An Empirical Study on Enhancing Online Exhibition Experiences: Quantitative Analysis Based on Multiple Models

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Abstract. The exhibition industry is often described as an emerging field in the 21st century. Nonetheless, it grapples with the challenge of adapting its marketing strategies due to the combined influences of the pandemic era and the digital age. Online exhibitions, integrated with internet technology, have been a focal point for industry development. As the pandemic subsides, assessing the ongoing relevance of online exhibitions and establishing effective transition strategies becomes imperative. This study employed a binary logistic regression model to investigate the characteristics and behaviors of existing users. It also utilized structural equation modeling to scrutinize factors influencing user satisfaction. The research revealed that women between the ages of 25 and 40, who frequently browse the internet and engage in freelance work, exhibit a pronounced preference for online exhibitions. Furthermore, variables such as content interest, diversity, and knowledge acquisition were identified as pivotal factors in influencing user satisfaction. This research provides guidance for the digital marketing transformation and the future development of online exhibitions.

Keywords: Online Exhibition; Regression Analysis; Structural Equation Model; User Profile

1 Introduction

The rapid growth of cloud computing, AI, and internet technology has profoundly transformed the culture and entertainment industry[1]. Online exhibitions (OE) are digital systems that utilize network platforms and a range of technologies, including multimedia and virtual reality, to store, organize, and visually present cultural artifacts and associated knowledge, thereby promoting knowledge sharing and facilitating inter-museum exchange[2]. In this digital era, online exhibitions are emerging as a fresh cultural experience, symbolizing the forefront of digital transformation. They redefine how individuals engage in cultural activities, providing unique opportunities for global audiences to explore culture, art, science, and beyond[3]. Due to the COVID-19 pandemic, online exhibitions have arisen as a viable substitute for physical displays, providing individuals the opportunity to experience art from their homes[4]. Despite experiencing rapid growth during the COVID-19 pandemic, the online exhibition market is now encountering challenges, including evolving audience demands, outdated marketing strategies, and difficulties in digital transformation as the pandemic subsides[5][6].

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Many scholars concentrate their research on the digital and intelligent evolution of online exhibitions[7][8], as well as their influence on education[9] and tourism[10]. Nevertheless, there has been limited emphasis on investigating the user profile and user satisfaction associated with online exhibitions. To address these research gaps and challenges faced by online exhibitions, this study utilizes market research and diverse data modeling techniques to analyze the essence and benefits of online exhibitions while focusing on comprehending the characteristics and expectations of current online exhibition users. By integrating knowledge from fields such as business management and digital marketing, it offers valuable insights to industry professionals for the development of online exhibition. This research supports cultural institutions in managing and marketing online exhibitions, with the goal of providing higher-quality exhibitions to the public.

2 Research settings

2.1 Source of data

In analysis of 'Online Exhibition' communication, we selected Jiangsu province, China, due to its robust economic and technological development, providing a representative observational setting. We distributed 109 pre-survey questionnaires within Jiangsu province and subsequently administered 705 electronic questionnaires titled 'Jiangsu Province Online Exhibition - User Experience Survey' in the same region. Through the online survey platform https://www.wjx.cn, we collected 679 valid responses from diverse respondents, including students, public servants, business managers, and freelancers across various industries and age groups. This data offered valuable insights into user characteristics, satisfaction levels, and online exhibition experiences.

2.2 Determination of sample size

This article employs a formulaic approach to determine the sample size, using the following formula to calculate the minimum required sample size:

$$N_0 = \frac{Z^2[p(1-p)]}{d^2} \tag{1}$$

In the equation 1, N_0 represents the minimum required sample size, p stands for the proportion of the desired sample in the population, and d is the margin of error. The article sets a 95% confidence level (α=0.05), resulting in a Z_α value of 1.96 based on tabulated values. To ensure precision, the margin of error (d) is set at 3.5%. A preliminary survey found that 61% of respondents had experienced online exhibitions (p=0.61). Plugging these values into the formula yields N_0=746. Taking into account stratified sampling and questionnaire effectiveness, the formula for calculating the questionnaire sample size is as follows:

$$N = N_0 \cdot \frac{Deff}{r} \tag{2}$$

In the equation 2, $Deff$ represents the design effect, and r stands for sample efficiency. We set $Deff$ to 0.8 and r to 88% based on the preliminary survey, which yields a sample size of N=678. To accommodate potential reductions in the response rate during questionnaire distribution, we initially distributed 750 questionnaires and received 679 valid responses.

2.3 Reliability test

For question 13 of the survey: 'Q13_What were your reasons for choosing online exhibitions?' (★1-5, from 'Very Dissatisfied' to 'Very Satisfied'), the analysis results are as follows:

Table 1. Formal reliability analysis for reasons to choose online exhibition

Cronbach's α coefficient	Number of Terms	Reliability Evaluation
0.834	5	good

For question 22 of the survey: 'Q22_What is your overall satisfaction with online exhibitions in Jiangsu Province?' (★1-5, from 'Very Dissatisfied' to 'Very Satisfied').

Table 2. Formal reliability analysis table for online exhibition satisfaction

Cronbach's α coefficient	Number of Terms	Reliability Evaluation
0.806	5	good

The results presented in Tables 1 and 2 elucidate the internal consistency of the survey questions. A Cronbach's α coefficient exceeding 0.8 is indicative of good internal consistency, and both tables meet this criterion, with values of 0.834 and 0.806, respectively. These results signify robust correlations among participants' responses to the survey questions, thereby bolstering the reliability of the survey findings. As a result, we can confidently employ these questions to evaluate participants' perspectives and satisfaction with online exhibitions.

2.4 Validity analysis

Q13_What were your reasons for choosing online exhibitions?' (★1-5, from 'Very Dissatisfied' to 'Very Satisfied'), the analysis results are as follows:

Table 3. Formal survey cause scale KMO and Bartley tests

KMO and Bartlett Tests		
Number of KMO Sampling Suitability Quantities		0.907
Bartlett Sphericity Test	Approximate Chi-Square	1692.469
	Degrees of Freedom	13
	Significance	0.000

Q22_What is your overall satisfaction with online exhibitions in Jiangsu Province?' (★1-5, from 'Very Dissatisfied' to 'Very Satisfied').

Table 4. Formal survey satisfaction scale KMO and Bartley tests

KMO and Bartlett Tests		
Number of KMO sampling Suitability Quantities		0.853
Bartlett Sphericity Test	Approximate Chi- square	1692.643
	Degrees of Freedom	14
	Significance	0.000

Tables 3 and 4 present noteworthy KMO values of 0.907 and 0.853, respectively, signifying a high degree of appropriateness for factor analysis. Furthermore, the results of the Bartlett's

Sphericity Tests are highly significant (p-value < 0.000) in both tables, affirming the suitability of the data for factor analysis and underscoring the overall reliability of the survey data.

2.5 Random test

This study employed SPSS software to conduct randomization tests on various categorical variables in the questionnaire using a significance level of 0.05. The Z-values obtained all fell within the (-1.96, 1.96) range, with significance levels exceeding 0.05. These results indicate a high degree of randomness in the questionnaire's structure and survey data, affirming the reliability of the survey results.

3 User analysis

3.1 Model building

This study utilizes a binary logistic model to analyze user characteristics in online exhibitions, where the dependent variable represents the binary choice of whether respondents have experienced Jiangsu region online exhibitions. The mathematical model is as follows:

$$\ln\left(\frac{P}{1-P}\right) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_m X_m \tag{3}$$

In the equation 3, $\ln\left(\frac{P}{1-P}\right)$ follows a binary logistic distribution, where P represents the probability of users participating in online exhibitions, and $1-P$ represents the probability of non-participation. The variables $X_1, X_2 \ldots\ldots X_m$ represent individual user characteristics (sex, age, education, record of formal schooling, occupation, monthly consumption level, time online, offline exhibition frequency), while $\beta_1, \beta_2 \ldots\ldots \beta_m$ are the estimated parameters known as regression coefficients.

3.2 Model application

Utilizing the established binary logistic model in SPSS, the analysis of the variables produced the following results after testing in Table 5.

Table 5. Final results of the binary Logistic model

Explanatory Variable	Regression Coefficient	Standard Error	P	OR(dominance ratio)
Constant	2.34	0.435	0.000**	1.405
Sex: Female	-0.543	0.199	0.013**	0.489
Age: 25-30	-0.642	0.187	0.024**	0.526
Age: 31-40	-0.318	0.145	0.012**	0.727
Job: Freelancer	-0.888	0.467	0.037*	0.412
Job: Businessman	-1.142	0.466	0.014**	0.319
Job: Students	-0.943	0.513	0.045*	0.389
TIME: 1-3 hours	-0.848	0.318	0.008***	0.428

Note: * * *, * * and * represent the significance levels of 1%, 5% and 10%, respectively

Table 6. Binary Logistic model accuracy

Accuracy	Recall	Precision	F1	AUC
0.695	0.695	0.689	0.689	0.746

The model Accuracy, Recall, Precision, F1, and AUC were subsequently calculated in Table 6 and the model accuracy can be considered very good.

3.3 Model analysis

The analysis of the above model has revealed the factors influencing user behavior in using online exhibitions.

1.Sex

Women are 51.1% more likely to choose online exhibitions than men. This highlights the significant role of gender in influencing user behavior, suggesting that marketing strategies for online exhibitions should target females to boost participation.

2.Age

Users aged 25-30 and 31-40 are more likely to engage in online exhibitions, with probabilities 47.4% and 27.3% higher, respectively, than those who do not participate. This underscores that the primary target audience for online exhibitions consists of young and middle-aged individuals.

3. Occupation

Freelancers, business managers, and students are more likely to experience online exhibitions, with probabilities 58.8%, 68.1%, and 61.1% higher, respectively, than those who haven't. This emphasizes the importance of targeting these professional groups in online exhibition marketing.

4.Internet Usage Duration

Users who spend 1-3 hours online daily are more likely to experience online exhibitions, with a 57.2% higher probability compared to those who don't. This conclusion highlights that internet usage frequency is another important factor for predicting user behavior.

In summary, females aged 25-40, frequent internet users, and freelancers are more likely to choose online exhibitions.

4 Satisfaction analysis

This section employs a structural equation model to analyze user satisfaction with online exhibitions, considering a total of 12 structural variables. These include 9 latent variables related to the platform's success factors like exhibition promotion, data security, integrated development, shopping, consumer rights protection, audio-visual experience, content engagement, knowledge acquisition, and presentation quality. Additionally, the model incorporates 3 latent variables—platform maturity, content experience, and overall satisfaction—that play a crucial role in determining users' satisfaction.

The research paper has proposed a series of hypotheses to explore the causal relationships among various structural variables. These hypotheses aim to gain a deeper understanding of the

critical factors contributing to the success of online exhibition platforms in light of their intricate interrelationships.

H1: Platform maturity has a positive impact on content experience

H2: Platform maturity has a positive impact on the overall satisfaction of the online exhibition platform

H3: Content experience has a positive impact on platform maturity

H4: Content experience degree has a positive impact on the overall satisfaction of the online exhibition platform

H5: Platform maturity has a positive impact on the publicity efforts of the exhibition

H6: Platform maturity has a positive impact on personal information security

H7: Platform maturity has a positive impact on the integrated platform construction

H8: Platform maturity has a positive impact on shopping consumption

H9: The maturity of platforms has a positive impact on the protection of consumers' rights and interests

H10: Content experience has a positive impact on the audio-visual experience

H11: Content experience degree has a positive impact on the content interest degree

H12: Content experience degree has a positive impact on the knowledge acquisition degree

H13: Content experience has a positive impact on form richness

Based on the 13 hypotheses, we constructed a structural equation model using maximum likelihood estimation and employed various methods to assess the goodness of fit of the model.

4.1 Model-fitting and evaluation

Structural equation models are essential for examining complex variable relationships. Assessing fit involves comparing the covariance matrix with model assumptions and actual data[11].A minor discrepancy indicates a satisfactory fit, though it may not fully capture the genuine relationships. Fit indices, such as those generated by Amos software, quantitatively assess how well the theoretical model aligns with data. In summary, structural equation models and fit indices are powerful tools for evaluating variable relationships and their impact on a system.

Table 7. Structural Equation Model Fit Results

Index	RESEA	CMIN	DF	CFI	NFI	IFI	CMIN/DF
Numerical Value	0.026	876.55	437	0.911	0.945	0.902	0.026

The Table 7 clearly illustrates that the CMIN/DF for the established model is less than 2, indicating a high level of fit. Furthermore, it's noteworthy that, in addition to the RMSEA value demonstrating an excellent fit well below the 0.05 threshold, the CFI, IFI, NFI values all surpass the 0.9 threshold. These values align with the rigorous requirements for model testing and fit,

offering compelling evidence that the model is not only acceptable but also well-suited for its intended purpose.

4.2 Interpretation of the model results

Table 8 displays the path coefficients of the structural equation model and the acceptance status of the null hypotheses. To visually depict the significance of the interactions between variables, we have annotated the standardized path coefficients on the structural equation model, as depicted in the Figure 1.

Table 8. Structural Equation Model Path Coefficients and Acceptance of Null Hypotheses

Serial Number	Hypothesis	Standardized Coefficient	Conclusion
H1	Platform maturity positively affects content experience	-0.325	Rejected
H2	Platform maturity positively affects overall satisfaction	0.742	Accepted
H3	Content experience positively affects platform maturity	0.934	Accepted
H4	Content experience positively affects overall satisfaction	0.872	Accepted
H5	Platform maturity positively affects exhibition promotion	-0.458	Rejected
H6	Platform maturity positively affects personal information security	0.768	Accepted
H7	Platform maturity positively affects integrated platform development	0.847	Accepted
H8	Platform maturity positively affects shopping consumption	0.656	Accepted
H9	Platform maturity positively affects consumer rights protection	-0.756	Rejected
H10	Content experience positively affects audio-visual experience	0.785	Accepted
H11	Content experience positively affects content interest	0.792	Accepted
H12	Content experience positively affects knowledge acquisition	0.798	Accepted
H13	Content experience positively affects richness of form	0.831	Accepted

Upon a more detailed examination of the data tables, it becomes evident that the initially hypothesized relationships H1, H5, and H9 did not attain the 95% significance level. This implies that there is no statistically significant causal relationship between platform maturity and content experience or exhibition promotion intensity. However, it is noteworthy that the impact coefficient of content experience on platform maturity is remarkably high at 0.934, and it also reaches 0.742 for overall satisfaction. These results indicate that existing users' satisfaction with their content experience significantly influences platform maturity and overall satisfaction levels. In fact, content experience appears to be the most critical factor shaping the online exhibition experience.

In summary, within the broader category of content experience, it is evident that content interest, richness of presentation, and knowledge acquisition are the three most critical factors.

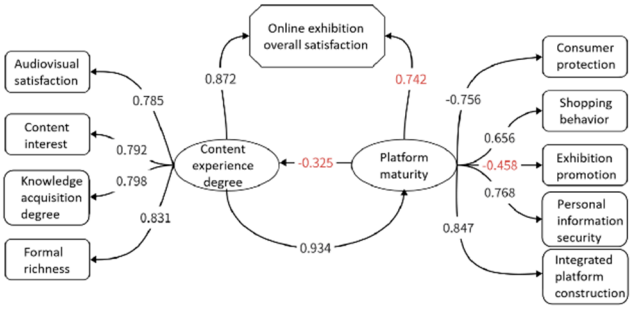

Fig. 1. Results diagram of the structural equation model

5 Conclusion

Regarding user demographics in the online exhibition market, a distinct preference is observed among women aged 25 to 40 who engage in frequent internet use and freelance work. Additionally, those with a keen interest in culture and creative products are drawn to the economic benefits and unique experiences offered by exhibitions. Therefore, targeting these demographic segments strategically is recommended for future market growth and expansion.

In the context of user content satisfaction in the online exhibition market, as the industry matures, user preferences are increasingly gravitating towards immersive and engaging content experiences. To meet these changing demands, online exhibitions should prioritize quality control in key areas such as audiovisual presentations, knowledge content, and user interface design. By offering informative yet entertaining online exhibition experiences, stakeholders can cultivate a more compelling and memorable user journey, potentially leading to sustained growth in traffic and engagement.

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