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What drives continued engagement with digital museums? Evidence from Beijing's Palace Museum

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Abstract

Digital museums extend access to cultural heritage beyond the spatial and capacity constraints of physical institutions, but initial access does not ensure that users will return, increase their use or recommend the experience. This study examines whether perceived economic value, perceived convenience, perceived platform quality and social influence are associated with continued engagement with digital museums, using the Palace Museum in Beijing as a case. The survey process ran from September to December 2025 and culminated in a 48 hour formal data-collection window among Weibo users who reported prior use of the Palace Museum's WeChat mini-program and linked digital services. After eligibility and data quality screening, responses from 53 individuals aged under 18 were excluded because legal guardian consent could not be verified, leaving 499 adult responses for structural equation modelling. The scales showed high internal consistency (Cronbach's α = 0.832–0.886), and the five construct, 19 item measurement model showed good fit (χ^2 (142) = 321.02, CFI = 0.962, TLI = 0.954, RMSEA = 0.050, SRMR = 0.042). The direct-effects model explained 36.3% of the variance in continued engagement. Perceived economic value (β = 0.217), perceived convenience (β = 0.209), perceived platform quality (β = 0.233) and social influence (β = 0.282) were each positively associated with continued engagement; all 2,000-sample bootstrap 95% confidence intervals excluded zero. Social influence produced the largest estimated standardised coefficient, although no pairwise coefficient-difference test was conducted. These associations are bounded by the cross-sectional, self-reported design and the digitally active adult Weibo sample.

Introduction

Museums increasingly use websites, mobile applications, virtual exhibitions and immersive systems to extend access to collections beyond geographical location, opening hours and physical visitor capacity (Giannini & Bowen, 2022; Yap et al., 2024). Recent research shows that digital cultural heritage experiences are shaped by platform performance, ease of use, perceived value, enjoyment, authenticity, cultural attachment and satisfaction (Jiang et al., 2025; Li et al., 2025; Wang & Nah, 2026; Zheng et al., 2024). These studies establish digital museums as both cultural institutions and post-adoption information systems: their long-term value depends not only on attracting first time users but also on sustaining return, repeated use and recommendation.

Evidence on continued digital engagement has developed rapidly. Zheng et al. (2024) used data from 377 users of the Cloud Central Axis digital museum and found that performance expectancy, effort expectancy, design aesthetics, enjoyment and cultural value were associated with continuous use intention, whereas task–technology fit and social influence were not. Li et al. (2025), studying 353 users of the Digital Palace Museum, separated continuance into stickiness and recommendation intentions and showed that perceived value and cultural memory operated through satisfaction and cultural identity. In HSSC, Jiang et al. (2025) connected authenticity, cultural attachment and satisfaction to reuse intention and social sustainability in an immersive cultural heritage application, while Wang & Nah (2026) linked pragmatic, aesthetic and hedonic product qualities to satisfaction and repurchase

intention in Digital Dunhuang. Beyond museums, Long & Suomi (2026) demonstrated that functional, hedonic, social and environmental values can have different relationships with satisfaction and continuance intention in theme-park applications.

Accordingly, the unresolved issue is no longer whether digital-museum continuance can be studied. Rather, existing models have mainly emphasised technology acceptance, immersive experience, cultural-emotional mechanisms and satisfaction. Less is known about whether four practical conditions perceived economic value, perceived convenience, perceived platform quality and social influence jointly explain continued engagement in a parsimonious direct-effects model. The social pathway is especially open to contextual testing because recent studies have reported non-significant effects for social influence or social interaction (Long & Suomi, 2026; Zheng et al., 2024), whereas recommendation, publicity and public legitimacy may operate differently in a museum ecosystem organised around social-media exposure.

The Palace Museum in Beijing provides a salient case for examining these conditions. Its digital ecosystem includes online exhibitions, virtual tours, digitised collections and mobile services intended to complement on-site access. Within this ecosystem, the focal digital environment examined in the present study comprised the Palace Museum's WeChat mini-program and the digital services reached through its interfaces. Respondents were asked to evaluate these services based on their own experience. Li et al. (2025) have already examined the Digital Palace Museum through a cognition emotion behaviour and expectation confirmation pathway. The present study does not duplicate that mediation model. Instead, it uses this specific WeChat based service environment to compare the direct associations of perceived economic value, perceived convenience, perceived platform quality and social influence with a compact continued engagement outcome comprising revisit, increased frequency and recommendation intentions.

This study therefore develops a bounded post-adoption framework that uses TAM and TPB as its principal theoretical anchors, while post-adoption and perceived-value research inform construct selection (Ajzen, 1991; Bhattacherjee, 2001; Davis, 1989). It does not claim to test TAM or TPB in full. The four predictors are labelled perceived economic value, perceived convenience, perceived platform quality and social influence to match the observed item content and scoring direction. Continued engagement comprises intentions to revisit, continue or increase use, and recommend the experience. Using survey data from 499 adult Weibo users and structural equation modelling, the study asks whether each practical condition is associated with continued engagement and whether the pattern extends or contrasts with recent digital museum evidence.

Theoretical background and hypotheses

Digital museums and continued engagement

A digital museum uses digital technologies to preserve, interpret and exhibit cultural or historical materials through fully virtual institutions, hybrid extensions of physical museums or online repositories (Giannini & Bowen, 2022). Digital access can support mobile or self-directed learning (Zhang & Hu, 2022), remote exploration of digitised collections (Corona, 2023) and continued contact with museum content after a visit (Chen, 2020), but technical availability alone does not ensure post-adoption engagement. Recent digital-museum models have linked continuous use to performance and effort expectancy, aesthetics, enjoyment and cultural value (Zheng et al., 2024), and to perceived value, cultural memory, satisfaction and cultural identity (Li et al., 2025). Jiang et al. (2025) positioned cultural attachment and satisfaction between immersive experience and reuse intention, whereas Wang & Nah (2026) linked product qualities and technology appraisals to satisfaction and repurchase intention.

Continued engagement is distinct from initial adoption because it concerns intended persistence after exposure or use (Bhattacherjee, 2001). The construct is not operationalised identically across studies: Zheng et al. (2024) measured continuous behavioural intention; Li et al. (2025) separated stickiness and recommendation; Jiang et al. (2025) examined reuse; and Wang & Nah (2026) examined repurchase intention. In this study, continued engagement integrates three related intentions: revisiting after an initial digital museum visit, continuing or increasing visit frequency, and recommending the experience to others. It therefore captures persistence and advocacy but remains an intention measure rather than observed behaviour.

A post-adoption framework

Technology acceptance research explains use through evaluations such as usefulness and ease of use, while planned behaviour research highlights attitudes, social norms and perceived control (Ajzen, 1991; Davis, 1989). Post-adoption research further distinguishes continuance from first-time acceptance and emphasises users' evaluations after experience (Bhattacherjee, 2001). Recent cultural heritage studies combine these traditions with task technology fit, perceived value, satisfaction, cultural identity, immersion and authenticity (Jiang et al., 2025; Li et al., 2025; Wang & Nah, 2026; Zheng et al., 2024). The present model therefore takes a deliberately parsimonious approach: it selectively draws on TAM and TPB to estimate four direct associations with continued engagement without claiming to test either framework in full. The proposed model is shown in Fig. 1.

Perceived economic value

Perceived economic value refers to whether digital museum access is perceived as worth its monetary and opportunity costs and affordable within the user's budget (Zeithaml, 1988). The survey items combine value for money, lower cost relative to physical visitation, willingness to pay a reasonable fee for high quality content, and budget fit. The item domain was developed with reference to prior Palace Museum, digital tourism and museum digital product research (Bai & Shao, 2021; Gu & Zhao, 2025; Sun & Guo, 2022). This construct is therefore broader than cost burden alone. Perceived value has already

been linked to satisfaction and cultural identity in the Digital Palace Museum (Li et al., 2025), while value-based continuance research shows that different forms of functional, hedonic, social and environmental value may have distinct relationships with future use (Long & Suomi, 2026). The present study isolates the economic component of this appraisal.

H1

Perceived economic value is positively associated with continued engagement with digital museums.

Perceived convenience

Perceived convenience refers to accessing museum content without excessive time, effort or physical constraints (Berry et al., 2002). The survey operationalised it through overall convenience, time saving, efficiency and ease of obtaining information relative to physical museums; its development drew on convenience related conditions in digital museum adoption research (Sun & Guo, 2022). This dimension is related to, but not identical with, ease of use. Zheng et al. (2024) found that performance and effort expectancy were associated with continuous digital museum use, and Wang & Nah (2026) showed that ease of use contributed to satisfaction and repurchase intention in Digital Dunhuang. Perceived convenience may therefore support return by reducing the situational effort required to access content repeatedly.

H2

Perceived convenience is positively associated with continued engagement with digital museums.

Perceived platform quality

Perceived platform quality refers to the perceived responsiveness, interface clarity, navigability and functional stability of the digital museum (DeLone & McLean, 2003). The original scale-development rationale situated this item set within technological-familiarity research, citing Venkatesh & Davis (2000), Thompson et al. (1994) and Sun & Guo (2022). However, the observed items evaluate the system rather than the respondent's prior experience or digital competence. The label perceived platform quality captures both usability and reliability without changing the item domain. Recent evidence supports this distinction: technological characteristics can reduce effort expectancy in digital museums (Zheng et al., 2024), while pragmatic product quality can shape usefulness, ease of use and enjoyment in immersive heritage environments (Wang & Nah, 2026). A responsive and dependable platform should reduce friction during repeated exploration.

H3

Perceived platform quality is positively associated with continued engagement with digital museums.

Social influence

Social influence refers here to a broad field of social cues comprising interpersonal recommendation, publicity exposure and a supportive development atmosphere. The item domain was linked to subjective-norm and digital tourism research (Ajzen, 1991; Sun & Guo, 2022; Taylor & Todd, 1995; Venkatesh et al., 2003). It is therefore wider than subjective norm or social interaction alone. Previous findings are mixed. Zheng et al. (2024) reported no significant direct association between social influence and continuous digital museum use, and Long & Suomi (2026) found no significant effect of perceived social interaction on theme-park-app continuance. By contrast, recommendation is itself an important post-adoption behaviour in online museums, and stickiness may support recommendation (Li et al., 2025). In a Weibo-based museum context, recommendations and public visibility may increase awareness, legitimacy and the likelihood of continued engagement; this possibility requires direct empirical testing rather than assumption.

H4

Social influence is positively associated with continued engagement with digital museums.

Methods

Research design and case context

The study adopted a quantitative, cross-sectional survey design to examine associations between four perceptual and social predictors and continued engagement with the Palace Museum's WeChat mini-program and linked digital services. The Palace Museum served as the digital case context rather than as a physical fieldwork or recruitment site. The questionnaire was administered entirely online through Weibo; respondents completed it remotely from their own locations in China, and no data were collected on the Palace Museum premises or through the Museum as an institution. All constructs were measured using a five-point Likert scale (1 = strongly disagree, 5 = strongly agree). Scale development drew on prior research on museum technology acceptance, digital tourism, information-system experience and social norms (Bai & Shao, 2021; Bhattacherjee, 2001; Gu & Zhao, 2025; Sun & Guo, 2022; Taylor & Todd, 1995; Thompson et al., 1994; Venkatesh & Davis, 2000), and the items were contextualised for the Palace Museum. Initial analyses used SPSS 27.0 and AMOS 26.0. The article-level reproducibility analysis of the de-identified item level data used Python 3.12 and semopy 2.3.11.

The overall survey process ran from September to December 2025 and comprised questionnaire development, a small-scale pre-test, a pre-survey and formal data collection. The formal survey invitation and response window lasted 48 hours. Eligibility was assessed using the screening item, 'Have you ever used the digital museum services of the Palace Museum in Beijing?' In this study, these services referred to the Palace Museum's WeChat mini-program and digital services accessed through its interfaces, including digital visiting functions and the digital collection. Only respondents who selected 'Yes' were

eligible for data quality screening; the adult-only analytical sample is described below. Representative interfaces are shown in Fig. 2.

Population, sampling and recruitment

The immediate target population consisted of Weibo users who reported prior use of the Palace Museum's digital museum services accessed through WeChat and confirmed prior use through the screening item. Weibo served as the recruitment environment rather than a population-representative sampling frame. Recruitment drew on Palace Museum-related posts, topics and users, including the official account and the #YunyouGugong# ("Cloud Tour of the Palace Museum") topic. The resulting sample should therefore be interpreted as contextually relevant to digitally engaged Weibo users rather than representative of the Chinese population as a whole.

A minimum sample size of approximately 385 was calculated using a 95% confidence level, a 5% margin of error and a conservative population proportion of 0.5; the large-population and finite-population formulations were cross-checked using Zhang (2003) and Dillman (2007). The study employed online convenience sampling with quota control. Posts containing keywords related to the Palace Museum, digital museums and cloud visits were used to identify an initial pool of approximately 23,000 unique Weibo user IDs. Institutional, verified organisational, inactive and suspected fake accounts were removed, leaving approximately 18,000 active users. The final survey invitations were distributed by private message, and the formal response window remained open for 48 hours. Of 18,000 invitations, 598 questionnaires were returned; 584 passed initial eligibility screening, including the prior-use item, and 552 remained after the full data quality cleaning procedure. After 53 respondents aged under 18 were excluded because legal guardian consent could not be verified, the final adult analytical sample comprised 499 respondents, producing an adult-sample response rate of 2.77%.

Data screening

Data quality was assessed through machine-assisted and manual screening. Duplicate submissions were identified using IP addresses and device identifiers (n = 9). Responses completed in less than 90 seconds or more than 1,800 seconds were excluded as abnormal (n = 8), as were responses showing the same option for ten consecutive questions (n = 6). The remaining submissions were manually reviewed for irrelevant open-ended responses (n = 4), contradictions between prior-use and use-frequency questions (n = 2), and overfilled quota cells (n = 3). These procedures yielded 552 otherwise usable responses. Because legal-guardian consent could not be verified for 53 respondents aged under 18, those responses were excluded from all analyses in the revised manuscript, yielding a final adult analytical sample of 499. The formal-sample screening process is summarised in Section 3.3 of S4.

Questionnaire development and pilot testing

Questionnaire refinement occurred in two stages. An initial revision sample of 50 respondents was used to identify problems in wording, semantic clarity and logical consistency. A subsequent pre-survey distributed 500 questionnaires through Questionnaire Star; 436 responses were returned and 407 valid

responses were retained after screening. The pre-survey sample was used exclusively for instrument validation. A five-construct, 19-item CFA specifying correlations among the latent constructs without causal paths demonstrated excellent fit (RMSEA = 0.028, GFI = 0.956, NFI = 0.955, IFI = 0.989 and CFI = 0.989; PNFI = 0.793, PCFI = 0.821 and PGFI = 0.714). Standardised factor loadings ranged from 0.708 to 0.951, composite reliability from 0.844 to 0.920 and AVE from 0.576 to 0.793; the Fornell Larcker criterion was met for all five constructs (Fornell & Larcker, 1981). The resulting 19-item instrument was then administered in the main survey. Following data quality screening and the exclusion of respondents aged under 18, 499 adult responses were retained for structural model testing.

The initial revision sample (*n* = 50), the pre-survey sample (*n* = 407) and the adult analytical sample from the main survey (*n* = 499) were mutually exclusive; no respondent participated in more than one stage.

Measures

Perceived economic value, perceived convenience, perceived platform quality and social influence were each measured with four items. Continued engagement was measured with three items covering revisit intention, continued or increased frequency, and recommendation intention. Complete wording is provided in Section 5 of S4. Higher scores represented more favourable evaluations or stronger intentions. The constructs labelled perceived cost and technological familiarity in the original questionnaire are termed perceived economic value and perceived platform quality here because their items assess favourable cost value appraisal and perceived system performance, respectively. These terminology adjustments did not change any item wording, response, score or model estimate.

The questionnaire was administered in Chinese. English translations of the analysed items are provided in Section 5 of S4 for reporting purposes.

Analytical strategy

The analytical workflow separated instrument validation from hypothesis testing, following standard multivariate-analysis and structural equation modelling procedures (Field, 2018; Hair et al., 2010; Kline, 2016). The pre-survey sample (*n* = 407) was analysed using reliability analysis, exploratory factor analysis and a five-construct, 19-item CFA with correlated latent constructs and no causal paths. In the adult main-survey sample (*n* = 499), respondent characteristics and item distributions were summarised using frequencies, percentages, means, standard deviations, skewness and excess kurtosis. The 19 model items contained no missing values. Internal consistency and two-tailed bivariate correlations were then assessed, followed by a five-construct CFA in which all 19 observed items loaded on their prespecified factors and the latent constructs were freely correlated. The same 19-item measurement structure was retained in the primary structural model, which estimated the four direct paths using maximum likelihood and freely estimated covariances among the four exogenous latent predictors. Maximum likelihood estimation was retained because the construct scores showed no severe univariate non-normality; percentile bootstrap intervals were used to supplement normal-theory inference. Standardised path estimates and R^2 are reported with 95% confidence intervals from 2,000 nonparametric case resampling bootstrap samples; all bootstrap models converged. All inferential tests

were two-tailed with $\alpha = 0.05$. A sensitivity model constrained the six covariances among the exogenous predictors to zero to reproduce the original direct-effects specification. Demographic group comparison tests were not carried forward because they do not address the article's central research question.

Results

Sample characteristics

The final adult sample comprised 499 respondents. Women accounted for 55.3% ($n = 276$) and men for 44.7% ($n = 223$). Beijing residents represented 63.1% ($n = 315$), with 36.9% ($n = 184$) residing elsewhere. The sample was predominantly young: 48.5% were aged 18–25 and 31.3% were aged 26–35. Respondents with an associate degree constituted 49.3% of the sample, followed by undergraduate education (25.7%) and secondary education or below (25.1%). The complete demographic characteristics of the final adult sample are presented in Table 1.

Table 1
Sample characteristics

Characteristic	Category	*n*	%
Gender	Female	276	55.3
	Male	223	44.7
Residence	Beijing	315	63.1
	Other	184	36.9
Age	18–25	242	48.5
	26–35	156	31.3
	36–45	51	10.2
	46–55	50	10.0
Education	Secondary or below	125	25.1
	Associate degree	246	49.3
	Undergraduate	128	25.7

Descriptive patterns and correlations

Items measuring perceived economic value had means between 3.50 and 3.59, those measuring perceived convenience between 3.67 and 3.79, and those measuring perceived platform quality between 3.78 and 3.83. Social-influence items had lower means, ranging from 2.92 to 2.99, whereas continued-engagement item means ranged from 3.53 to 3.72. All four predictors were positively correlated with continued engagement (all two-tailed $p < .001$). Most inter-predictor correlations were also positive and

significant, although perceived economic value was not significantly correlated with perceived platform quality (p = .066) or social influence (p = .065). Correlations with continued engagement were r = .299 for perceived economic value, r = .338 for perceived convenience, r = .347 for perceived platform quality and r = .391 for social influence. The complete inter-construct correlation matrix is presented in Table 2.

Table 2
Correlations among study constructs

Construct	1	2	3	4	5
1. Perceived economic value	1				
2. Perceived convenience	.203**	1			
3. Perceived platform quality	.082	.220**	1		
4. Social influence	.083	.212**	.271**	1	
5. Continued engagement	.299**	.338**	.347**	.391**	1

Note. ** p < .01 (two-tailed Pearson correlations); n = 499. All correlations marked ** had p < .001. Perceived economic value–perceived platform quality: p = .066; perceived economic value–social influence: p = .065.

At the construct level (n = 499), the mean (SD) was 3.54 (0.89) for perceived economic value, 3.72 (0.97) for perceived convenience, 3.81 (0.89) for perceived platform quality, 2.97 (1.00) for social influence and 3.65 (0.68) for continued engagement. Skewness ranged from − 0.85 to − 0.04 and excess kurtosis from − 0.98 to 0.72. These values indicate no severe univariate departure from normality. All construct scores used the full 1–5 response range.

Measurement quality

Measurement quality was established in two mutually independent samples. In the pre-survey sample (n = 407), the five construct, 19-item CFA demonstrated excellent fit (RMSEA = 0.028, GFI = 0.956, NFI = 0.955, IFI = 0.989, CFI = 0.989, PNFI = 0.793, PCFI = 0.821 and PGFI = 0.714). Standardised factor loadings ranged from 0.708 to 0.951, composite reliability from 0.844 to 0.920 and AVE from 0.576 to 0.793, and all five constructs met the Fornell Larcker criterion (Fornell & Larcker, 1981). In the adult main sample (n = 499), internal consistency exceeded 0.70 (Nunnally, 1978) for perceived economic value (α = 0.832), perceived convenience (α = 0.862), perceived platform quality (α = 0.855), social influence (α = 0.868) and continued engagement (α = 0.886). The overall KMO value was 0.838, and Bartlett's test was significant (χ^2 = 4821.692, df = 171, p < .001). The five-construct, 19-item CFA showed good fit: $\chi^2(142)$ = 321.02, χ^2/df = 2.261, CFI = 0.962, TLI = 0.954, GFI = 0.935, AGFI = 0.921, RMSEA = 0.050 and SRMR = 0.042. Standardised loadings ranged from 0.694 to 0.934, composite reliability from 0.833 to 0.890 and AVE from 0.556 to 0.731. The square root of AVE for each construct (0.746–0.855) exceeded all latent correlations (0.089–0.431), satisfying the Fornell Larcker criterion. The reliability and validity statistics for the adult main sample are summarised in Table 3, and the measurement model is shown in Fig. 3.

Table 3
Scale reliability and measurement validation

Construct	α	Loading range	CR	AVE
Perceived economic value	0.832	0.694–0.793	0.833	0.556
Perceived convenience	0.862	0.719–0.843	0.862	0.611
Perceived platform quality	0.855	0.718–0.795	0.855	0.597
Social influence	0.868	0.765–0.820	0.869	0.623
Continued engagement	0.886	0.803–0.934	0.890	0.731

Note. α, Cronbach's alpha; CR, composite reliability; AVE, average variance extracted. Values are from the five-construct, 19-item CFA in the adult main sample (n = 499).

Structural model and hypothesis tests

In the primary structural model, the four exogenous latent predictors were allowed to covary. Model fit was good: $\chi^2(142) = 321.02$, $\chi^2/df = 2.261$, CFI = 0.962, TLI = 0.954 and RMSEA = 0.050. These global fit values equal those of the CFA because the latent structural component is just identified: the four correlated predictors jointly regress the single outcome factor. The model explained 36.3% of the variance in continued engagement ($R^2 = 0.363$, bootstrap 95% CI [0.271, 0.471]). All four hypothesised conditional associations were positive and statistically significant. Perceived economic value was associated with continued engagement ($\beta = 0.217$, bootstrap 95% CI [0.118, 0.309], $p < .001$); the corresponding estimates were $\beta = 0.209$ for perceived convenience (95% CI [0.112, 0.305], $p < .001$), $\beta = 0.233$ for perceived platform quality (95% CI [0.150, 0.315], $p < .001$), and $\beta = 0.282$ for social influence (95% CI [0.184, 0.373], $p < .001$). Social influence produced the largest estimated standardised coefficient; the other three coefficients were similar in magnitude. The structural model is shown in Fig. 4, and the path estimates, confidence intervals and hypothesis decisions are summarised in Table 4.

Because the study was cross-sectional and observational, these coefficients are interpreted as conditional associations rather than causal effects. In addition, no pairwise coefficient-difference tests were reported, so the largest estimate should not be described as statistically stronger than the other estimates.

Table 4
Structural model and hypothesis tests

Path	β	95% CI	*z*	*p*	Decision
Perceived economic value → continued engagement	.217	[.118, .309]	4.771	< .001	H1 supported
Perceived convenience → continued engagement	.209	[.112, .305]	4.458	< .001	H2 supported
Perceived platform quality → continued engagement	.233	[.150, .315]	4.892	< .001	H3 supported
Social influence → continued engagement	.282	[.184, .373]	5.989	< .001	H4 supported

Note. β values are standardised estimates from the primary model. The two-tailed z tests use the corresponding unstandardised estimates and standard errors. Confidence intervals are percentile intervals from 2,000 nonparametric case-resampling bootstrap samples; all 2,000 bootstrap models converged.

A sensitivity analysis constrained the four exogenous latent predictors to be mutually uncorrelated. It yielded standardised estimates of β = 0.238, 0.242, 0.263 and 0.313, respectively, and R^2 = 0.282 (bootstrap 95% CI [0.208, 0.388]). The four associations remained positive with bootstrap intervals excluding zero, but model fit was poorer than in the primary correlated-predictor model ($\chi^2(148) = 420.48$, χ^2/df = 2.841, CFI = 0.942, TLI = 0.933 and RMSEA = 0.061).

Discussion

Principal findings

This study examined continued engagement with digital museums through four practical conditions: perceived economic value, perceived convenience, perceived platform quality and social influence. All four were positively associated with intentions to revisit, increase use and recommend digital museums. The estimates for perceived economic value, perceived convenience and perceived platform quality were closely clustered, whereas social influence yielded the largest standardised coefficient. The pattern complements recent models centred on performance and effort expectancy, cultural value, satisfaction, authenticity and immersive product quality (Jiang et al., 2025; Li et al., 2025; Wang & Nah, 2026; Zheng et al., 2024) by showing that economic, access, platform and social conditions can be compared directly within a more parsimonious post-adoption model.

Perceived economic value

The positive association for perceived economic value suggests that respondents were more willing to continue engaging when paid content appeared worth its price, digital access was viewed as less costly than a physical visit, and charges remained within their budget. This should not be interpreted to mean

that higher cost increases engagement. Rather, favourable value and affordability appraisals were associated with stronger continued engagement. The result is consistent with the broader importance of perceived value in the Digital Palace Museum (Li et al., 2025) and with value-based continuance research showing that users distinguish among different kinds of benefit (Long & Suomi, 2026). The present contribution is narrower: it identifies the economic dimension through price, relative cost, willingness to pay and budget fit.

Perceived convenience

Perceived convenience was also positively associated with continued engagement. The items emphasised time saving, efficiency, general convenience and ease of finding information relative to physical visits. This pattern is compatible with findings that effort expectancy and ease of use matter for future digital-heritage behaviours (Wang & Nah, 2026; Zheng et al., 2024). However, perceived convenience should be understood as a complement to meaningful cultural content rather than evidence that digital access substitutes for the material, spatial and sensory qualities of an on-site visit.

Perceived platform quality

The positive association for perceived platform quality is consistent with the argument that smooth interaction reduces barriers to continued use. Respondents who perceived the platform as responsive, logically organised, easy to navigate and reliable reported stronger continued engagement. This interpretation converges with Zheng et al. (2024), who linked technological characteristics to effort expectancy, and with Wang & Nah (2026), who showed that pragmatic product quality supports usefulness, ease of use and enjoyment. The present items nevertheless measure perceived system performance, not users' prior technological familiarity, self-efficacy or digital literacy.

Social influence

Social influence had the lowest average item ratings but the largest estimated standardised association with continued engagement. This differs from Zheng et al. (2024), who found no significant direct effect of social influence on continuous digital-museum use, and from Long & Suomi (2026), who reported no significant effect of social interaction on theme-park-app continuance. One plausible explanation is measurement scope: the present construct combines interpersonal recommendation with publicity exposure and a favourable development atmosphere, whereas social interaction and conventional social influence are narrower. Li et al. (2025) also showed that stickiness can support recommendation in the Digital Palace Museum, reinforcing the relevance of social transmission to post-adoption behaviour. These comparisons suggest a context and measurement-sensitive social pathway, but they do not establish why the coefficients differ.

Theoretical contribution

The study makes three bounded contributions. First, it operationalises continued engagement as a compact combination of revisit, continued frequency and recommendation intentions. This builds on, but

differs from, studies that use a single continuous-use outcome (Zheng et al., 2024), separate stickiness and recommendation outcomes (Li et al., 2025), reuse intention (Jiang et al., 2025) or repurchase intention (Wang & Nah, 2026). Second, it compares perceived economic value, perceived convenience, perceived platform quality and social influence simultaneously without introducing satisfaction, cultural identity or immersion as mediators. The contribution is therefore parsimony and practical comparability, not a claim to replace those richer process models. Third, the positive social influence association provides a contextual contrast to recent non-significant social findings and identifies a testable question about how interpersonal recommendation, publicity and public atmosphere operate in socially visible museum ecosystems.

Practical and design implications

The findings provide a user-centred basis for digital-museum planning. Economic access can be supported through free basic access, transparent pricing and optional premium content whose cultural and experiential value is clearly communicated (Gu & Zhao, 2025; Li et al., 2025). Perceived convenience can be strengthened through responsive cross-device access, clear information architecture, efficient search and minimal friction in login or navigation (Wang & Nah, 2026; Zheng et al., 2024). Users with different levels of digital capability can be supported through onboarding, contextual help, consistent layouts, progressive disclosure and multiple modes of interaction. Finally, social visibility can be encouraged through carefully designed sharing functions, community participation, recommendation features and partnerships that connect digital content with relevant cultural communities (Li et al., 2025).

These implications should guide user research and prototyping rather than be treated as directly tested interventions. The survey did not experimentally compare pricing models, interface designs, onboarding procedures or social features. Museums should therefore validate proposed changes with usability studies, behavioural analytics and, where appropriate, experiments before implementation.

Implications for sustainable cultural engagement

Digital access may support more inclusive and sustained cultural participation by reducing geographical, temporal and some economic barriers (Giannini & Bowen, 2022; Jiang et al., 2025). Jiang et al. (2025) explicitly modelled reuse intention in relation to social sustainability, but the present study did not measure environmental, social, institutional or cultural-sustainability outcomes. Its results therefore support only a cautious practical implication: improving perceived economic value, perceived convenience, perceived platform quality and social relevance may help museums maintain engagement with digital cultural resources, while any sustainability effect requires separate measurement.

Limitations and future research

Several limitations define the scope of the findings. First, the cross-sectional design identifies associations at one point in time and cannot establish causal direction or changes in engagement as

technologies and user expectations evolve. Longitudinal or experimental research is required to evaluate persistence and causality. Second, the sample was recruited from Weibo users interested in digital museums, and 63.1% of respondents lived in Beijing. The study therefore overrepresents a digitally active and geographically concentrated audience and may not reflect less-connected users, rural communities or audiences outside China. Additionally, 53 otherwise usable responses from individuals aged under 18 were excluded from every analysis because legal-guardian consent could not be verified. The findings therefore apply only to adults and should not be generalised to minors.

Third, all variables were self-reported. The results may be affected by social desirability and common-method bias (Podsakoff et al., 2003), and intention should not be equated with actual behaviour. Future work should combine surveys with clickstream data, platform logs or direct observation. Fourth, the quantitative design does not capture the emotional, symbolic and experiential dimensions of digital heritage engagement. Interviews, focus groups and ethnographic approaches could examine authenticity, enjoyment, cultural attachment and trust. Fifth, the single case design limits generalisation across national, local, art, history and science museums. Comparative studies should examine whether the observed relationships hold across institutions and cultural settings.

Finally, the article's construct labels were aligned retrospectively with the semantic content of the observed items. Perceived economic value combines value for money, lower relative cost, willingness to pay and budget fit; perceived platform quality combines responsiveness, interface clarity, navigation and stability; and social influence combines interpersonal recommendation with publicity and public atmosphere. The original five-construct, 19-item pre-survey CFA supported convergent and discriminant validity, so the relabelling changes terminology rather than item composition or model estimates. Nevertheless, future studies should validate these article specific labels in independent samples and examine whether the broad social-influence item domain is invariant across settings.

Conclusion

Using survey data from 499 adult Weibo users, this study found that perceived economic value, perceived convenience, perceived platform quality and social influence were positively associated with continued engagement with digital museums. Social influence yielded the largest estimated standardised coefficient, while the other three associations were similar in magnitude. The findings suggest that digital museums seeking repeat use and recommendation should consider economic access, platform performance and social visibility together rather than treating engagement as a purely technical adoption problem. These conclusions remain limited to self-reported intentions in a cross-sectional sample of digitally active adult users connected to the Palace Museum case.

Declarations

Data availability

The adult-only de-identified item-level dataset (S1), the analysis code and verified outputs (S2), the complete Chinese questionnaire (S3), and the variable codebook, English reporting translations of the 19 analysed items, data-collection and screening protocol, and analysis documentation (S4) are provided as confidential supporting files through the journal submission system for editorial and peer review assessment. The shared dataset contains no names, contact details, social-media account identifiers, IP addresses, device identifiers or open-ended responses. The participant-level dataset is not deposited publicly because the participant information provided at data collection did not cover unrestricted public deposition of individual responses. Requests after publication will be considered by the corresponding author subject to institutional ethics and confidentiality requirements.

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Competing interests

The authors declare no competing interests.

Ethical approval

Ethical approval for the original doctoral study was obtained before data collection from the Universiti Teknologi MARA Research Ethics Committee in Malaysia, an approval body located outside China (REC/04/2025 (PG/MR205); approval period: 8 April 2025 to 19 December 2025). No separate ethics approval was obtained in China. Recruitment, participant information and questionnaire completion were conducted remotely online through Weibo, and participants completed the questionnaire from their own locations. The Palace Museum was the case-study context only; it did not sponsor, host or administer the study, and no data were collected on its premises or through its staff. The present article analyses only de-identified records from 499 adult participants. A signed and sealed local institutional statement subsequently confirmed these circumstances and determined that no additional ethics review was required for the current secondary analysis of the existing de-identified data. Participants indicated informed consent by proceeding with the questionnaire after reading the study information.

Informed consent

Before beginning the questionnaire, respondents were shown a study information statement explaining the research purpose, the academic use of their responses and confidentiality. Participation was voluntary, and proceeding with and submitting the questionnaire constituted electronic informed consent under the REC-approved procedure. Informed consent was obtained from all participants retained in the adult-only analytical sample. Responses from 53 individuals aged under 18 were excluded from every analysis because legal-guardian consent could not be verified.

Supplementary information

The English reporting translations of the 19 measurement items and the formal-sample screening documentation are provided in S4.

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Figures

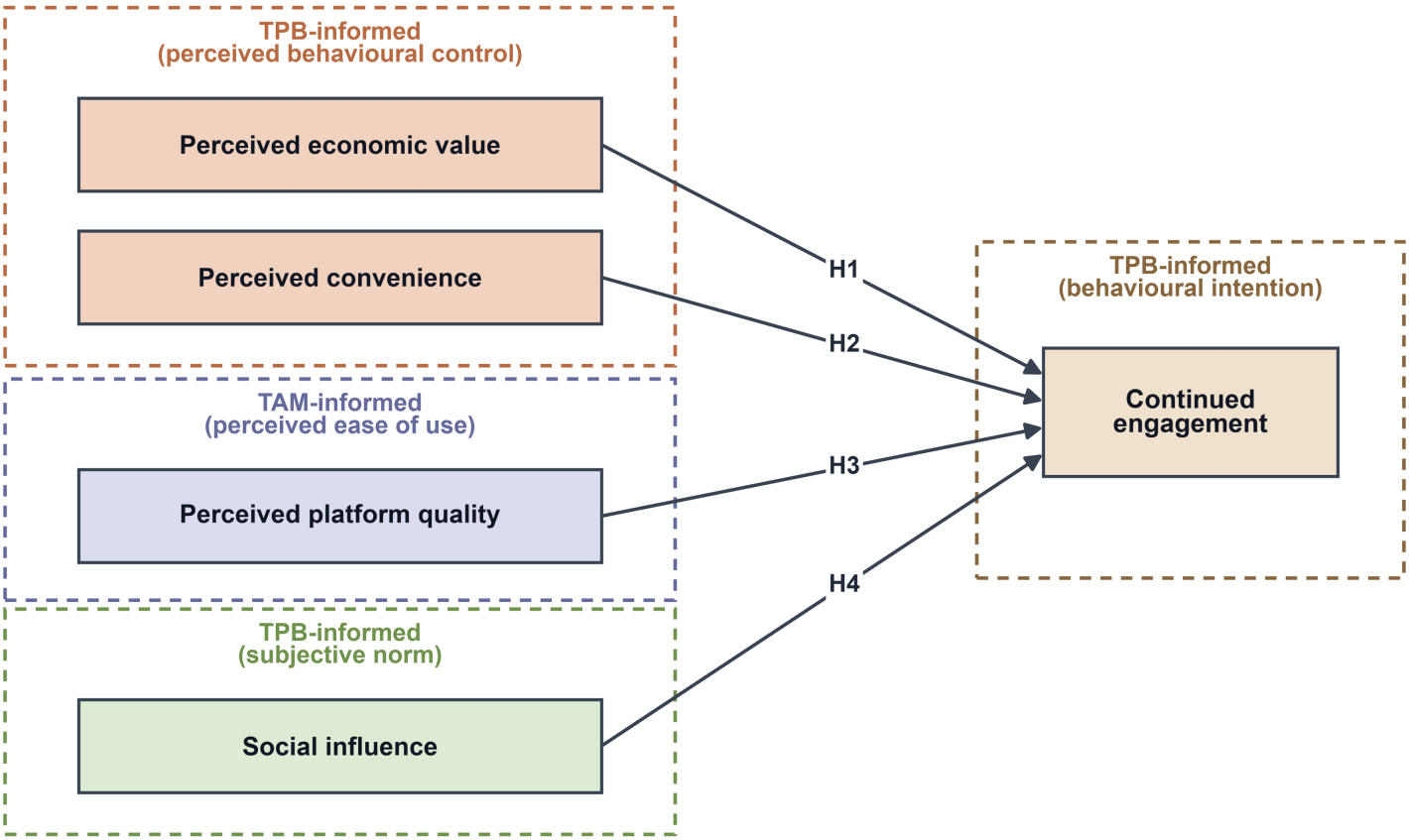


Figure 1

Conceptual model. Dashed frames indicate the TPB and TAM domains; arrows show H1–H4. TPB, Theory of Planned Behaviour; TAM, Technology Acceptance Model.

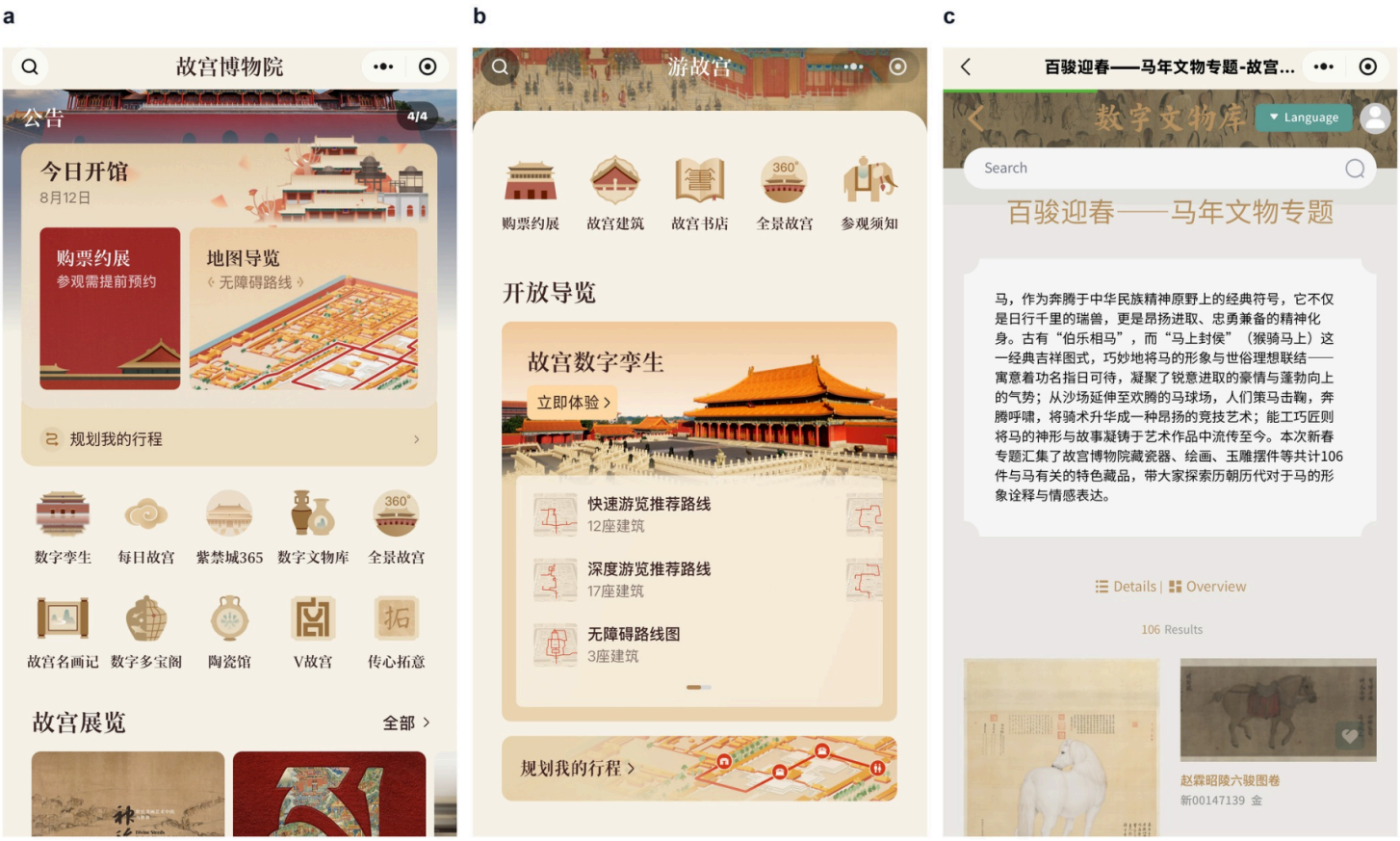


Figure 2

Mini-program interface. (a) Home; (b) digital visit; (c) collection. Author screenshots, 12 August 2026; shown to identify the study platform, not as a record of the 2025 interface.

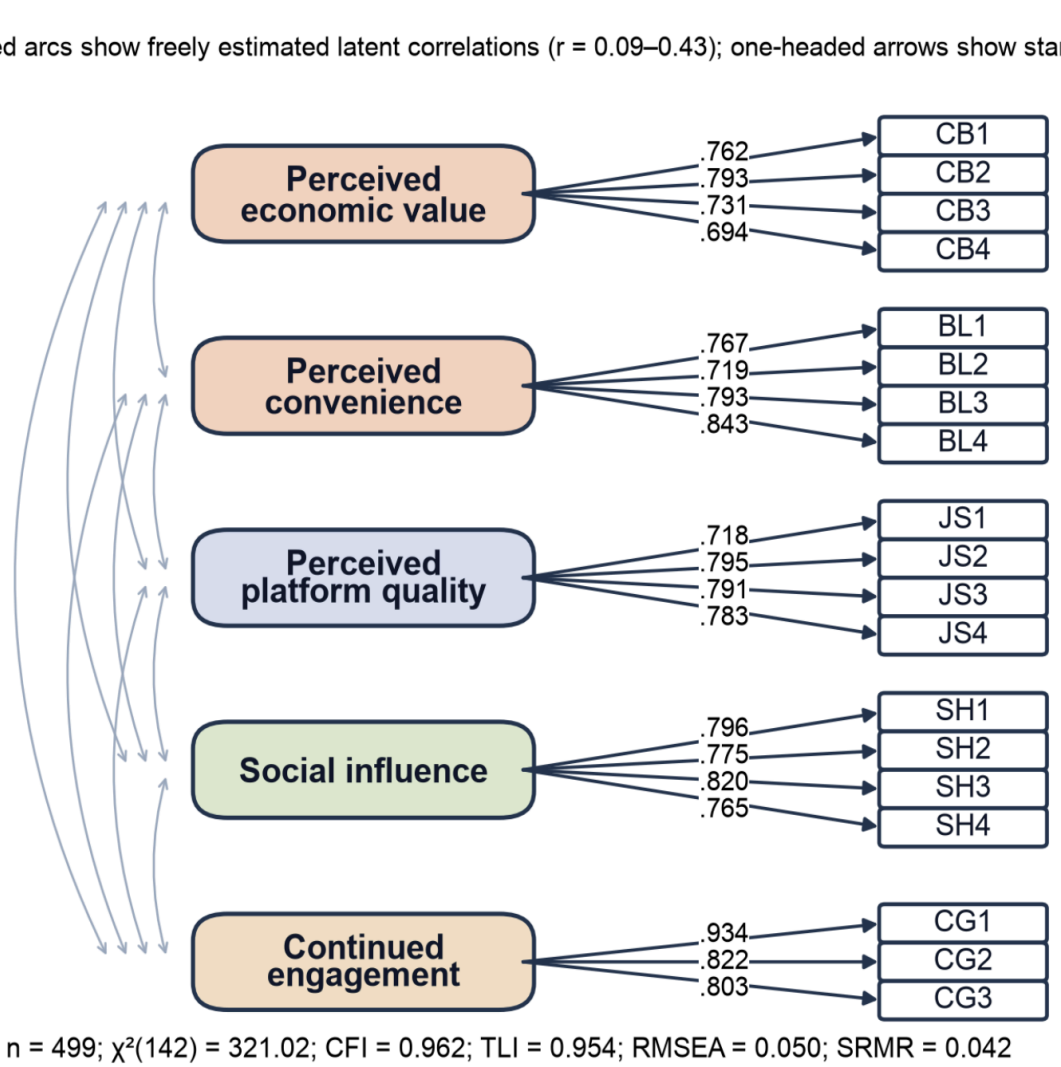


Figure 3

Measurement model. Standardised loadings from the five-construct, 19-item CFA in the adult main sample (*n* = 499). Double-headed arcs denote freely estimated latent correlations. Model fit: $\chi^2(142) = 321.02$, $\chi^2/df = 2.261$, CFI = 0.962, TLI = 0.954, RMSEA = 0.050 and SRMR = 0.042.

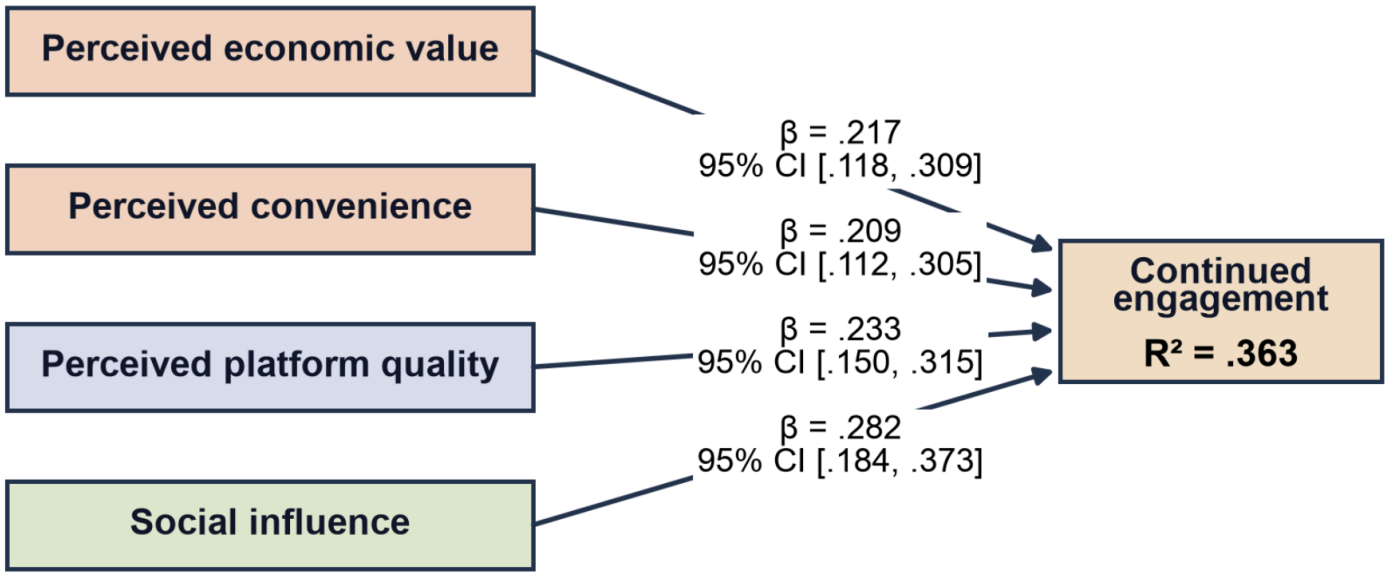


Figure 4

Structural model. Standardised β (bootstrap 95% CI); R^2 = 0.363; n = 499; 2,000 samples; all $p < .001$.