, and public services. For example, the research on the internal mechanism of the characteristics of online communities in digital museums to enhance users’ emotional resonance and participation shows that the interest performance perceived by users effectively improves users’ involvement. At the same time, interactive displays among members encourages visitors to participate in the online community [4]. In terms of the research results of experience factors of informal learning in digital museums, by describing the characteristic elements necessary for user emotion stimulation, such as novelty, coordination, lack of time constraint, appropriate promotion, and association, it provides a practical design guide for the field of informal learning in digital museums [5]. In terms of the research results of interactive learning resources on museum websites, by integrating informal learning and formal learning and presenting the results in a small and interactive form, relevant scholars have found that it was possible to effectively stimulate learning behavior [6].

A significant difficulty in current website experience research is how to control the variables that affect user experience. The visual design, interaction design, website content, client/server quality, and branding of museum websites all impact user experience. Current research on digital museum websites focuses on visual, interaction, and service areas, and there is a lack of research on website content.

Therefore, this paper investigates the influence of website form on the user experience of digital museum. Firstly, the interaction forms of 20 digital museums are analyzed and three models are extracted to control two objective variables—component completeness and hyperlink richness. Meanwhile, by implementing the 3 models in a unified experimental platform, the interference of content factors is reduced. Then, based on WebQual consumer website evaluation tool [7] and the Website Usability Measurement Model [8], an experiment is designed to evaluate the user experience of the prototype website, including website quality, user attitude, and user intention. Data analysis shows that both variables can affect the user experience, in addition to the user’s specialty. Based on the experimental results, we provide valuable suggestions for improving the user experience of digital museums and meeting users’ expectations and needs.

The structure of this paper is as follows: the Literature Review introduces digital museums, the WebQual website evaluation tool and usability measurement model, and new museum theory. The Methodology provides the research framework and hypotheses, measurements, and sampling methods for this study. The Results describe the respondent profile, statistical results analysis, and hypothesis testing. The Discussion describes the analysis of the results, theoretical research contributions, strategic recommendations, and future research of this study.

2. Literature Review

2.1. Digital Museum and Culture

Currently, research on digital museums focuses on the following areas.

First, digital coping strategies for museums in the context of the epidemic. Over the last two decades, digital technologies have become an essential resource for functional innovation in museums, and the epidemic confirmed the reliance of museums on digital tools, which are widely accepted to have become the only means of reaching the public during the blockade [9]. COVID-19 forced the closure of many cultural and physical venues, and digital tools became the bridge between the museum and visitors. For example, by analyzing the effectiveness of digital communication and the characteristics of visitors’ communication and consumption during the epidemic, some scholars proposed digital strategies to respond to the epidemic crisis, relying on the change in the way people access information [10]. In terms of communication, cultural diplomacy in museums in the
context of the epidemic reflects digitization [11], which meets the expectations of virtual visitors and enriches cultural services. Current technologies used in cultural heritage have expanded to immersive technologies, encompassing augmented, virtual, and mixed reality technologies that provide sensory experiences through various combinations of real and digital content [12]. Among them, VIRMUF is a virtual museum development framework for non-developers. Museum staff publish digital content from their collections and can quickly create and publish virtual museums [13].

Second, the cultural accessibility and inclusive design of digital museums. While digital technologies have aided museum communication, they have also led to inequalities in access to heritage and participation in cultural life [14]. Museums should explore an effective way of community interaction with the help of digital innovations, primarily digital interactive technologies. For example, Lo Presti, O. explored the impact of the New Crown epidemic on the cultural life of older people. To break the isolation of older people under technological barriers, he proposed digital adaptation strategies for museums, relying on virtual museum tours and nature diary programs [15]. The digital divide faced by different groups in digital museums deserves attention [16]. Especially for digital experiences in physical museums, distance rules under epidemic conditions and sanitization regulations create barriers for special populations to access venues and get close to collections [17].

Third, digital museum exhibition narratives and interactive behavioral research. As younger generations become immersed in technology, museums must create familiar digital experiences and new exhibition narrative strategies to cultivate a connection with new 21st century visitors. Extensive collection of user background and behavioral data to drive research on user segmentation of museum website visits [18] and quantitative results on the experience of factors such as narrative, aesthetic and emotional space [19] can help scholars to reveal user motivation, engagement, knowledge acquisition [20], and to drive the construction of personalized and participatory tour experiences for meaningful innovation in digital museums. For example, museums provide space and permanent collections for personal (audience and artist) narratives, co-creation of exhibitions in virtual spaces, and the introduction of private emotions and “intimacy” in collective memory narratives [21]. Wu et al. extended the ECM and TAM experience models and constructed a digital museum user intention model to explore the influence of experience variables on user experience perceptions and behaviors [22]. In terms of content co-creation, museums and experts have created digital toolkits that allow groups of K-12 students to activate the museum’s heritage content and engage in cognitive learning [23]. Daniela investigates learning behaviors in virtual museums that provide a knowledge dissemination platform for teaching and learning by visualizing abstract concepts and interacting with digital resources in a virtual museum [24]. In the online age, museum visitation is a reflection of value. It has become common to enhance the user experience and increase museum visitor traffic through digital technologies. An analysis of the impact of websites, social networks, and virtual communities on museum traffic reveals that social networks and virtual communities play an essential role in museum visitor narratives and interactions [25]. At the same time, museum websites need to be further enhanced in terms of digital experiences and content narrative strategies.

In the field of digital museums, areas such as addressing the challenges posed by the epidemic to museums, research on cultural accessibility and inclusiveness in digital museums, and thinking about new relationships between museums and audiences triggered by the new population oriented to the technological age have become new hotspots of research. Digital technologies have strengthened the adaptability of museums to the cultural consumption situation of their users. However, digital museums have diverged into multiple types in the context of rapid technological iteration and content growth. It is difficult to reveal the content characteristics and experience influencing factors of different kinds of museums by studying individual museums. Therefore, this paper attempts to extract a digital museum experience model by analyzing different digital museum display
models, exploring the influencing factors on user experience, and finally proposing design suggestions for museum websites.

2.2. Museum Website Quality Model

Current research on digital museum website experience covers various dimensions of user experience. Jimenez-Barreto and Campo-Martinez studied the effect of website quality on user attitude and willingness to participate in tourism destination websites and revealed a positive relationship between variables [26]. Mohd-Any et al. studied the value perception dimensions of users during website visits from practical value, emotional value, social value, and other six dimensions to measure users’ value experience [27]. Jiang et al. constructed five design dimensions for website aesthetic evaluation, and their study proved that aesthetic perception was the core influencing factor of users’ attitudes [28]. Visinescu et al. studied the influence of interaction characteristics of 2D and 3D websites on users’ experience and behavior [29]. They constructed a design model containing cognitive absorption, ease of use, and usefulness as experience evaluation dimensions. Among many evaluation dimensions of website experience, website quality is not only one of the core elements of user experience but also closely related to the website content dimension studied in this paper. Therefore, this paper will focus on the website quality dimension in user experience and explore the influence of website content on website quality, user attitude, and user intention of digital museums.

Website quality dimensions have received continuous attention from researchers and professionals in different fields. Agarwal and Venkatesh described a heuristic evaluation procedure for examining website usability, indicating that website usability was closely related to the content, ease of use, promotion, made-for-the-medium, and emotion dimensions [8]. Pallud and Straub added the “aesthetic” dimension to the website experience evaluation model and examined the effect of user attitudes on “willingness to return” and “willingness to visit offline museums” [30]. Kim and Stoel explored the components of website quality, proposing a model based on the “aesthetic” dimension [31]. Loiacono et al. integrated the Theory of Reasoned Action (TRA) and Technology Acceptance Model (TAM) into this evaluation model [7]. They developed a WebQual tool for consumer evaluation of websites with solid measurement validity. Garcia-Madariaga et al. proposed a measurement model centered on content, ease of understanding, emotion, information fit to tasks, promotion, and visual appeal [32], drawing on the first-order dimensions of Kim and Stoel’s [31] and Pallud and Straub’s [30] models of website quality. This paper synthesizes the first-order dimensions of website quality from Madariaga et al. [32] and Pallud and Straub [30], while considering users’ needs and expectations of digital museum data and information from Fortier and Menard [33]. A website quality model containing five dimensions—usefulness, ease of use, emotion, innovation, and context—was developed to assess the impact of digital museum construction differences on website quality, user attitudes, and intentions.

At the same time, user behavior is also an important indicator of user experience. The article constructs five dimensions: user attitude, willingness to participate, willingness to recommend, willingness to return to visit, and willingness to visit offline museums, to assess the impact of website content on users’ attitudes and willingness.

2.3. The New Museum Concept

In 2007, the International Council of museums defined the “Museum” as “a permanent non-profit institution that serves the society and its development and is open to the public. It collects, protects, studies, disseminates, and displays material and nonmaterial evidence of human beings and their environment for research, education, and appreciation”.

The concept of the museum has experienced a cognitive evolution from “individual and family” to “society or public”. Relying on “fragments” in time and space, the museum weaves a utopian fantasy to help people break through the spiritual cage of “here and now” and the constraints of time, space, role, and social regulations. Hu Kaiyun points
out that museums under modernist epistemology tend to tell irrefutable “truths” with an authoritative voice and “indoctrinate” the audience by establishing a uniform order [34]. At the same time, postmodernism tries to break away from this constraint and seek a compatible cultural atmosphere, allowing for differences and conflicts. The post-museum gives a broader meaning to “education”, stimulating interest in the audience’s dialectical thinking, looking at the past and present with introspection, and exploring the future [34].

With the global spread of COVID-19, the virus has irreversibly changed the way of human production and life, and people are increasingly bound to limited space. While using digital technology to expand the virtual space and time for social service activities has become a hot topic in the museum field. Based on the recognition of the post-museum theory, we explore the mechanism of museums’ digital platform construction, especially the study of the relationship between digital museums, audience experience, and display content, which helps to expand the new positioning of museums’ social roles.

3. Methodology
3.1. Research Framework and Hypothesis

The core purpose of this paper is to investigate the impact of digital museum website form on website quality, user attitudes, and user intentions. The preliminary research revealed that the content in digital museums often appears in the form of components. Some of them have hyperlink properties, which are determined by the characteristics of the website itself.

To better achieve the goal, we divided the research into four stages, as illustrated in Figure 1.

In phase 1, the significance of the concept of digital museums and its research development history are explored through historical literature combing, review, and analysis. Based on the statistical analysis of the number of functional components of 20 museum websites worldwide, we understand the current status of digital museum construction.

In phase 2, the functional components counted in phase 1 are analyzed through the lens of “number of components” and “percentage of hyperlinks” to uncover digital museum websites’ characteristics and build several prototypes of digital museum experiences for comparative testing.

In phase 3, we compared several experimental platforms and finally chose the most reasonable method for cost and effectiveness—prototype testing. By redrawing the website components in phase 2 and creating user-accessible pages, we could ensure that the website quality, user attitudes, and user intentions in the subsequent comparison experiments were only influenced by the non-content factors of website.

In phase 4, we construct a user evaluation questionnaire for this experiment by combining the experience analysis models in website design, interaction design, and usability research. The questionnaire was distributed through a combination of online and offline methods.

Table 1 reflects the current construction of functional components of 20 museum websites worldwide. Thirty-two components were involved in the research, representing a
single, primary website function. The components were combined and stitched together to form the functional information modules of the digital museum.

Table 1. Target museums and the number of their components.

| No. | Museum Name                        | Number of Components | Number of Components Containing Hyperlinks |
|-----|------------------------------------|----------------------|-------------------------------------------|
| 1   | Beijing National Palace Museum     | 14                   | 5                                         |
| 2   | National Museum of China           | 10                   | 2                                         |
| 3   | Digital Dunhuang                   | 8                    | 3                                         |
| 4   | Nanjing Museum                     | 9                    | 3                                         |
| 5   | Sanxingdui Museum                  | 8                    | 2                                         |
| 6   | Suzhou Museum                      | 10                   | 2                                         |
| 7   | Taipei National Palace Museum      | 15                   | 5                                         |
| 8   | Chengdu Jinsha Site Museum         | 5                    | 1                                         |
| 9   | Hunan Provincial Museum            | 10                   | 3                                         |
| 10  | Shandong Museum                    | 10                   | 2                                         |
| 11  | Louvre                             | 16                   | 6                                         |
| 12  | The Metropolitan Museum of Art     | 19                   | 7                                         |
| 13  | Hermitage Museum                   | 12                   | 6                                         |
| 14  | The British Museum                 | 21                   | 9                                         |
| 15  | Art Institute Chicago              | 16                   | 7                                         |
| 16  | Kyoto National Museum              | 12                   | 4                                         |
| 17  | National Gallery of Art            | 13                   | 4                                         |
| 18  | Europeana                          | 16                   | 8                                         |
| 19  | Google art and culture             | 19                   | 11                                        |
| 20  | The Prado Museum                   | 18                   | 11                                        |

To better investigate the impact of website content on website quality, user attitudes, and user intentions, the research team needed to explore further the differences between “website content” and its corresponding components. On the one hand, the statistics of the number of components of the digital museum show that the current museum website content varies significantly in quantity and type. On the other hand, the nature of the Internet makes some of the content hyperlinked, which broadly expands the depth and breadth of the website content and impacts the user experience.

Therefore, the article proposes two points of difference between the content of the digital museum websites and uses them as a basis for component division.

Point of difference 1: frequency of website components.

Point of difference 2: frequency of website components in the form of hyperlinks.

In this paper, the 32 components are divided based on these two significant points of difference, where the axes of the scatter plot are as follows.

Frequency Of Components = number of occurrences of content components/total number of digital museums researched.

Frequency Of Hyperlink = number of times the content component appears as a hyperlink/number of times the content component appears.

Figure 2 shows the results of the component statistics and segmentation. As can be seen, the larger the horizontal coordinate value, the more frequently the component appears in the digital museum; the more significant the vertical coordinate, the more frequently the component is presented in the form of hyperlinks.
Frequency of Hyperlink = number of times the content component appears as a hyperlink/number of times the content component appears.

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![Figure 2. Scatter diagram and zoning of digital museum components.](image)

Table 2 shows the mean and standard deviation of both coordinates. We use the mean value (the green line in Figure 2) as the basis for content partitioning. Considering components that appear less frequently than the mean-standard deviation (the red line in Figure 2) are rarely used in the current digital museum construction, we include them in the uncommon components set. As a result, we divide Figure 2 into 5 Sections, where Sections A–D are valid.

**Table 2.** Means and standard deviations of the coordinate axis.

| Axis     | Title                | Mean     | SD   |
|----------|----------------------|----------|------|
| X        | FrequencyOfComponents| 0.4048   | 0.3496|
| Y        | FrequencyOfHyperlink | 0.4235   | 0.4207|

After dividing the content components, the team combined the 4 Sections as needed to build a model of the digital museum experience. On the one hand, to verify the impact of the frequency of website content on website quality, user attitudes, and user intentions, the team looked at the X-axis in Figure 2. It is worth noting that the sections in the high-frequency component set are essential components for the digital museum website.

- High-frequency component set = Section A + Section B.
- Low-frequency component set = Section C + Section D.

We then combine component sets into digital museum experience models A and C.

- Model A = High-frequency component set.
- Model C = High-frequency component set + Low-frequency component set.

Model A contains only the content of components that appear in high frequency in the digital museum, while Model C has a higher content component completeness. On the other hand, to verify the impact of hyperlinked content on website quality, user attitude, and user intention, the team focused on the Y-axis in Figure 2.

- Metadata component set = Section C.
- Hyperlink component set = Section D.
The components are combined to form the digital museum experience Models B and C. Both Model B and Model C contain necessary components for the digital museum, i.e., the high-frequency component set.

- Model B = High-frequency component set + Metadata component set.
- Model C = High-frequency component set + Metadata component set + Hyperlink component set.

Model B is missing the set of hyperlinked components, so Model C has higher linked data richness than Model B. From this, the team constructed digital museum experience Models A, B, and C, and formulated the following hypotheses.

**Hypothesis 1 (H1).** Content component completeness affects the usefulness and ease of use dimensions of the digital museum website quality.

**Hypothesis 2 (H2).** Content component completeness affects the attitude and intentions of digital museum website users.

**Hypothesis 3 (H3).** Link data richness affects usefulness, ease of use, emotion, innovation, and context dimensions of digital museum website quality.

**Hypothesis 4 (H4).** Link data richness affects the attitudes and intentions of users of digital museum websites.

**Hypothesis 5 (H5).** There is a difference between professional and non-professional users’ perception of digital museum website experience.

### 3.2. Experimental Platform Design and Implementation

To verify the differences in website quality, user attitudes, and user intentions among the three digital museum models, the team designed and implemented an experimental platform to meet the needs of the study. The design and implementation process is described in the following section, which is also illustrated in Figure 3.

#### (1) Experimental scheme selection

The first step of the process is to select a solution that meets the research needs, Table 3 shows the advantages and disadvantages of the available options. And the team focuses on three main elements: “scenario restoration”, “control variables”, and “cost control”. Among them, scenario restoration requires the platform to restore the real digital museum access environment as much as possible. “Paper prototype” and “Prototype software” are eliminated because they differ significantly from actual visits.

#### Table 3. Advantages and disadvantages of the available options.

| Options            | Advantages                                      | Disadvantages                                |
|--------------------|-------------------------------------------------|----------------------------------------------|
| Direct access      | No development barrier                          | Difficult to control variables              |
| Paper prototype    | Fast production and low cost                    | Unable to restore the real visit scenario    |
| Prototype software | Low-cost web interaction                        | Off-line access only                         |
| Prototype website  | Balanced between effectiveness and cost         | Server and domain name required             |
| Complete websites  | Completely simulates the real situation         | High cost and long production cycle         |
Variable control ensures that website form is the only variable of experience. “Direct access” is eliminated because the variable is not unique.

Cost control requires both effect and cost. “Building complete websites” is eliminated due to the long development cycle and high cost. After comparison, the experimental platform based on high-fidelity prototypes is an experimental scheme that meets the research needs.

(2) Wireframe design

In this step, the team relies on wireframes to build the basic framework and structure of the digital museum experience model and set up the required content and functions on the corresponding pages. The content components shared in Models A, B, and C are
identical in presentation and interaction, minimizing the impact of irrelevant variables on user experience. Figure 4 shows the appearance and design principles of the wireframes.

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|--------------------------------|-------------------------------------------------|---------------------------------------------------|
| Direct access                  | No development barrier                          | Difficult to control variables                     |
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| Prototype website              | Balanced between effectiveness and cost         | Server and domain name required                    |
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Variable control ensures that website form is the only variable of experience. “Direct access” is eliminated because the variable is not unique. Cost control requires both effectiveness and cost. “Building complete websites” is eliminated due to the long development cycle and high cost. After comparison, the experimental platform based on high-fidelity prototypes is an experimental scheme that meets the research needs.

(3) High-fidelity prototyping and implementation

To transform the wireframes into accessible and interactive pages, the team customized a high-fidelity interface to meet the experiment’s needs with the help of WordPress. The experimental platform contains 26 pages, and users are randomly assigned to one of the three experience models upon entry, ensuring the scientific validity of the comparison experiment.

(4) Deployment

After completing the design and development of the experimental platform, the research team configured the cloud server and domain name service. In this process, to ensure the accessibility of the website, the team conducted access and stress tests on the web pages in mainstream browsers. The results showed that the web pages met the design specifications and satisfied the launch needs.

3.3. Measurement

Based on the previous research, we constructed the scale of website quality, user attitude, and intentions based on the case of digital museums in this study. The “Digital Museum Website User Assessment Scale” questionnaire consists of 38 questions. The questionnaire can be divided into four parts: website serial number, demographic information, website quality measurement information, and user attitude and intentions measurement information. There are 19 questions divided into five sections: usefulness, ease of use, emotion, innovation, and context. There are 12 questions on user attitude and intentions, divided into five sections: user attitude, willingness to participate, willingness to recommend, willingness to return, and willingness to visit offline museums. All questions on the website assessment were scored using a Likert scale with a total score of 7. The scores were
1, 2, 3, 4, 5, 6, and 7. The means and standard errors of the questions on website quality, user attitudes, and intentions to measure are shown in Table 4, and the data show the differences in user experience across digital museum models. Informed consent was obtained from each subject after explaining the study. The sociodemographic characteristics of the subject users are shown in Table 5.

Table 4. Means and standard deviations of all questions of the measurement.

| Questions                              | Model A |       | Model B |       | Model C |       |
|----------------------------------------|---------|-------|---------|-------|---------|-------|
|                                        | Mean    | SE    | Mean    | SE    | Mean    | SE    |
| Usefulness (USE)                       |         |       |         |       |         |       |
| The website provides the appropriate bread and depth of content. | 5.52    | 0.17  | 5.41    | 0.16  | 5.6     | 0.18  |
| The website provides timely and innovative information.          | 5.35    | 0.23  | 5.36    | 0.18  | 5.48    | 0.17  |
| The content of the webpage meets my need for information on exhibits. | 5.81    | 0.19  | 5.75    | 0.18  | 5.7     | 0.16  |
| Customized information on the website meets my individual needs. | 5.03    | 0.21  | 4.89    | 0.17  | 5.02    | 0.18  |
| Ease Of Use (EOU)                      |         |       |         |       |         |       |
| I can achieve the desired goal quickly during use.            | 5.55    | 0.21  | 5.59    | 0.18  | 5.54    | 0.18  |
| The website is well structured and organized.                    | 6.16    | 0.15  | 5.75    | 0.17  | 5.92    | 0.14  |
| I received clear results and clear feedback during my visit.   | 6.03    | 0.21  | 5.68    | 0.18  | 5.86    | 0.14  |
| The content presented is easy to read and understand.          | 6.32    | 0.14  | 6.00    | 0.15  | 5.76    | 0.13  |
| The operation is intuitive and easy to understand.              | 6.32    | 0.16  | 6.00    | 0.15  | 6.32    | 0.14  |
| Emotion (EMO)                                                      |         |       |         |       |         |       |
| Completing online exploration gives me a sense of achievement. | 5.19    | 0.25  | 4.80    | 0.19  | 4.96    | 0.19  |
| The content and storyline of the website aroused my interest.  | 5.03    | 0.25  | 5.05    | 0.18  | 5.08    | 0.18  |
| I believe the content of the website is reliable and trustworthy. | 6.42    | 0.14  | 5.86    | 0.17  | 5.74    | 0.17  |
| When visiting, I can actively control the rhythm of the information presented. | 5.90    | 0.18  | 5.86    | 0.15  | 5.6     | 0.17  |
| Innovation (INN)                                                    |         |       |         |       |         |       |
| The website design is innovative.                                | 5.16    | 0.21  | 5.14    | 0.20  | 5.1     | 0.20  |
| The content information presented is innovative.                | 5.16    | 0.24  | 5.02    | 0.17  | 5.02    | 0.18  |
| The presentation and interaction of content are innovative.      | 5.00    | 0.25  | 5.04    | 0.19  | 4.8     | 0.18  |
| Context (CTX)                                                      |         |       |         |       |         |       |
| The website provides rich extended knowledge and contextual information. | 5.77    | 0.18  | 5.59    | 0.16  | 6.04    | 0.13  |
| The website broadens the understanding of the background and context of the exhibits. | 5.84    | 0.15  | 5.59    | 0.17  | 5.86    | 0.17  |
| I found a wealth of contextual content in the exhibit.          | 5.68    | 0.16  | 5.32    | 0.17  | 5.62    | 0.17  |
| User Attitude (ATT)                                                 |         |       |         |       |         |       |
| I will give positive feedback about this visit experience.       | 6.10    | 0.17  | 5.86    | 0.16  | 5.94    | 0.14  |
| I think the experience of this visit was pleasant.              | 6.06    | 0.17  | 5.66    | 0.18  | 5.82    | 0.17  |
| I think the journey of this visit was enjoyable.                | 5.65    | 0.22  | 5.32    | 0.17  | 5.46    | 0.16  |
| I found this visit to be a valuable experience.                  | 5.81    | 0.20  | 5.38    | 0.18  | 5.54    | 0.18  |
| Willingness to Participate (WTP)                                  |         |       |         |       |         |       |
| Given a chance, I would like to participate in the museum’s online community and activities. | 5.77    | 0.24  | 5.36    | 0.16  | 5.6     | 0.18  |
| I would like to like, retweet, favorite, and comment on exhibits that interest me on the site. | 5.65    | 0.23  | 5.27    | 0.19  | 5.36    | 0.19  |
| Willingness to Recommend (REC)                                   |         |       |         |       |         |       |
| I would recommend this online museum to others.                  | 5.71    | 0.26  | 5.27    | 0.20  | 5.24    | 0.18  |
| I would like to share this positive experience with my friends. | 5.61    | 0.28  | 5.16    | 0.20  | 5.32    | 0.17  |
| Willingness to Revisit (REV)                                     |         |       |         |       |         |       |
| I would like to revisit this online museum in the future.        | 5.71    | 0.26  | 5.32    | 0.19  | 5.46    | 0.16  |
| If necessary, I will choose to visit this online museum.         | 6.19    | 0.15  | 5.66    | 0.17  | 5.7     | 0.16  |
| Willingness to Visit Offline Museum (VOM)                        |         |       |         |       |         |       |
| I would like to visit the corresponding offline Museum.          | 5.94    | 0.22  | 5.39    | 0.18  | 5.32    | 0.18  |
| This visit made me interested in the corresponding offline Museum. | 5.58    | 0.27  | 5.32    | 0.18  | 5.12    | 0.18  |
Table 5. Participant's sociodemographic features \([n = 137]\).

| Background | Catagory | Frequency | Percentage (%) |
|------------|----------|-----------|----------------|
| Gender     | Male     | 84        | 61.32          |
|            | Female   | 53        | 38.69          |
| Age        | ≤18      | 13        | 9.5            |
|            | 19–22    | 78        | 56.93          |
|            | 23–30    | 44        | 32.12          |
|            | 31–45    | 2         | 1.5            |
|            | ≥46      | 0         | 0              |
| Professional | Yes | 58        | 42.34          |
|             | No       | 79        | 57.66          |
| Visit frequency of online museum (per year) | ≤3 | 63 | 45.99 |
|            | 4–11     | 8         | 5.8            |
|            | ≥12      | 1         | 0.7            |
| Visit frequency of offline museum (per year) | ≤3 | 22 | 16.06 |
|            | 4–11     | 25        | 18.25          |
|            | ≥12      | 1         | 0.7            |

3.4. Sampling Method

This study takes the website quality, user attitudes, and user intentions of digital museums as the research object. By extracting the construction characteristics of 20 digital museum websites worldwide and dividing them into three museum website models, a questionnaire survey was conducted for this model. To facilitate the questionnaire distribution and ensure the questionnaire’s quality, we surveyed the university student population. The sampling method was as follows: First, the domain name and cloud server were set to ensure users could only access the website through their computer browsers. Second, a hyperlink to the questionnaire URL and related instructions was placed at the experience page’s bottom. After the users finished the experience, they could immediately jump to the questionnaire platform to complete the questionnaire. All participants received a short training, and the sampling generated a total of 155 samples, of which 137 were valid questionnaires, with an 88.4% effective questionnaires rate.

4. Results

4.1. Respondents’ Profile

Among the 137 valid samples, 84 were males, and 53 were females, accounting for 61.31% and 38.69%. Regarding age distribution, 9.49% were in the under-18 age group, 56.93% in the 19–22 age group, 32.12% in the 23–30 age group, and 1.46% in the 31–45 age group. The survey was conducted mainly with young people such as university students and newly employed people (the presence of a technical competence threshold for accessing digital museums, so that visitors are mostly young, is the main reason for choosing this age distribution). From the perspective of professional fields, 42.34% of respondents are engaged in museums, design, art, and exhibition professions, and this group is the potential user group of digital museums. Regarding visit frequency, 52.55% of the valid sample visited digital museums at least once a year, and 83.94% of the respondents visited physical museums at least once a year. Therefore, most of this research population were museum experience-sensitive users, guiding meaning for digital museum experience optimization. Table 5 shows the sociodemographic profile of the participants.

4.2. Data Analysis and Hypothesis Validation

We compared the mean values of scores for website quality, user attitude, and user intention in the data analysis stage. The comparison results between Model A and Model C are shown in Figure 5, and Model C is lower than Model A in terms of ease of use, emotion,
and innovation in terms of website quality. However, Model C outperforms Model A in terms of usefulness and context, thanks to a more significant improvement in content completeness. It can be concluded that the content completeness of the digital museum website affects all dimensions of website quality, and Hypothesis 1 is not valid. In terms of user attitude and user intentions, as shown in Figure 6, the increase in content completeness of Model C also increases the difficulty of reading and understanding the content, which leads to an overall decline in the scores of user attitude and intentions dimensions, and Hypothesis 2 holds.

![Figure 5. Website quality comparison between Model A and Model C.](image-url)

![Figure 6. Comparison of user attitudes and user intentions between Model A and Model C.](image-url)

Figures 7 and 8 show the findings of Model B and Model C. In terms of website quality, Model C has an advantage over Model B in the usefulness, ease of use, and context dimensions and scores lower in the emotion and innovation dimensions. Among them, the increase of link data richness in Model C harms the fourth item of the ease of use dimension, the third and fourth items of the emotion dimension, and the innovation dimension. Model C and Model B scores are very close in user attitude and intention.

The data analysis results show that the increase of link data richness impacts all five website quality dimensions, and Hypothesis 3 is valid. At the same time, the impact of increasing link data richness on users’ attitudes and intentions is minimal, and Hypothesis 4 is not valid.

The user groups are classified as “professional” if their profession is related to museums, design, art, and exhibitions, and “non-professional” if not. Figures 9–11 show the average scores of professional and non-professional groups in Model A, Model B, and Model C in terms of website quality, user attitude, and user intention. It can be seen that the scores of the professional group in all experience dimensions are lower than those
of the non-professional group in all three types of digital museum experience models, and the difference in experience scores is most evident in Model B. It can be seen that, as the content completeness and link data richness of digital museum exhibits improve, the difference between professionals' and non-professionals' experience perceptions of the website gradually emerges. Although the replenishment of website content somewhat alleviates the problems of information overload caused by content overload, the lack of display narratives in the digital context still makes the professionals' experience of the digital museum website rated lower. Thus, Hypothesis 5 holds.

![Figure 7. Website quality comparison between Model B and Model C.](image)

![Figure 8. Comparison of user attitudes and user intentions between Model B and Model C.](image)

![Figure 9. Comparison results of all measurements of Model A between professional and non-professional groups.](image)
Figure 10. Comparison results of all measurements of Model B between professional and non-professional groups.

Figure 11. Comparison results of all measurements of Model C between professional and non-professional groups.

The data analysis results show that the increase of link data richness is closely associated with website experience. The results indicate that digital museum users have more pressing needs for content meaning, interest, and interactive attributes. The significant differences in website experience between professional and non-specialist groups suggest that different user groups have different needs for digital museums. Strengthening the content meaning and display narrative construction in digital museums can become a meaningful way to improve the museum user experience.

5. Discussion

This study aims to examine the impact of the website content of digital museums on website quality, user attitudes, and user intentions. The improvement in content completeness and link data richness is closely associated with website experience. The results indicate that digital museum users have more pressing needs for content meaning, interest, and interactive attributes. The significant differences in website experience between professional and non-specialist groups suggest that different user groups have different needs for digital museums. Strengthening the content meaning and display narrative construction in digital museums can become a meaningful way to improve the museum user experience.
and Hypothesis 2, it is clear that the increase in content completeness of digital museum websites increases the difficulty of reading and understanding for users.

For this reason, digital museums in the knowledge society should make full use of media-advantaged technologies such as hyperlinks and semantic networks to create a state of continuous human–computer–society contact, making the audience an appreciator and participant and creator of knowledge. At the same time, museums should adopt a user-centered display narrative logic to alleviate the information overload caused by content overload. It also helps digital museums establish interactive connections with different user groups in various contexts and build new knowledge dissemination and production model.

Second, construct multi-dimensional contextual information to enhance the narrative of online exhibitions. The display is a spatial art, the narrative is a mode of expression, and the narrative display is a mode of display space organized using narrative. Museum display has evolved along with the evolution of museum concepts and perceptions and has extended into a more systematic scientific methodology and practical guidelines. Digital museums are undergoing a paradigm shift from “object-centered” to “audience-centered”, and the Internet is a medium that offers many possibilities for recontextualizing museum “objects”. The Internet is a medium that offers many possibilities for recontextualizing museum objects.

From Hypotheses 3 and 4, it is clear that the improvement of link data completeness in digital museums does not fully contribute to the advancement of user experience, which means that museums need to think about the narrative design of their websites from the perspective of users. By optimizing the data association network, content presentation mode, and museum narrative framework, the digital museum bridges the “hands-on state” suspension and the original “grammatical structure” break caused by the museum collection in the process of multi-dimensional and multi-modal presentation of information, and achieves meaning reconstruction in the recontextualization of objects. In the process of recontextualizing the objects, the museum achieves meaning reconstruction. The museum uses the contextualized “display narrative” as the core to connect the increasingly rich content information, thus bringing the audience an immersive, authentic, and emotionally intertwined narrative experience.

Finally, dig deep into individual needs and present differentiated content for different users. The public and open nature of digital museums has created a rich and diverse audience, and the “general public” and “professionals” have become the main visitor groups of digital museums. Thus, the single website design of traditional digital museums has made it challenging to meet the increasingly variable access need.

From Hypothesis 5, we know that there are significant differences in the needs of different groups for digital museum content and interaction, and their perceptions of the website experience are also different. Among them, professional groups put higher demands on the content completeness of the website to meet their professional needs. At the same time, non-professionals prefer more innovative designs of interaction and display narratives to enhance the fun and comprehensive experience during the visit. The results require museums to grasp the idea of “user-centered” design, fully consider the diverse needs of professional and non-professional users, and provide differentiated exhibition services according to users’ information reception characteristics and aesthetic habits.

Regarding the limitations of this research work, the research object is limited to students due to the COVID-19. In reality, the users of digital museum websites are diverse, and the student population is only one of the high-frequency user groups of the website. On the other hand, the diversity of identities of digital museum users does not simply boil down to “professional” and “non-professional” groups; the identities of current museum visitors are transient and dynamic, and most visitors “customize” their identities during their museum visits. Most visitors “customize” their identities to fit the culture and context of the moment during their museum visit, and this identity change also influences visitors’ behavior and attitudes. Therefore, it is necessary to incorporate the dynamics of user
identity and its corresponding influence on attitudes and behaviors in the study of digital museum experiences.

Regarding future improvements, on the one hand, the research team will further expand the sample size and group coverage to restore the actual characteristics of digital museum website visitors as much as possible. On the other hand, the findings of this paper reveal the variability of needs among user groups and the lack of narrative design of current digital museum displays. The research team will further study the digital museum user identities and the differentiated needs of different user groups for display content and narratives. At the same time, explore innovative strategies and experience construction paths with a dynamic perspective to construct new strategies for digital museum display and experience design.

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