Research on the Interface Design of Museum Mini Programs Based on Flow Theory

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Abstract. As digital technologies increasingly permeate public cultural services, museums are adopting lightweight mobile platforms such as WeChat mini programs to expand visitor engagement. However, most existing museum mini programs suffer from functional homogeneity, fragmented user journeys, and shallow interactivity, which hinder sustained attention and deep satisfaction in short-session digital encounters. This study introduces flow theory as a design framework to address these challenges. By systematically reviewing the core components of flow experience including its conditional, experiential, and outcome factors we construct a three layer flow model tailored to museum mini program interface design, comprising a trigger layer, a process layer, and a result layer. To validate the model, we conducted a comparative user experiment with 40 participants, divided into an experimental group using the flow-based design and a control group using a conventional interface. Both subjective flow experience scales and objective task performance were measured. Results show that the experimental group scored significantly higher across all 10 flow indicators and achieved markedly better objective accuracy, particularly in tasks requiring spatial reasoning and detailed observation. This research offers a practical, theory-driven framework for transforming routine digital museum services into engaging, educationally effective experiences, and points toward future integration of AI and AR technologies for deeper cultural immersion.

Keywords: Flow theory, Museum mini program, Interface design, user experience.

1 Introduction

Against the backdrop of digital technology deeply empowering public cultural services, museums are undergoing an unprecedented transformation. WeChat mini programs, with their lightweight, download free, and ready to use features, have quickly become the core digital touchpoint for museums to connect with visitors[1]. Most existing mini programs are limited to basic functions such as ticket booking, exhibit listing, and voice playback. This fragmented and disjointed interactive experience makes it difficult for

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users to achieve a deep sense of cultural immersion in digital media. The flow experience is regarded as the optimal state in user experience, providing a new design perspective and deepening the user's immersion during use.

2 Overview of Flow Theory

Flow refers to an emotional experience state in which an individual shows a strong interest in a certain activity and is fully engaged as a result[2]. In this state, individuals enter a state of selflessness, where actions and consciousness merge into one, fully focused on the current task and turning a blind eye to the distractions around them. The process itself brings a strong sense of pleasure and fulfillment. The initial two channel model evolved into an eight channel model[3], as shown in Figure 1.

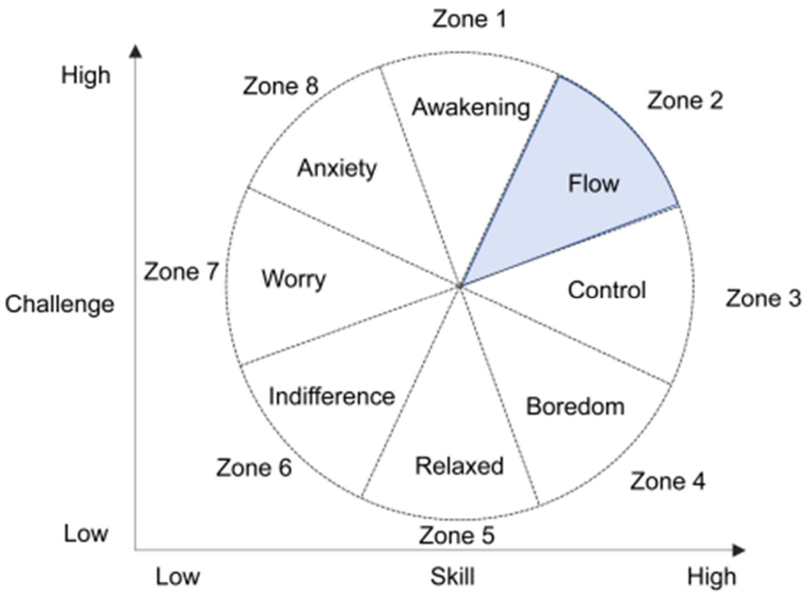

Fig. 1. Museum Mini Program Interface Design Trigger Process Result Three Layer Flow Model.

3 Construction Logic of Museum Mini Program Interface Design Model Based on Flow Theory

As a specific scenario for cultural dissemination[4], museum mini programs include reservation functions, cultural relic displays, map guides, etc. In order to provide users with a sense of cultural immersion satisfaction during use, flow theory is applied to study the construction of a flow design model for museum mini programs from the trigger layer, process layer, and result layer[5].

3.1 Trigger Process Result Three-Layer Flow Model

Trigger layer (preconditions): By matching clear information architecture and personalized tasks, achieve a balance between "skills challenge" and induce user motivation to use.

Process layer (immersive experience): Through visual atmosphere creation and multi sensory interaction design, it shields external interference and promotes users to achieve a focused state of "behavior and consciousness integration".

Result layer (emotional sublimation): By using instant action effects and spiritual reward mechanisms, users are given a sense of control, ultimately achieving cultural resonance of self satisfaction,as shown in Figure 2.

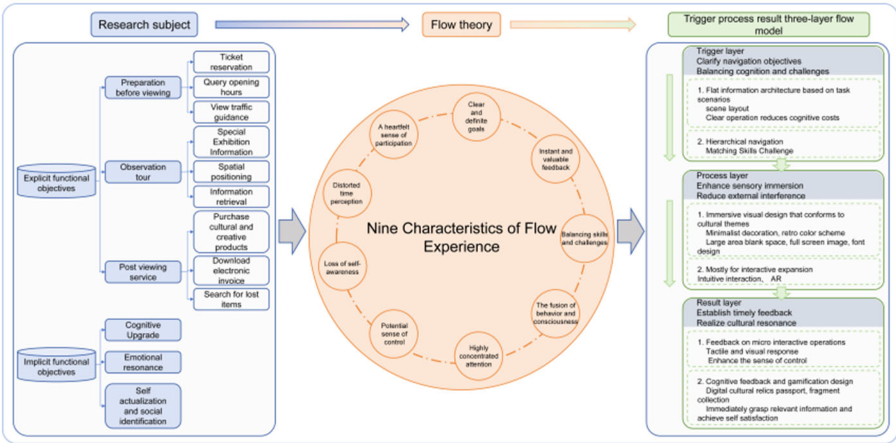

Fig. 2. Museum Mini Program Interface Design Trigger Process Result Three Layer Flow Model.

4 Verification of Interface Design Strategies for Museum Mini Programs Based on Flow Theory

4.1 Trigger Layer Design: Clarify Navigation Objectives and Balance Cognitive Challenges

To verify whether the optimization design proposed in this study effectively improved the user experience, 40 participants were recruited and randomly divided into experimental group A and control group B. Group A completed the interface task designed based on the flow model, while Group B completed the task based on the existing interface and filled out the flow chart after completing the task.

(1)Subjective flow experience analysis

This study used Cronbach's alpha coefficient to evaluate the internal consistency reliability of the scale. The test results show that the Cronbach's alpha coefficient of the flow experience summary table, which includes 10 items, is 0.97. The Cronbach's alpha coefficients of the trigger layer, process layer, and result layer in each dimension are all greater than 0.7, indicating that the scale has good internal consistency and highly reliable measurement results, as shown in Table 1.

Table 1. Reliability Test of Cardiac Flow Scale

Number of terms	Sample size	Cronbach α
10	40	0.977

To quantitatively evaluate the improvement effect of the new interactive design on users' subjective immersion, this study conducted an independent sample t-test on the scores of the flow experience scale for two groups of participants. The specific statistical analysis results are shown in the table. The data results indicate that the experimental group has a significant advantage in all 10 measurement indicators of flow experience. The specific analysis is as follows: the average scores of the experimental group on various indicators remain stable between 6.05 and 6.50 points, with a maximum score of 7 points, indicating an overall high-level flow state; The average score of the control group only hovered between 3.15 and 4.55, indicating a relatively average experience. The t-test results showed that the significance p-values of all 10 items were less than 0.05, indicating that the difference in scores between the experimental group and the control group was statistically significant and not caused by accidental errors. On the two items of Q10 continuous exploration willingness and Q5 challenge skill matching, the t-values reached 12.979 and 12.187, respectively, indicating that the optimized system has the most outstanding improvement effect in helping users concentrate and enhance overall immersion, as shown in Table 2.

Table 2. T-test results of heart flow meter

Measurement dimension	Measurement metrics	Group (mean ± standard deviation)		t	p
		A(n=20)	B(n=20)		
Trigger layer	Q1 (Path clarity)	6.50±0.61	4.30±0.80	9.787	<0.05
	Q2 (Smooth operation experience)	6.45±0.69	4.55±0.76	8.303	<0.05
Process layer	Q3 (Attention concentration)	6.15±0.88	3.60±0.75	9.873	<0.05
	Q4 (Emotional immersion)	6.05±0.76	3.35±0.99	9.690	<0.05
	Q5 (Challenge skill matching)	6.35±0.75	3.60±0.68	12.187	<0.05
	Q6 (Time distortion sensation)	6.20±0.89	3.20±0.77	11.382	<0.05
Result layer	Q7 (Feedback clarity)	6.50±0.69	3.80±1.01	9.911	<0.05
	Q8 (Interactive Control Sense)	6.45±0.69	3.70±0.86	11.142	<0.05
	Q9 (Collect a sense of achievement)	6.30±0.57	3.50±0.95	11.332	<0.05
	Q10 (Continuous exploration willingness)	6.35±0.75	3.15±0.81	12.979	<0.05

(2) Objective task performance analysis

On the basis of verifying the significant improvement in subjective user experience, this study further quantitatively analyzed the objective answering performance of users at the process level. The test includes three answering tasks: Q21 cultural relic age, Q22 cultural relic land release, and Q23 cultural relic characteristics, to measure the efficiency and understanding of users' acquisition of cultural relic background knowledge. The average scores of the two groups of users are shown in Figure 3. In the task of identifying the age of cultural relics, Group A achieved a perfect score of 10.00, while Group B scored 7.50, indicating that the optimized visual layout and information hierarchy design enable users to efficiently and accurately capture key historical basic information. In the task of identifying cultural relics on land, Group A scored 9.00 points, higher than Group B's 5.50 points. Land information usually requires users to establish spatial and geographical associations in their minds, proving that design has lower cognitive load in conveying background knowledge. The Q23 cultural relic features have the highest difficulty and require in-depth observation. Group A scored 8.00 points and Group B scored 4.00 points. Group A users can obtain richer multidimensional visual information through 3D free rotation and scaling interaction, thereby enhancing their cognitive depth and memory effect on the detailed features of cultural relics. The objective answer scores have achieved cross validation with the subjective flow chart results mentioned earlier. The optimized 3D interactive design subjectively stimulates users' desire for exploration, and objectively translates into higher knowledge transfer efficiency and learning performance.

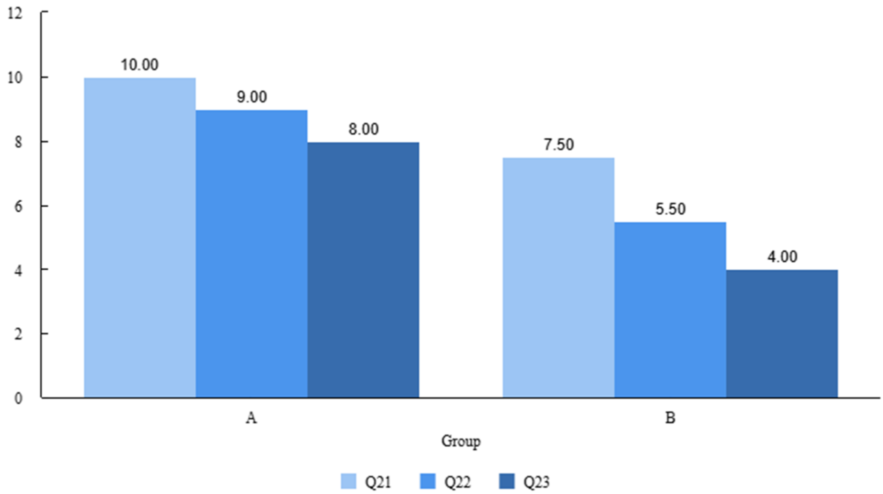

Fig. 3. Statistics of Objective Question Answering Scores.

5 Conclusion

This study addresses the experience fragmentation in current museum mini-programs by proposing a three-layer interface design model based on Flow Theory, comprising the trigger, process, and result layers. Empirical testing confirmed that the optimized design significantly enhances both users' subjective flow experience and their objective efficiency in acquiring cultural knowledge. This research provides an effective practical framework for transforming basic digital services into highly engaging cultural experiences. Future studies will expand the sample size and explore the integration of AI or AR technologies to further deepen digital cultural immersion.

References

1. Jungle, Li Wenlong, Dong Ronghui Construction and Design Translation of Digital Display Narrative in Museums Based on Knowledge Graph: A Case Study of the Museum of the Morgan Ancient Road Station [J]. Industrial Design, 2026, (05):117-120. DOI:10.26920/j.cnki.231516cn.2026.05.036.
2. Guan Ying, Li Ning, Zhao Huimin Research on the Design of Shared Kitchen Services in Universities Based on Flow Experience [J]. Design, 2022, 35 (04): 76-79 .DOI: 10.3969/j.issn.1003-0069.2022.04.021
3. Xiao Wangqun, Sun Xiaolu, Lou Ming, etc Research on Interactive Interface Design of New Energy Vehicles for Young Women Guided by Flow Experience [J]. Packaging Engineering, 2026,47 (02): 460-473. DOI: 10.19554/j.cnki. 1001-3563.2026.046
4. Ji Xin, Ning Fang Research on Interface Design of Cultural and Tourism App under Scene Interaction Theory: Taking Xuzhou Cultural and Tourism as an Example [J]. Industrial Design, 2026, (05):53-57.DOI:10.26920/j.cnki.231516cn.2026.05.019.
5. Cao Jing Digital Experience and Derivative Design of Rice Customs in Wannian County [D]. Hunan University of Technology, 2024. DOI: 10.27730/d.cnki.ghngy.2024.000156