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Research on Users' Adoption of Digital Dissemination of Cultural Heritage: A Case Study of the Mini-program 'Cloud Tour in Dunhuang'

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Abstract. This paper discussed about digital dissemination of cultural heritage, using the example of a mini-program, Cloud Tour in Dunhuang. Based on the technology acceptance model (TAM) and the result of data collection, this study proposed a proper model for researching the technology acceptance about mini-program Cloud Tour in Dunhuang. Perceived usefulness and perceived entertainment were found to positively and significantly influence users' behavioral intention. The effect of perceived ease of use on behavioral intention is not significant. And the possible reasons for this result are also explored. With these results, suggestions about the digital dissemination of cultural heritage and museums were proposed to attract more people use such applets and improve Perceived Usefulness (PU) by tapping the potential of Perceived Entertainment (PE). In this way, the public will be able to better know about the cultural heritage and protect them.

Keywords: Dital Dissemination; Cultural Heritage; TAM; Cloud Tour in Dunhuang.

1. Introduction

With the rapid development of science and technology in modern society, more and more institutions are using emerging technologies to organically combine the ancient and the modern to get better development. The museums explored in this paper are typical examples. The concept of museum digitization refers not only to the digital management of the museum's collections and exhibition, but also to the use of digital technology in the interaction and promotion process. This technology can help museums and cultural heritage institution expand their outreach and thus get better publicity. This paper aims at analyzing the practical effectiveness of digital technology in the promotion of cultural heritage by examining the public's acceptance of online digital applications launched by museums with a typical example of "Cloud Tour in Dunhuang". Through this case study, the paper will propose feasible suggestions for the digital promotion of cultural heritage.

First of all, it is important to define digitalization. Because the definition of digitalization varies in different situations, here the definition is specified in museums. Digital heritage is the use of digital technology in the service of understanding and preserving cultural or natural heritage. Therefore, employing new media or technologies in museums will bring a plenty of benefits to both the museums and visitors. The application of new media to cultural heritage within proper realm of art and legal scope is beneficial to creators, consumers, cultures, and society as a whole (Sullivan, 2016). Individuals experiencing digital culture are touched in ways that create empathy, remembrance, and knowledge. Because individuals now have unprecedented access to cultural exhibits through personal digital devices, museums gain enhanced ability to complete their role of civic engagement. Moreover, with the interactive involvement of consumers and cooperation of digital exhibits, museums are able to create reciprocal exchanges in learning and engagement (Cameron & Kenderdine, 2007). Researches related to this novel concept create an increasing number of new concepts and methods to protect this kind of cultural and natural heritages (Davis, 2016).

And this paper discusses about the new digital media co-developed by Dunhuang Academy, the People's Daily and the tech giant Tencent: Cloud Tour in Dunhuang Mini-Program. This mini-program can be easily used within WeChat (a widely used social media in China) that make it possible for visitors to view the beautiful murals in the Dunhuang Caves directly on their smart phones and share the mural pictures to their friends. In this way, individuals get access to enjoying those murals anywhere and anytime. Such convenience provides people a new way to get relaxation

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with no charge. Moreover, unlike offline field tours, e-users can choose to tour through different themes: dynasties, colors, art forms, or a direct geographically sequential panoramic tour. Therefore, the huge amount of information about heritage can be taught to visitors more logically. Thus, museums better achieve their goal of spreading knowledge and educating visitors. As for the purpose of better preservation, such new digital media encourages people to pay attention to Dunhuang Caves through various ways. To be more specific, users can buy souvenirs related to Dunhuang Caves or design their own artifacts online and pay for them. These activities enhance the engagement of users and provide the museum with additional fund for preservation and further research.

2. Research Method and Objects

2.1 Conceptual model

As mentioned above, this study is based on the Technology Acceptance Model (TAM) and its extensions in order to explore the factors influencing users' use of the "Cloud Tour in Dunhuang" mini program. This model suggests key factors that influence users' willingness to use new technologies: Perceived Usefulness (PU), Perceived Ease of Use (PEOU) and Intention to Use (IU) (CHENG, CHEN & YEN, 2015). In addition, considering that there are some interactive and entertainment features in the mini program discussed in this paper, Perceived Entertainment (PE) was added as an additional consideration. Also, these factors interact with each other: Perceived Ease of Use has a positive effect on Perceived Usefulness (Davis, 1989), and they both affect the intension to use. Eventually, a conceptual model (as shown in Figure 1) was obtained that fits the reality of this paper.

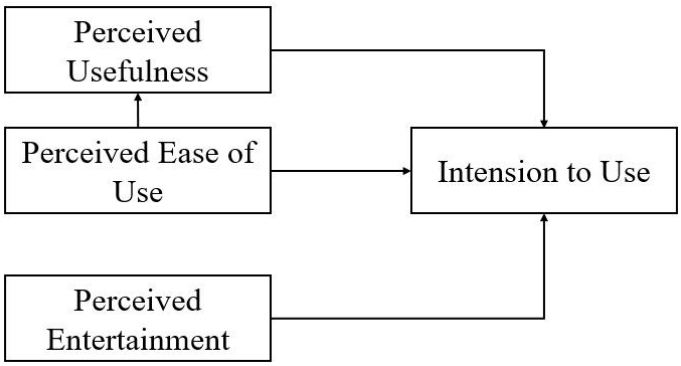

Figure 1. Mini program technology acceptance model

2.2 Research Hypothesis

Combining the previous literature review and the conceptual model in this paper, the following hypotheses are proposed:

1) Perceived Ease of Use positively influences Perceived Usefulness
2) Perceived Usefulness positively influences users' intension to use
3) Perceived Ease of Use positively influences users' intension to use
4) Perceived entertainment positively influences users' intension to use

2.3 Research Object

As a mini program, "Cloud Tour in Dunhuang" is free for all users with smartphones. There are four sections of it: Exploration, Excursions, Conservation, and New Culture and Creativity, in which users can enjoy the charm of Dunhuang in multiple dimensions through digital derivatives such as animations, H5 interactions, and 3D panoramas.

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2.4 Questionnaire Design

This questionnaire contains two main parts: the first part is about the demographic characteristics of the respondents' statistics and the second one is about TAM scale. The questions in the first section provide basic information about the respondents, including gender, age, and whether they have visited the Dunhuang Caves. The second part of the questionnaire is a 5-point scale measuring the respondents' willingness to use the Cloud Tour in Dunhuang mini program, with 5 representing "strongly agree" and 1 representing "strongly disagree".

The options for the variable measurement questions in the questionnaire were based on many previous scales and contained a total of three variables: Perceived Usefulness, Perceived Ease of Use, and Intention to Use were based on Davis's scale (Davis, 1986 & 1989); Perceived Entertainment was based on a scale designed by Holsapple and Wu (Holsapple & Wu, 2007). The final questionnaire was derived after a comprehensive consideration.

2.5 Data Collection

The information collected in this questionnaire is mainly from users who have used the mini program before. The questionnaire was distributed to users via the web with the mini program portal attached. After users had experienced the "Cloud Tour in Dunhuang" mini program, they were invited to collect data through the link. A total of 315 questionnaires were distributed, and after eliminating those who had not used this mini-program and those who filled out the questionnaire in a perfunctory manner, a total of 201 valid questionnaires were obtained, with an efficiency rate of 63.8%.

2.6 Data Analysis Tools

After screening out the valid data, the data were processed using SPSSAU. Frequency analysis was used to derive the demographic characteristics of the participants. And exploratory factor analysis was conducted to test the validity of the data to see if the sample data were suitable for information extraction. After ensuring the validity of the sample data, validation factor analysis was conducted to ensure that the options were clearly distinguishable from each other. Finally, the structural equation model was tested, in which the independent variables were perceived ease of use, perceived usefulness, and perceived entertainment, and the dependent variable was users' intention to use.

3. Finding

3.1 Demographic Characteristic

The demographic characteristics of the valid sample were analyzed using SPSSAU. In terms of visiting experience, there were more fillers who had not visited Dunhuang Caves than those who had (57.71% and 42.29% respectively); in terms of gender, there were fewer male users than female users (47.76% and 52.24%); and in terms of age, the highest percentage of users were aged 18-45 (71.14%). This indicates that more young people in the sample used the mini-program, Cloud Tour in Dunhuang, followed by middle-aged users aged 46-69 (14.93%), and the total percentage of the remaining two age groups was about 15%. According to the statistical table, it is easy to see that more than half of those who completed the questionnaire were people who had not visited the Dunhuang Caves, mainly young people (18-45 years old), and mostly women.

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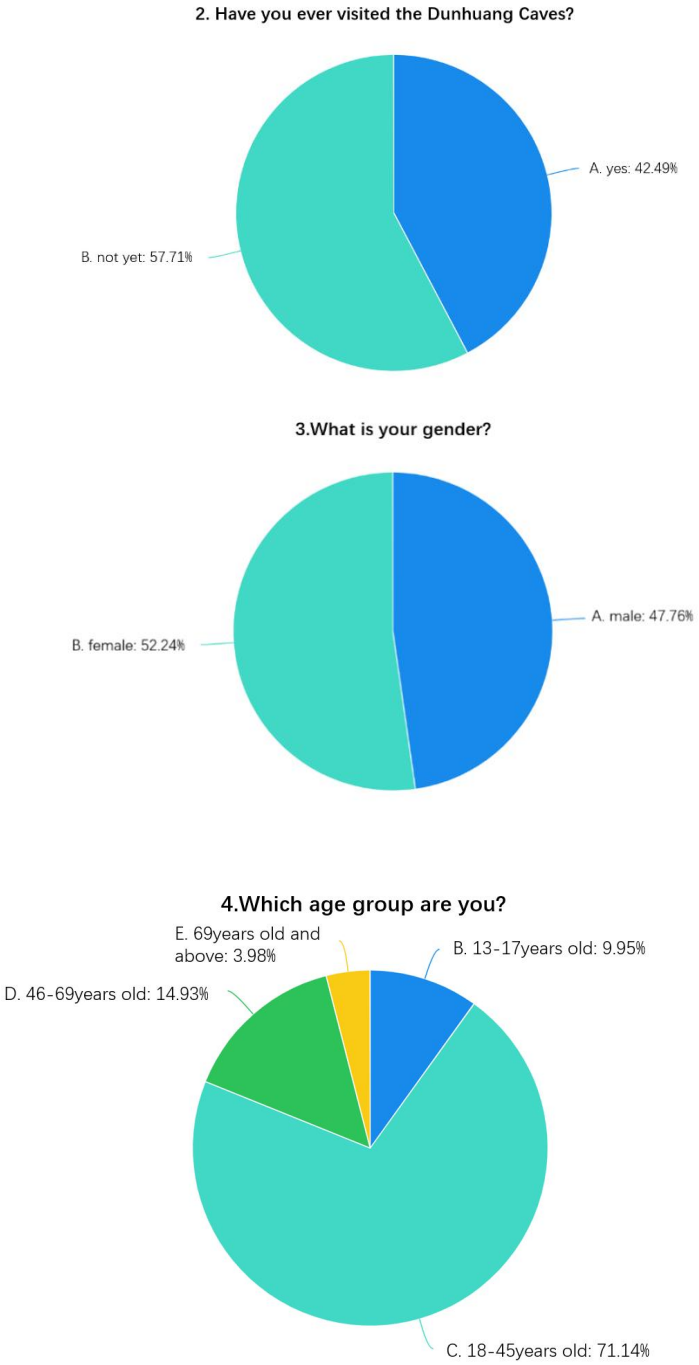

Figure 2. Demographic Characteristics Chart

3.2.1 Reliability Test

In the reliability analysis part, this paper obtained the required values by Bartlett's sphericity test, and the results are shown in Table 1.

Table 1 Results of Cronbach Reliability Test

Question	Correction Item Total Correlation (CITC)	Corresponding value of α	Cronbach's α
Q5-1. PEOU: It is easy to learn how to use the mini-program Cloud Tour in Dunhuang.	0.896	0.987	0.987

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Table 1 Results of Cronbach Reliability Test

Question	Correction Item Total Correlation (CITC)	Corresponding value of α	Cronbach's α
Q5-2. PEOU: It is easy to operate the mini-program Cloud Tour in Dunhuang.	0.898	0.986	
Q5-3. PEOU: The mini-program Cloud Tour in Dunhuang helps me learning about Dunhuang Cave.	0.894	0.987	
Q6-1. PU: It is a novel way to know about Dunhuang Cave through the mini-program Cloud Tour in Dunhuang.	0.918	0.986	
Q6-2. PU: The mini-program Cloud Tour in Dunhuang meets the needs for online tour about Dunhuang Cave.	0.923	0.986	
Q6-3. PU: The mini-program Cloud Tour in Dunhuang improves the efficiency of learning about Dunhuang Cave.	0.941	0.986	
Q7-1. PE: Using the mini-program Cloud Tour in Dunhuang is an enjoyment.	0.95	0.985	
Q7-2. PE: The mini-program Cloud Tour in Dunhuang makes me have more fun in the process of learning about Dunhuang Cave.	0.942	0.986	
Q7-3. PE: The process of using the mini-program Cloud Tour in Dunhuang is a pleasure.	0.96	0.985	
Q8-1. IU: When want to know about Dunhuang Cave, I will be glad to use the mini-program Cloud Tour in Dunhuang.	0.93	0.986	
Q8-2. IU: I will continue to use the mini-program Cloud Tour in Dunhuang to know about Dunhuang Cave.	0.913	0.986	
Q8-3. IU: I will recommend the mini-program Cloud Tour in Dunhuang to others.	0.917	0.986	

Standardized Cronbach's α：0.987

The results show that the overall reliability coefficient value of the scale is 0.987, which is greater than 0.9, indicating a high quality of reliability of the study data. Regarding the CITC values, the CITC values of the analyzed items are all greater than 0.4, which indicates that the analyzed items have a good correlation with each other and also indicates a good level of reliability. In summary, the study data reliability coefficient values are higher than 0.9, which collectively indicates a high quality of data reliability and can be used for further analysis.

3.2.2 Validity Analysis

Three factors were extracted using principal component analysis, and the results in Table 2 were obtained after processing through the analysis tool.

Table 2 Results of Validity Analysis

Variable	Factor Loading Coefficient	Common Factor Variance

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	Factor 1	Factor 2	Factor 3	
Q5-1	0.818	0.431	0.339	0.969
Q5-2	0.829	0.408	0.35	0.976
Q5-3	0.766	0.379	0.44	0.924
Q6-1	0.514	0.504	0.633	0.918
Q6-2	0.431	0.522	0.706	0.958
Q6-3	0.486	0.502	0.678	0.949
Q7-1	0.467	0.766	0.41	0.973
Q7-2	0.434	0.769	0.434	0.967
Q7-3	0.458	0.761	0.423	0.969
KMO value		0.931		-
Bartlett's Test value		3462.431		-
df value		36		-
P value		0		-

The results show that the cumulative variance explained after rotation is 95.602% (>50%), then the amount of information of the study items can be effectively extracted. As shown in Table 2, the KMO value is 0.931 (>0.8), which indicates that the study data is well suited for extracting information and also reflects the good validity of the study data from the side. In addition, considering the factor loading coefficients, each group of question items corresponds to the highest value of a factor respectively, and this correspondence is basically consistent with the psychological expectation of the study.

3.2.3 Confirmatory Factor Analysis

The model fit results from the validated factor analysis were $x^2/df = 211.176/200 = 1.056$; $GFI = 0.848$; $NFI = 0.959$; $RMSEA = 0.13$. All these values together indicate that the model fits well and meets the acceptance criteria. Table 3 shows that the CR of each latent variable is greater than 0.9 and the AVE is greater than 0.9. Also, the value of the square root of the latent variable is an important criterion for differentiating validity. The values on the diagonal of Table 4 are the square root of AVE values, and the rest of the values are the correlation coefficients of each variable. The data in the table show that the square root of the AVE value is the maximum value of the column respectively, which proves the high discriminant validity among the measured variables in the questionnaire.

Table 3 Model AV E and CR Indicator Result

Factor	Average Variance Extraction (AVE)	Combinatorial Reliability (CR)
Factor1	0.934	0.977
Factor2	0.913	0.969
Factor3	0.954	0.984
Factor4	0.96	0.986

Table 4 Differentiation Validity: Pearson Correlation and Square Root Value of AVE

	Factor1	Factor2	Factor3	Factor4
Factor1	0.966			
Factor2	0.889	0.956		
Factor3	0.867	0.931	0.977	
Factor4	0.813	0.882	0.924	0.98

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3.2.4 Structural Equation Model Test

Based on the results of the data analysis and combined with the above hypotheses, a structural equation model for the technical acceptance model of the mini-program, “Cloud Tour in Dunhuang", was established, as shown in Figure 3.

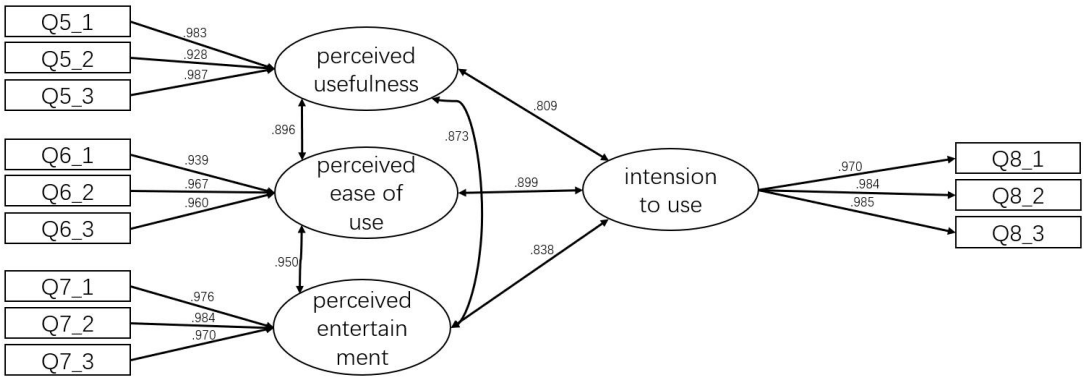

Figure 3. Test result of the structural equation model

With the help of the analysis tool SPSS AU, the fit indices obtained were： $TLI = 0.923 > 0.9; CFI = 0.943 > 0.9$; $NFI = 0.934 > 0.9$ $NNFI = 0.923 > 0.9; IFI = 0.943 > 0.9$, indicating that the hypothetical model passed the test and the fit indices were all within the acceptable range. Therefore, the model can reveal the relevant factors affecting the behavioral intention of users of the mini-program, Cloud Tour in Dunhuang.

3.2.5 Hypothesis Test

By analyzing the results of hypothesis testing, perceived entertainment ($CR = 13.37$), perceived usefulness ($CR = 3.262$) had a significant positive effect on users' behavioral intentions, i.e., H3 and H4 were proven. Perceived ease of use has strong positive influence on perceived usefulness, so H1 is convincing. Regarding the effect of perceived ease of use on users' behavioral intentions, since -1.478 < 0, there is no significant positive effect between these two, and H2 does not hold.

Table 5 Summary of the Regression Coefficients of the Model

X	→	Y	Unstandardized Regression Coefficient	SE	z (CR value)	p	Standardized Regression Coefficient
PEOU	→	PU	0.807	0.037	22.017	0	0.906
PEOU	→	IU	-0.123	0.083	-1.478	0.139	-0.136
PU	→	IU	0.236	0.072	3.262	0.001	0.233
PE	→	IU	0.809	0.06	13.37	0	0.865

4. iscussion

Firstly, the demographics data not only shows that the main users of this mini-program are youths, which is similar to the official report， but also finds the middle-aged people rank second most with 15% (more than teenagers).

Secondly, according to the results of the hypothesis test, H1, H3, and H4 of the four hypotheses made above are all verified: perceived usefulness and perceived entertainment both positively affect users' behavioral intentions; perceived ease of use positively affects perceived usefulness. However, H2 is not valid: it is not proven that perceived ease of use positively affects users' behavioral

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intentions. The failure of this hypothesis is contrary to the mainstream view. There are two main possible reasons for this. One is the technology acceptance model itself: although TAM is one of the most explanatory and widely used models in the field of new technologies, systems, platforms and models promotion, there is a range of applicability. Based on the results in the finding section, it can be demonstrated that perceived ease of use positively affects perceived usefulness, and perceived usefulness significantly and positively affects users' behavioral intentions. Therefore, the role of perceived ease of use is relatively weak in general, and does not affect users' intention to use. The other reason is the digitalization in museums itself. At the moment, museum digitization is in the process of experimentation and the related technology is not yet mature, so the attitude of the users is positive and very tolerant of the related shortcomings. Therefore, perceived ease of use has little impact on users' willingness to act. Users pay more attention to other factors, such as perceived usefulness and entertainment. Based on the results of the analysis in this paper, it is clear that users are more interested in whether digitally distributed museum content helps them to understand cultural heritage in a more interesting way and to communicate the cultural excellence that it contains.

In addition, the results in the finding section also point to the significant influence of perceived entertainment on users' intention to use. Not only the hypothesized positive correlation, but also the strongest positive correlation between perceived entertainment, compared to other factors, and users' behavioral intentions, which is also related to the positioning of the mini-program Cloud Tour in Dunhuang itself. Because it is a way for the Dunhuang Academy to promote the Dunhuang Caves through an online digital platform, its main purpose is to attract many people who have not visited the Dunhuang Caves in person and to spread the excellent cultural heritage of the Dunhuang Caves. Combined with the background music, elegant interface and variety of holiday themed activities designed into the mini-program, it is logical that perceived entertainment is the most obvious part of the user experience. Therefore, in order to promote awareness, we can continue to build on this strength and expand our audience.

5. Suggestion

Considered at the national level, the mini-program Cloud Tour in Dunhuang was able to be widely disseminated with the support of the government. In the 14th Five-Year Plan（2021-2035） published in 2021, there was a significant increase in the proportion of content about cultural heritage and relics. The priority of digital content has also been raised, with several references to Digital development of museums. The digitization of cultural heritage and institution has been raised to the level of national strategy. And the plan mentions many specific application areas: online digital experience products for museums, immersive experiences for scenic spots and new cultural tourism services such as virtual exhibition halls. In other words, the mini-program Cloud Tour in Dunhuang was born in such a suitable environment.

In the field of cultural heritage and museums, the development of the mini-program Cloud Tour in Dunhuang is also in line with the trend of times. According to the "Digitization Report 2022", in the process of gradually completing the digitization, it is also moving towards deeper fields. The deep digitization requires the digitization of the "whole life chain", the "presentation of multiple content forms" and the "strong connection and interaction" of multiple interaction. Digitization of the "whole life chain" refers to the digitization of all aspects and process in museums, from the heritage relics collection to conservation, from research to exhibition and communication. "Multi-content presentation" is the use of advanced digital content to innovate the expression of cultural communication. The "strong connection and interaction" of multi-collaboration is the adoption of a market-based operation model to attract public attention to participate in and support the conservation of cultural heritage and related digital development.

(1) Digitalization of the whole life chain: to further this goal, the mini-program should improve the usefulness by inviting users to be deeply involved in all process of Dunhuang Cave online. To

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make the online users experience a more complete and fulfilling cultural feast and learn more from it, not only the tour function needs to be enhanced, but also the protection and research functions deserve further development.

(2) Presentation of multiple content forms: perceived entertainment will enhance the willingness to use, and different forms will enhance entertainment. the mini-program's game linkage activities with Tencent have tapped into more potential users. Coupled with digital content forms such as music videos and painting of the day appreciation in its publicity, the innovative cultural communication presentation has strong implications for other museums as well. Therefore, the Dunhuang Academy and Tencent's joint effort to launch the mini-program Cloud Tour in Dunhuang is a model worthy of consideration for other museums.

(3) Strong connection and interaction with multiple collaborations: the interactive experience mode fully attracts the public to use mini-program. This also reflects that the public's enthusiasm and initiative for the production of a novel and well-developed digital model of cultural and historical museums is extremely high. In this paper, it is found that even the elderly are actively using the mini-program Cloud Tour in Dunhuang. Therefore, the digitalization of cultural and museums through social media and other online resources, as represented by such mini-programs, can lead the public to pay more attention to the development of digitalization of cultural and museums.

To be concluded, the mini-program Cloud Tour in Dunhuang can improve the interactive section to attract more attention from the users, which can also be generalized to other similar mini-programs. And the cultural heritage and institution should be open to the cooperation of digitalization with several parties.

6. Conclusion

By using TAM and delivering questionnaires, this paper explores the factors and the corresponding relationships that influence users' behavioral intention of mini-program Cloud Tour in Dunhuang. Perceived usefulness and perceived entertainment were found to positively and significantly influence users' behavioral intention. The effect of perceived ease of use on behavioral intention is not significant. And the possible reasons for this result are also explored.

Therefore, in the future, the mini-program Cloud Tour in Dunhuang should pay special attention to the user experience of the youth group, pay attention to the needs of the middle-aged group, and further benefit the old group. In terms of function, to improve Perceived Usefulness (PU), tap the potential of Perceived Entertainment (PE), and strengthen multi-party cooperation, it can be made from three aspects: the whole life chain, multi-content form and strong interactive connection.

The process of this study also has certain shortcomings. First, this paper is based on TAM model to analyze the influencing factors about user be intention to use of the mini-program Cloud Tour in Dunhuang. However, in real life, there are other factors that affect the audience's intention to use, such as the popularity of the mini-program itself. Therefore, the conceptual model of this study does not cover all the influencing factors. Second, the questionnaire for this study was distributed via the Internet, which is non-probability sampling. This suffers from sampling bias, which makes the findings of this study limited. Therefore, more theoretical models and influencing factors will be selected for the subsequent study, and a more integrated and comprehensive theoretical framework will be constructed. On the other hand, a strictly random sampling of should be conducted to avoid sampling bias.

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