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Optimization of the space design of the ethnic cultural transmission hall based on post-occupancy evaluation

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Abstract

Ethnic cultural transmission halls play a vital role in preserving and revitalizing intangible cultural heritage, yet many suffer from low youth engagement due to design shortcomings. This study applies the post-occupancy evaluation method—combining surveys, on-site observations, and expert interviews—to assess the spatial design of eight Chuanxi Halls. According to the survey, 80.1 percent of young participants preferred interactive workshops, and 68.7 percent favored immersive exhibitions, confirming the importance of experiential learning spaces. Building on these findings, the study develops an integrated design model that organizes spaces into layers for cultural learning, social interaction, and accessibility support. This framework aligns with Self-Determination Theory and Field Theory, offering both theoretical contributions and practical guidance for creating youth-friendly cultural halls that strengthen intergenerational cultural transmission.

Keywords: Chuanxi Hall; Post-occupancy evaluation; Cultural heritage; Spatial design; Inclusive design

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1. Introduction

The establishment of ethnic cultural transmission halls (hereby referred to as Chuanxi Halls; 传习馆, *chuanxiguan*) aims to safeguard and revitalize traditional crafts. Their functions extend beyond exhibitions, workshops, and educational activities to serve as vital spaces for community-based cultural transmission. Unlike museums that emphasize static displays, Chuanxi Halls highlight interactive and participatory experiences, particularly targeting youth groups in rural and suburban areas. Interactive technologies, such as digital displays and motion-based installations, have been shown to significantly enhance youth engagement in museum contexts (Ibrahim *et al.*, 2021). However, in recent years, many of these halls have faced challenges, including declining visitor numbers and low youth participation. For example, according to the Beijing Municipal Bureau of Culture and Tourism (2024), minors accounted for approximately 16.3 percent of all museum visitors in Beijing, reflecting the persistent challenge of low youth engagement across cultural institutions. These institution-level data lend plausibility to the argument that unsatisfactory transmission effects stem from limited youth attendance across cultural venues. Studies suggest that this trend is linked to multiple challenges in the digital era, including labor shortages and financial

constraints that disrupt services (Ng *et al.*, 2024), as well as the aging of cultural bearers and the weakening of younger generations' sense of identity and willingness to engage in traditional culture (Xie *et al.*, 2024). At the same time, conventional exhibition formats that lack digital and interactive design have further exacerbated young people's sense of detachment from cultural experiences (J. Li *et al.*, 2025; Weng *et al.*, 2019). Therefore, incorporating innovative approaches—such as artificial intelligence and immersive interaction—has become a critical priority for enhancing youth engagement and ensuring the sustainable transmission of intangible cultural heritage (ICH) (Chai-Arayalert *et al.*, 2023; Y. Wang & Zhou, 2025).

The modern concept of Chuanxi Halls gradually took shape following United Nations Educational, Scientific, and Cultural Organization's official adoption of the Convention for the Safeguarding of Intangible Cultural Heritage in 2003, which emphasized the critical role of education and training in safeguarding ICH and encouraged countries to treat it as an integral part of sustainable development (H. L. Wang, 2017; Yan & Li, 2023). At the same time, handicraft archaeology has been recognized as a crucial pathway for understanding the origins of Chinese civilization and the historical continuity of traditional crafts (Zhang, 2022). In 2005, China formally introduced the strategy of "safeguarding and transmitting ICH," aiming to leverage the vitality of the cultural industry to provide new momentum for ICH and to move beyond the limitations of static display models (J. Zhu & Ling, 2022). Against this backdrop, the government has enacted successive laws and policies to strengthen institutionalized protection of ICH and promote closer collaboration between academic institutions and practitioners to enhance educational impact and knowledge sharing (Guo & Ahn, 2023; W. Hu *et al.*, 2024). Similarly, W. Hu *et al.* (2024) emphasized that China's ICH protection now increasingly relies on intellectual property regulation and cross-sector collaboration to ensure sustainable cultural transmission. At the same time, the integration of digital technologies has offered new pathways for the dynamic development of Chuanxi Halls. For instance, mobile applications and virtual reality/augmented reality systems enable immersive, interactive experiences that expand public participation and maintain the relevance of traditional crafts in contemporary contexts (Yidan *et al.*, 2025). Nevertheless, despite advances in policy and technology, many Chuanxi Halls continue to face challenges in spatial design and operational models, including unclear target group positioning and insufficient funding and manpower, which limit their effectiveness in cultural transmission (Zhao & Li, 2022).

This study aims to refine the spatial design of ethnic cultural transmission halls to strengthen their appeal and practical value for younger generations. The study sets out to:

(i) Investigate the preferences of youth in terms of spatial organization, opportunities for social interaction, and the availability of supportive facilities
(ii) Diagnose the core challenges within current design practices and identify the key determinants that shape user experience
(iii) Formulate targeted strategies for improvement and develop a design framework that aligns with the expectations and needs of young users.

The contribution of this study lies in its application of post-occupancy evaluation (POE) in combination with interdisciplinary theories, such as Field Theory, Self-Determination Theory, and Universal Design principles. POE provides a systematic framework for assessing the gap between design intent and user satisfaction across a building's lifespan, generating feedback that informs future design and spatial optimization (Altomonte *et al.*, 2019; Preiser *et al.*, 2015). In contrast to prior research that has largely centered on museums or heritage parks, this work highlights the rural context of Chuanxi Halls while incorporating digital interactive design as an innovative analytical perspective.

This study advances existing scholarship in three key ways. First, it is among the few to apply POE to ethnic cultural transmission halls, moving beyond museum-centered research toward a community-based heritage context. Second, by integrating Self-Determination Theory and Field Theory into spatial analysis, the study introduces a novel interdisciplinary framework that links psychological motivation with environmental design. Third, the research combines quantitative and qualitative methods—including on-site behavioral observation and expert validation—to construct a "three-layer optimization model" that bridges theoretical insights and actionable design strategies. Together, these contributions enhance both the academic understanding and practical improvement of youth-oriented cultural spaces.

Previous research has employed various approaches for evaluating cultural space design, including the Analytic Hierarchy Process, satisfaction-based models, and geographic information system-based visualization methods (J. Wang, 2020; Wong & Aziz, 2020). Among these, POE has emerged as a particularly valuable approach, as it focuses on how spaces function and are experienced after being put into use (Al Mughairi *et al.*, 2023; Mundo-Hernández *et al.*, 2015). POE allows for the assessment of practical issues, including the effectiveness

of spatial organization, circulation efficiency, accessibility, and the role of social interaction in enhancing participation (Maslova & Burgess, 2023).

The present study adopts POE as its core framework while integrating multiple theoretical perspectives: Field Theory for analyzing behavior within spatial contexts, Self-Determination Theory for examining the roles of autonomy and social relatedness, and Universal Design for promoting inclusiveness. Together, these approaches provide a comprehensive set of evaluation dimensions that inform strategies to improve the design of cultural transmission halls, thereby offering both theoretical insights and practical guidance for future practice. As Hou (2023) observed, immersive exhibition design plays a vital role in transforming traditional displays into multisensory experiences that enhance emotional engagement and learning outcomes.

2. Research methodology

The POE framework was adopted as the core methodological approach because it enables a systematic assessment of how built environments perform in actual use, effectively bridging the gap between design intentions and user experiences (Vischer, 2001). This framework is particularly suitable for cultural and educational environments, where behavioral patterns and psychological responses are deeply influenced by spatial configurations. Within the context of Chuanxi Halls, POE provides a structured basis for connecting user satisfaction with spatial and functional performance, thereby supporting evidence-based design refinement. This approach aligns with Meirissa *et al.* (2021), who demonstrated that experience design in museum interiors can shape visitors' sensory perceptions and learning motivation. The research process followed a structured, three-phase POE-based framework encompassing preparation, evaluation, and optimization. In the preparation phase, theoretical constructs were established through a literature review and Delphi validation to ensure conceptual clarity and measurement reliability. The methodological foundation for this approach draws on early POE applications in museum settings (Chen, 2016), which demonstrated how post-occupancy insights can guide spatial refinement and visitor-centered evaluation. During the evaluation phase, on-site observations and user surveys were conducted to assess the spatial performance and user perceptions of eight ethnic cultural transmission halls. Finally, in the optimization phase, survey data, expert interviews, and field notes were triangulated to develop a three-layer spatial design model. This process was informed by the POE framework proposed by Xiao and Yoon (2024), which emphasizes iterative assessment and continuous feedback between design and user experience. The integration of POE into Building Information Modeling workflows has proven effective for performance tracking and iterative design (Dos Santos *et al.*, 2023), offering potential for future digital evaluation systems.

Building on this methodological foundation, the present study employs a mixed-methods design that integrates quantitative techniques (questionnaires) with qualitative approaches (observations and expert interviews). This integration enables a comprehensive and replicable evaluation of Chuanxi Hall's spatial design. The following sections detail the three research phases: (i) literature review and instrument development, (ii) data collection and analysis, and (iii) model construction and optimization.

2.1. Literature review and instrument development

The theoretical framework was constructed by integrating Field Theory, Self-Determination Theory, Universal Design, and Expected Utility Theory. The reference to Expected Utility Theory (Neumann & Morgenstern, 1944) provides a conceptual link between user satisfaction and rational preference optimization in design evaluation. This inclusive perspective aligns with Universal Design for Learning principles, which emphasize flexibility and differentiated accessibility for diverse users (Griful-Freixenet *et al.*, 2020). Following the principles of Self-Determination Theory, design strategies emphasizing autonomy and relatedness have been shown to improve sustained engagement (Cheng *et al.*, 2021), supporting their integration in participatory cultural spaces. From these perspectives, preliminary evaluation indicators were generated. To secure content validity, a Delphi process involving three rounds with five experts refined the items' structure and wording. Internal consistency was later tested using Cronbach's was later tested using Cronbach's alpha.

2.2. Data collection and analysis

The participants were young visitors aged 18–29 who had attended transmission halls between early 2024 and mid-2024. Ethical approval was obtained from the institutional review board, and informed consent was obtained from all respondents. Stratified sampling was adopted to balance gender and educational backgrounds. Of 330 distributed questionnaires, 312 completed and valid responses were obtained after screening. Items covered three aspects: spatial layout and circulation, social and activity spaces, and accessibility/supportive facilities.

Data analysis was performed using the Statistical Package for the Social Sciences (SPSS 25.0, IBM, United States), including descriptive statistics, correlations, and regression analyses. Correlation tests assessed potential

multicollinearity, while regression models identified predictors of youth satisfaction and engagement.

2.3. Model construction and optimization

Beyond survey data, on-site behavioral observations were conducted in eight halls to record circulation flows, use of interaction spaces, and accessibility barriers. Notes were triangulated with interviews from eight cultural experts to enrich interpretations. Findings informed an optimization framework, which outlined strategies for spatial refinement. Experts subsequently reviewed the framework to verify its feasibility and cultural appropriateness (Lin *et al.*, 2022).

3. Results

This section presents the empirical results derived from the quantitative survey, qualitative feedback, and field observations. The findings are presented descriptively without interpretive commentary.

3.1. Quantitative results

3.1.1. Reliability and validity

Following previous POE research that adopted data-driven dimension-reduction techniques to interpret complex user feedback (Kent *et al.*, 2021; Y. Zhu, 2016), exploratory factor analysis was applied to identify latent constructs that explain interrelations among spatial and experiential indicators. This approach provides a clearer understanding of the multidimensional factors that influence user satisfaction and alignment of expectations. All measurement dimensions achieved Cronbach's α values above 0.80, with an overall reliability coefficient of 0.863. As shown in Table 1, sampling adequacy was verified (Kaiser–Meyer–Olkin [KMO] = 0.740; Bartlett's test $p<0.05$), indicating suitability for factor analysis. Exploratory factor analysis yielded 10 factors with eigenvalues > 1, accounting for 86.825 percent of the total variance.

3.1.2. Model

Drawing on Field Theory, Self-Determination Theory, Universal Design, and Expectancy-Value perspectives, a POE-based framework was developed. Three clusters of predictors were assessed:

Table 1. Validity statistics

Statistical analysis		Value
KMO measure of sampling adequacy		0.740
Bartlett's test of sphericity	Chi-square	3590.094
	Degrees of freedom	210
	Significance	0.000

Abbreviation: KMO: Kaiser–Meyer–Olkin.

- Spatial planning (site placement, zoning, and circulation design)
- Social and activity spaces (autonomy, relatedness, competence support)
- Accessibility and amenities (barrier-free routes, facility adequacy, signage, and navigation).

The outcome variable was expectation alignment, reflecting how closely actual experiences matched initial expectations and satisfaction levels. Figure 1 illustrates the hypothesized relationships among these dimensions, and three hypotheses were formulated in this study:

- H_1: Spatial layout and circulation design have a positive impact on users' expectation confirmation
- H_2: Social space and activity design positively influence users' expectation confirmation.
- H_3: Accessibility and supporting facilities have a positive impact on users' expectation confirmation.

3.1.3. Data collection and statistical findings

The questionnaire included three dimensions, nine constructs, and 18 indicators, measured with a five-point Likert scale. Reliability and validity were confirmed (Cronbach's $\alpha = 0.86$; KMO = 0.74; Bartlett's $p<0.05$). Using stratified sampling across eight transmission halls, 330 surveys were distributed, and 312 responses were retained. Participants were aged 18–29, familiar with ethnic crafts, and balanced in gender and education. SPSS analysis included descriptive, correlation, and regression tests. Descriptive results show respondents lived nearby (62% within walking distance) and visited occasionally (56% reported 1–5 visits). The main motivations were workshops and craft learning (80% combined). Correlation and multiple regression analyses were performed following standard statistical procedures (Field, 2018; Pallant, 2020; Vietze *et al.*, 2019) to examine the relationships between spatial, social, and accessibility dimensions and expectation alignment. Pearson's correlation coefficient indicated that all three dimensions—layout, social interaction, and accessibility—were positively related to expectation alignment ($0.17 \leq r < 0.36$, $p<0.01$). Regression analysis further demonstrated that site selection, zoning, autonomy support, competence building, and signage systems were significant predictors, whereas convenient facilities exhibited a weaker influence.

Percentages are calculated based on the total number of valid responses ($n = 312$). Most participants were students (89.1%) and early-career professionals (10.9%). Values are rounded to one decimal place. Table 2 summarizes participants' familiarity with ethnic culture, residential proximity, visit frequency, and the primary purpose of their visit.

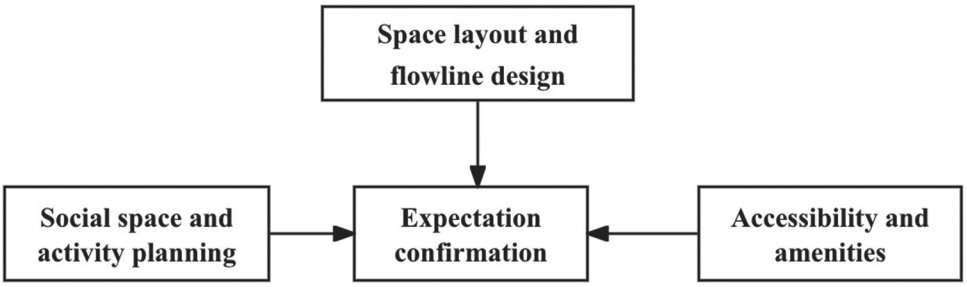

Figure 1. Post-occupancy evaluation-based model
Source: Diagram by the authors.

Table 2. Descriptive statistics of demographic variables (*n*=312)

Variable	Category	*n*	%
Ethnic culture	Very familiar	144	43.4
	Quite familiar	176	53.0
	Somewhat familiar	8	2.4
	Slightly familiar	4	1.2
Residential area	Very close (within walking distance)	206	62.0
	Quite close (reachable by bicycle)	99	29.8
	Quite far (reachable by car or public transport)	17	5.1
	Very far (requires long-distance travel)	10	3.0
Frequency of visiting the Chuanxi Hall	1–5 times	187	56.3
	6–10 times	134	40.4
	More than 10 times	11	3.3
Purpose of visit	Learning arts and crafts	120	36.1
	Participating in activities or workshops	146	44.0
	Sightseeing	49	14.8
	Socializing or leisure	10	3.0
	Others	7	2.1

3.1.4. Correlation and regression analysis

Pearson's correlation coefficients were computed among the nine constructs (Table 3). All correlations were positive and significant ($p<0.01$).

Multiple linear regressions were conducted for each predictor group. Spatial-layout variables explained 12.4 percent of the variance (Adjusted $R^2 = 0.124$; $F = 16.579$; $p<0.01$). Social-activity variables accounted for 12.3 percent (Adjusted $R^2 = 0.123$; $F = 16.514$; $p<0.01$). Accessibility variables explained 18.6 percent (Adjusted $R^2 = 0.186$; $F = 26.176$; $p<0.01$). These findings parallel zoning dilemmas observed in world heritage sites, where preservation goals often conflict with urban development pressures (Jones *et al.*, 2020). Detailed coefficients are shown in Tables 4-6.

Table 4 presents the multiple linear regression analysis of spatial-layout variables, namely site selection, functional zoning and layout, and traffic-flow lines, as predictors of expectation confirmation. The model explained 12.4 percent of the variance (adjusted $R^2 = 0.124$) and was statistically significant ($F = 16.579$, $p<0.01$). The regression equation is shown in Equation (1).

$$\textit{Expectation confirmation} = 4.265+(0.311 \times \textit{Site selection}) + (0.247 \times \textit{Functional zoning and layout}) + (0.184 \times \textit{Traffic-flow lines}) \quad (1)$$

All three predictors had significant positive effects on expectation confirmation ($p<0.05$), supporting hypothesis H_1.

Table 5 presents a multiple linear regression analysis with autonomy support, sense of competence, and enhanced connectedness as predictors of expectation confirmation. The model, with an R^2 of 0.123, explains 12.3 percent of the variance and passed the F-test ($F = 16.514$, $p<0.01$), indicating a significant relationship. The regression equation is shown in Equation (2).

$$\textit{Expectation confirmation} = 4.331 + (0.212 \times \textit{Autonomy support}) + (0.365 \times \textit{Sense of competence}) + (0.148 \times \textit{Enhanced connectedness}) \quad (2)$$

All predictors significantly impact expectation confirmation ($p<0.05$), supporting hypothesis H_2.

Table 6 shows a multiple linear regression analysis with accessible pathways, facility configuration, information signage, and wayfinding systems as predictors of expectation confirmation. The model, with an R^2 of 0.186, explains 18.6 percent of the variance and passed the F-test ($F = 26.176$, $p<0.01$), indicating a significant relationship. The regression equation is shown in Equation (3).

$$\textit{Expectation confirmation} = 3.979 + (0.336 \times \textit{Accessible pathways}) + (0.065 \times \textit{Facility configuration}) + (0.402 \times \textit{Information signage and wayfinding systems}) \quad (3)$$

All predictors, except facility configuration, significantly affect expectation confirmation ($p<0.05$), supporting hypothesis H_3.

Table 3. Pearson's correlation efficiency matrix

Variables	1	2	3	4	5	6	7	8	9
1. Site selection	1.000								
2. Functional partitioning and layout	0.219**	1.000							
3. Traffic-flow lines	0.149**	0.144**	1.000						
4. Autonomy support	0.246**	0.297**	0.111*	1.000					
5. Improved sense of ability	0.261**	0.326**	0.112*	0.287**	1.000				
6. Enhancement of relatedness	0.206**	0.216**	0.178**	0.212**	0.152**	1.000			
7. Accessible pathways and routes	0.263**	0.170**	0.137*	0.318**	0.225**	0.257**	1.000		
8. Convenient facilities configuration	0.308**	0.207**	0.194**	0.276**	0.252**	0.201**	0.235**	1.000	
9. Information signage and wayfinding systems	0.306**	0.292**	0.130*	0.325**	0.345**	0.225**	0.260**	0.232**	1.000
10. Expectation confirmation	0.280**	0.249**	0.189**	0.242**	0.308**	0.174**	0.179**	0.327**	0.358**

Note: *p<0.05, **p<0.01. The variables shown in the columns correspond to those listed in the rows.

Table 4. Multiple linear regression analysis of spatial-layout variables predicting expectation confirmation

Variables	Unstandardized coefficients		Standardized coefficients	t	p
	B	Standard error	β		
Constant	4.265	0.642		6.641	0.000
Site selection	0.311	0.075	0.221	4.165	0.000
Functional zoning and layout	0.247	0.072	0.181	3.415	0.001
Traffic-flow lines	0.184	0.074	0.130	2.480	0.014
Adjusted R^2			0.124		
F			16.579**		

Notes: **p<0.01; Dependent variable: Expectation confirmation.

Table 5. Multiple linear regression analysis of social-activity variables predicting expectation confirmation

Variables	Unstandardized coefficients		Standardized coefficients	t	p
	B	Standard error	β		
Constant	4.331	0.646		6.703	0.000
Autonomy support	0.212	0.078	0.149	2.724	0.007
Sense of competence increases	0.365	0.079	0.250	4.625	0.000
Enhancement of relatedness	0.148	0.075	0.105	1.979	0.049
Adjusted R^2			0.123		
F			16.514**		

Notes: **p<0.01; Dependent variable: Expectation confirmation.

Table 6. Multiple linear regression analysis of accessibility variables predicting expectation confirmation

Variables	Unstandardized coefficients		Standardized coefficients	t	p
	B	Standard error	β		
Constant	3.979	0.581		6.845	0.000
Accessible paths and routes	0.336	0.070	0.249	4.806	0.000
Facility configuration	0.065	0.075	0.046	0.872	0.384
Information signage and navigation system	0.402	0.073	0.289	5.527	0.000
Adjust R^2			0.186		
F			26.176**		

Notes: **p<0.01; Dependent variable: Expectation confirmation.

3.2. Qualitative and observational results

3.2.1. Interview findings

Open-ended interview data were thematically coded to identify recurring categories of spatial, social, and accessibility factors. Table 7 summarizes the coded responses. Respondents generally preferred halls located in culturally concentrated areas and noted variations in transportation convenience between rural and urban sites. Participants also mentioned issues related to functional zoning, circulation congestion, skill development opportunities, and the insufficiency of barrier-free facilities.

3.2.2. Observational findings

Direct observations were conducted in eight halls, including 30 youth participants. This method reduced self-report bias and provided behavioral insights into circulation,

Table 7. Interview results statistics

Level 2 indicators	Level 3 indicators	Feedback ratio (%)	
		Rural cultural exchange center	Urban cultural exchange center
Site selection	SL1. The location of the cultural exchange center in a culturally concentrated area promotes enthusiasm for learning.	68.5	33.0
	SL2. The site selection of the cultural exchange center considers environmental and traffic convenience.	45.0	89.0
Functional partitioning and layout	SL3. The functional zoning design is reasonable and meets various functional needs.	21.0	46.0
	SL4. The spatial layout of the cultural exchange center is rationalized, optimizing space utilization efficiency.	15.0	30.0
Traffic-flow lines	SL5. The traffic-flow design of the cultural exchange center is reasonable and avoids congestion.	12.0	31.0
	SL6. The traffic-flow design effectively guides pedestrian movement.	17.0	32.0
Autonomy support	SS1. The social space of the cultural exchange center supports individual autonomy in activities.	51.0	57.0
	SS2. The social space design of the cultural exchange center encourages individual interaction.	45.0	34.0
Enhancement of relatedness	SS3. Activities in the cultural exchange center help participants establish connections.	80.0	66.0
	SS4. The arrangement of activities enhances participants' sense of belonging to the group.	53.0	78.0
Improved sense of ability	SS5. The event planning of the cultural exchange center has developed my organizational skills.	46.0	48.0
	SS6. The design of the cultural exchange center supports my skill development.	33.0	30.0
Accessible pathways and routes	AA1. The design of accessible pathways increases convenience for use.	48.0	47.0
	AA2. The layout of accessible pathways meets the needs of different purposes.	36.0	37.0
Convenient facilities configuration	AA3. Convenient amenities configuration meets basic usage needs.	23.0	35.0
	AA4. The configuration of convenient facilities adequately covers key areas of the cultural exchange center.	20	30
Information signage and wayfinding systems	AA5. The signage system of the cultural exchange center is clear and easy to understand.	37.0	31.0
	AA6. The navigation system of the cultural exchange center helps users quickly find the facilities they need.	18.0	34.0

Abbreviations: AA: Accessibility and amenities; SL: Site selection/spatial layout; SS: Social space and activity planning.

social interaction, and facility usage. The collected data and results are shown in Table 8, revealing that:

- Spatial layout: 75 percent of halls lacked clear zoning, leading to inefficient use of areas
- Circulation: Narrow corridors often caused congestion during peak hours
- Social spaces: Activities attracted limited voluntary engagement, requiring external guidance
- Accessibility: 87.5 percent of sites had design flaws in barrier-free routes
- Facilities: Rest areas and signage were incomplete or unclear, making navigation difficult.

3.3. Observational findings

The observations revealed distinct variations among the eight surveyed Chuanxi Halls in terms of location, functional zoning, and circulation design. Halls with rural cultural origins generally had limited transportation access, whereas those in urban areas had relatively higher accessibility. Functional zoning varied across cases, with several sites showing unclear boundaries between learning, social, and resting zones. Circulation routes also differed considerably; in multiple halls, narrow or intersecting pathways were observed, causing temporary congestion during peak hours (Figure 2A and B).

Regarding accessibility, 87.5 percent of the observed halls presented incomplete barrier-free provisions, and three-quarters lacked adequate supportive facilities. In addition, signage and wayfinding systems were often inconsistent or missing, hindering visitors' navigation. These findings collectively summarize the spatial characteristics and facility conditions documented during the field observation phase.

The design of an ethnic cultural transmission hall can be guided by the following essential components:

(i) Three-layer structural framework: cultural learning, social interaction, and supportive accessibility. Based on the quantitative and qualitative findings, a three-layer spatial hierarchy for Chuanxi Hall design was

Table 8. Observational data collection and analysis

Dimension	Variable	Specific behavioral observations	Result
Space layout and flowline design	Site selection	SL1. Site selection and transportation conditions	(i) 62.5 percent of the Chuanxi Halls are located in rural areas, which are the birthplace of ethnic culture, but transportation is inconvenient (ii) 37.5 percent of the Chuanxi Halls are located in urban areas, where transportation is convenient
	Functional partitioning and layout	SL2. Youth activities in different zones, such as crafting behaviors in the learning area or interactions in the social area	(i) 75 percent of the Chuanxi Halls have incomplete functional zoning, with unclear divisions between learning, social, and rest areas (ii) The space utilization efficiency is low (iii) Young people's willingness to participate in activities is low
	Traffic-flow lines	SL3. The movement patterns of youth in the hall, including the presence of congestion or preference for certain paths	The main corridors of Chuanxi Halls experience congestion Young people prefer specific pathways
Social space and activity planning	Autonomy support	SS1. Youth's engagement in activities and how they exhibit independence in these activities	(i) 83 percent of young people are not actively inclined to participate in activities and need guidance (ii) The activities lack sufficient attractiveness
	Enhancement of relatedness	SS2. Youth's formation of new connections and strengthening of social relationships through the activities	(i) Young people have established some connections through activities (ii) It has strengthened social relationships
	Improved sense of ability	SS3. Youth's involvement in planning activities and demonstration of their skills during activities, such as improvements in organizational skills	(i) The activities do not sufficiently cultivate participants' subjective initiative (ii) The enhancement of organizational skills is not prominent enough
Accessibility and amenities	Accessible pathways and routes	AA 1. Use of barrier-free passages and difficulties in passing through	(i) 87.5 percent of the Chuanxi Halls have issues with the design of accessible pathways (ii) Young people encounter certain difficulties during use
	Convenient facilities configuration	AA 2. Availability of facilities in public spaces, such as rest areas and toilets	(i) 75 percent of the Chuanxi Halls have incomplete convenient facilities (ii) The facility layout is unreasonable
	Information signage and wayfinding systems	AA3. Clarity of signage and the navigation system for spaces or facilities	(i) All Chuanxi Halls exhibit varying degrees of inaccurate or unclear directional signage and wayfinding systems, and some even lack signage entirely (ii) Youth have difficulty locating convenient facilities and equipment

Abbreviations: AA: Accessibility and amenities; SL: Site selection/spatial layout; SS: Social space and activity planning.

Figure 2. Main passage and exit of the training hall. (A) The main passage. (B) The exit area of the passage.
Source: Photos by the authors (2024).

established. As shown in Table 9, the framework consists of a core layer dedicated to cultural learning and craft training, an interaction layer that fosters social engagement and belonging, and a supporting layer that ensures accessibility and comfort.

(ii) Circulation organization optimization: a combination of main and auxiliary circulation. The design optimizes circulation through a combination of main circulation connecting core functional areas and auxiliary circulation subdividing different areas to reduce crowding (Table 10).

(iii) Dual-mode learning system: static teaching and dynamic experience. The model combines static teaching for knowledge input and dynamic experience for interactive and immersive activities to enhance learning (Table 11).

(iv) Interaction methods: social interaction optimization strategy. The model enhances social interaction through immersive experiences, open discussions, and online communities, thereby promoting cultural exchange and community engagement (Table 12).

(v) Barrier-free and convenience facilities optimization. The model ensures accessibility and comfort by providing accessible pathways, smart navigation systems, and convenient facilities such as themed rest areas and accessible restrooms (Table 13).

Table 9. Three layers of the theoretical model of the Chuanxi Hall

Spatial hierarchy	Main functions
Core layer: cultural learning area	Knowledge transfer and skills training
Interaction layer: social interaction area	Promote community connections and enhance a sense of belonging
Supporting layer: accessibility and convenient facilities	Ensure accessibility and comfort

Table 10. Schematic of circulation organization optimization

Type of traffic flow	Effect
Main circulation	Connect the core functional areas
Auxiliary circulation	Subdivide different areas

Table 11. Schematic of learning mode content

Learning mode	Main features
Static teaching	Primarily knowledge input
Dynamic experience	Primarily practice exploration

Table 12. Schematic of interaction method optimization

Interaction methods	Objectives	Specific strategies
Immersive interaction	Enhance cultural experience	Craft and art experience hall, immersive exhibitions, handicraft displays
Open discussion	Promote knowledge exchange	Discussion corners, interactive display walls, cultural salons
Online community	Extend learning space	Online forums, live streaming, virtual learning spaces

Table 13. Schematic of facility and accessibility optimization

Facility type	Goal	Specific optimization measures
Accessible pathway	Ensure accessibility for all	Install elevators, ramps, and accessible entrances
Smart navigation system	Improve spatial recognition	Multilingual signage, app navigation
Convenient facilities	Enhance comfort	Cultural-themed rest areas, accessible restrooms, relaxation library

4. Discussion and theoretical implications

The observed inconsistencies in zoning, circulation, and accessibility indicate underlying design limitations that affect spatial efficiency and user experience. These findings suggest that the physical configuration of Chuanxi Halls plays a crucial role in shaping youth engagement. Previous POE-based research in cultural and educational environments has emphasized that spatial configuration, user autonomy, and accessibility jointly shape users' satisfaction and engagement (J. Zhu & Ling, 2022; Kim & Kwon, 2020; Mosca & Capolongo, 2020; Vischer, 2001). These insights provide theoretical grounding for interpreting this study's results, highlighting how spatial planning, social interaction, and inclusiveness collectively contribute to the optimization of Chuanxi Hall design. Building on the survey and observation findings, this section interprets the empirical results and presents a theoretical model to optimize the design of Chuanxi Hall. The model integrates three dimensions—spatial planning, social interaction, and accessibility—drawing on Field Theory, Self-Determination Theory, and Universal Design. It aims to balance cultural transmission with user experience, particularly among young participants. The integration of Field Theory also aligns with Ni and Ji (2013), highlighting how spatial organization reflects underlying social and symbolic power structures within cultural fields (Ni & Ji, 2013).

4.1. Model development and interpretation

The model was constructed through an iterative process integrating quantitative and qualitative evidence:

- Preliminary model: A three-layer structure was proposed: (i) a core layer for cultural learning and craft training, (ii) an interaction layer for social exchange and knowledge sharing, and (iii) a supporting layer for accessibility and comfort.
- Expert feedback: Six specialists in craft education, spatial design, and cultural studies reviewed the framework and suggested clearer zoning between teaching and exhibition areas, non-overlapping circulation routes, autonomy-supportive workshops, and immersive digital experiences.
- Refined model: After three iterative revisions, the final version incorporated modular learning areas, dual circulation systems, immersive activities, and barrier-free facilities to form an optimized design model for ethnic cultural halls.

4.2. Core dimensions and design strategies

As shown in Figure 3, the final Preferences–Chuanxi Hall–Spatial/Social/Universal design (P–C–SSU) model synthesizes empirical results and theoretical insight. It

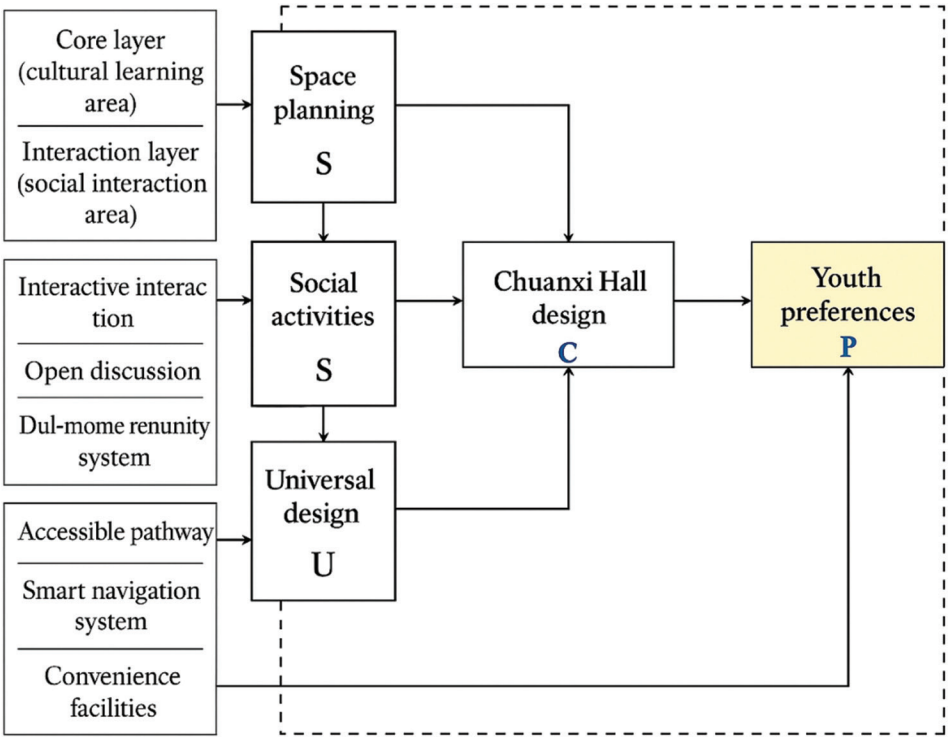

Figure 3. Preferences–Chuanxi Hall–Spatial/Social/Universal design theory model for the design of the ethnic culture inheritance hall
Source: Diagram by the authors.

emphasizes not only cultural preservation but also youth participation and satisfaction:

- Space planning: Modular learning areas and dual circulation (primary vs. secondary routes) improve movement efficiency and reduce congestion
- Social activities: Immersive exhibitions, interactive workshops, and online communities foster relatedness and sustained engagement
- Universal design: Multilingual signage, barrier-free pathways, and inclusive facilities improve usability and comfort.

4.3. Theoretical integration

The P–C–SSU model reflects a cross-disciplinary synthesis: Based on Field Theory, it interprets user behavior as context-dependent and spatially situated (Peponis, 2024). Regarding Self-Determination Theory, it highlights autonomy, competence, and relatedness as psychological needs met through spatial and social design. Universal Design ensures accessibility and inclusiveness as core design values. This integration demonstrates that effective cultural hall design must move beyond aesthetic or functional goals toward motivational, experiential, and inclusive dimensions that promote long-term participation and intergenerational transmission.

4.4. Practical implications

This model provides actionable design guidance for future Chuanxi Hall projects: Adopt dual circulation systems to optimize flow and reduce congestion. Integrate three spatial layers to balance learning, interaction, and support. Incorporate digital and immersive experiences to engage younger generations. Recent studies also indicate that immersive virtual exhibitions can significantly enhance cultural engagement and user experience among younger audiences (Wang *et al.*, 2024). Ensure inclusive design with barrier-free routes and clear signage (Patrick & Hollenbeck, 2021). Through these strategies, Chuanxi Halls can evolve into participatory environments that support intergenerational cultural transmission.

5. Conclusion

The study demonstrates that locating Chuanxi Halls near culturally significant areas enhances both accessibility and authenticity, allowing visitors to experience cultural heritage within its original social and environmental context. Dual-circulation layouts have been shown to improve space efficiency, alleviate congestion, and promote smoother visitor movement, thereby enhancing the overall sense of spatial order and comfort (Ryan

et al., 2014). The proposed three-tier spatial hierarchy—encompassing cultural learning, social interaction, and supportive facilities—proved effective in reinforcing the functional and experiential depth of these spaces. Moreover, immersive exhibitions and hybrid online–offline communities encourage sustained engagement and emotional connection among younger visitors, thereby revitalizing traditional crafts through participatory experience and collective identity (Strange & Banning, 2015). This result is consistent with Chan *et al.* (2024), who found that revitalized heritage buildings can foster place attachment and cultural identity through immersive participation and emotional connection. Inclusive and barrier-free design is essential to ensuring equitable access, aligning with universal design principles that value diversity, autonomy, and social inclusion.

By integrating these findings, the P–C–SSU model provides both theoretical and practical contributions to the optimization of ethnic cultural transmission halls. Theoretically, it bridges environmental psychology, cultural heritage studies, and spatial design by framing user experience as a dynamic interaction between spatial form and psychological needs. Practically, it offers a replicable design strategy for balancing educational, social, and accessibility goals in community-based cultural venues. Ultimately, this study extends the scope of POE beyond its conventional architectural applications, demonstrating its potential as a reflective, evidence-based approach for sustaining ICH through participatory spatial design.

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Conflict of interest

The authors declare that they have no competing interests.

Author contributions

Conceptualization: Xingcan Zhao
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Ethics approval and consent to participate

This study was reviewed and approved by the Institutional Review Board of Naresuan University in 2024 (IRB No. P2-0355-2567). Informed consent was obtained from all participants before data collection.

Consent for publication

All participants provided informed consent for the publication of the findings derived from this study. Where applicable, participants gave explicit permission for the publication of any data, images, or information that could potentially reveal their identity. The authors affirm that all relevant consent forms have been obtained and are available upon request.

Availability of data

The datasets generated and analyzed during the current study are not publicly available due to ethical restrictions and institutional policies regarding student privacy. However, anonymized data and relevant supporting materials may be provided upon reasonable request to the corresponding authors, subject to approval by the institutional review board of Naresuan University. Please contact the authors for further details.

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