

ORIGINAL ARTICLE

Canal culture integration in canal-side urban squares: Comparative evidence from Qinzhou, China

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Abstract

Canal-side public spaces are increasingly expected to translate canal heritage and contemporary canal development into everyday urban experience. This study investigates the effectiveness of canal culture integration in urban squares along the Pinglu Canal corridor in Qinzhou, Guangxi, China, and examines how such spaces can carry canal-related cultural expression into everyday public life within the context of canal-side public space development. Based on a preliminary survey of seven canal-side squares in the urban area of Qinzhou, Yongfu Square and Tingyin Square were selected as representative cases for comparative analysis. Both squares provide leisure and public service functions, but they differ substantially in spatial scale, environmental quality, and modes of cultural display. The study combined field observation with a structured questionnaire survey. A total of 127 valid responses were analyzed through descriptive statistics and between-group tests across four dimensions: cultural identity, perceived value, experience quality, and public use. The results indicate that public recognition of canal-themed cultural content remains generally weak in both squares, suggesting that the existing cultural symbols have not yet achieved sufficient readability in everyday use. At the same time, the two cases showed differences in selected dimensions. Yongfu Square showed stronger performance in cultural value, experience-quality indicators, and willingness to participate. These findings suggest that canal culture integration in daily-use public spaces requires attention to cultural readability, spatial quality, and everyday usability, and they provide case-based empirical support for the renewal of comparable canal-side public spaces in Qinzhou.

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1. Introduction

Urban public spaces not only accommodate everyday leisure, social interaction, and public activities but also serve as important arenas through which local cultural memory, urban identity, and social ties are continuously reproduced (Carmona, 2021; Mehta, 2014). The quality of such spaces shapes patterns of staying, interaction, and intensity of use, while also affecting whether cultural information can be effectively perceived and understood

in everyday life (Carmona, 2021; Ma *et al.*, 2023; Varna & Tiesdell, 2010). For canal cities characterized by linear heritage, canal-side squares and waterfront public spaces assume an additional role in linking historical waterway heritage with contemporary urban life. The effectiveness of their cultural expression directly influences how canal heritage values are sustained and translated within urban space (Chen *et al.*, 2021; Zhang, Liu, Pei, Chan, Wang, & Meng, 2023).

Qinzhou in China provides a meaningful urban context for examining this issue. As an important node city in southeastern Guangxi, Qinzhou is connected both to the historical trajectory of the Maritime Silk Road and to new opportunities for spatial restructuring associated with the ongoing development of the Pinglu Canal, China's first strategic river-sea transport canal linking the inland waterway trunk line with the Beibu Gulf International Hub Port (Feng *et al.*, 2025). As the Pinglu Canal project advances, canal-side public spaces are no longer merely open venues for general activities, but are increasingly becoming key interfaces through which canal culture enters everyday urban life (Ye Li & Gu, 2024). International discussions of canal and waterway heritage usually understand canals as cultural landscapes shaped by engineering infrastructure, urban planning, water transport, local memory, technical skills, and everyday use (Inland Waterways Association, 2021; UNESCO World Heritage Centre, n.d.). This view is also consistent with heritage-conservation principles that treat infrastructure, landscape, technical knowledge, and social use as interconnected components of heritage value (ICOMOS & TICCIH, 2011). Drawing on this understanding, this study defines canal culture as the cultural meanings associated with the Pinglu Canal and Qinzhou's canal-side urban environment. It includes historical waterfront memory, contemporary canal development, and everyday cultural expression in public space. Historical waterfront memory covers Qinzhou's maritime connections, old-city remains, and local historical figures. Contemporary canal development concerns the spatial narrative produced by the Pinglu Canal and its role in reshaping the city's canal-side public interface. Everyday cultural expression includes signs, landscape elements, commemorative settings, craft-related references, and public activities through which users encounter canal-related meanings in daily use. This definition ties canal culture to the specific urban and spatial context of Qinzhou and avoids treating it as a general or abstract heritage category. Within the system of canal-side public spaces in urban Qinzhou, seven canal-side squares constitute the broader observation scope of this study, while Yongfu Square and Tingyin Square are selected as the two core cases for focused comparison. Both squares

perform daily leisure and public service functions, but they differ in spatial scale, cultural association, environmental conditions, and modes of cultural display.

Existing studies have shown that the effectiveness of cultural heritage conservation, urban renewal, and public space governance depends not only on physical improvement or symbolic display but also on whether users develop cultural recognition, value identification, and willingness to participate through everyday use (Foroughi *et al.*, 2023; J. Li *et al.*, 2020). In settings where heritage space overlaps with everyday living space, public perception, spatial experience, and user satisfaction are closely interconnected. The authenticity, readability, and environmental quality conveyed through space directly affect both the communicative performance of culture and the sustained value of continued use (Dai *et al.*, 2021; Gao *et al.*, 2022). This issue is particularly significant for canal-side urban squares because such spaces must support the expression of local culture while also accommodating frequent, routine, and open-ended public use.

However, existing discussions of canal-related urban squares have focused mainly on modes of cultural display, design principles, or interpretations of heritage value (Zhu *et al.*, 2025). Empirical evidence remains limited on how canal culture is actually perceived in everyday use and on how such perception is associated with experience quality, perceived value, and public use. This limitation is especially evident in newly built or rapidly restructured canal-city spaces, where the installation of cultural symbols does not necessarily produce spatial experiences that are recognizable, understandable, or engaging for users. A clear gap therefore emerges between culture being placed in space and culture being effectively perceived by the public (L. Li & Wang, 2025; Zhang, Liu, Pei, Chan, Wang, & Meng, 2023). Against this background, comparative research based on actual use contexts is needed to assess the practical effectiveness of canal culture integration in canal-side urban squares, rather than relying on design intentions or conceptual claims alone (Bernabeu-Bautista *et al.*, 2023).

In response to this issue, the present study used seven canal-side squares in urban Qinzhou as the broader research context and selected Yongfu Square and Tingyin Square as the core cases. By combining field observation with a structured questionnaire survey, the study analyzed 127 valid responses and compared the 2 cases across 4 dimensions: cultural identity, perceived value, experience quality, and public use. The study aims to identify the practical limitations of canal culture expression in Qinzhou's canal-side urban squares, compare how cultural integration is perceived under different spatial conditions,

and provide case-based empirical support for the renewal of public spaces along the canal corridor in Qinzhou.

2. Study area and research methods

2.1. Scope of research and case selection

This study used the canal-side public space system in urban Qinzhou as its overall research context. As construction of the Pinglu Canal continues, public spaces along both sides of the canal are gradually becoming important interfaces through which canal culture enters everyday urban life. Their function is no longer limited to that of general open activity spaces, but has increasingly expanded to include cultural display, spatial recognition, and public interaction (Cheshmehzangi & Tang, 2022; Zhang, Liu, Pei, Chan, Gao, & Meng, 2023). Based on a preliminary field investigation, this study included seven canal-side squares in urban Qinzhou within the overall scope of observation to understand the broader conditions of canal culture expression in canal-side public spaces. These seven squares include Jinxi Square, Song Dynasty City Wall Relics Square, Yongfu Square, Martyrs' Memorial Square, Youth Square, Tingyin Square, and Xianyin Square. Their spatial distribution is shown in Figure 1, and their basic characteristics are summarized in Table 1.

On the basis of this broader observation, Yongfu Square and Tingyin Square were selected as the core cases for in-depth comparison. Both squares are situated within the relevant public space system of Qinzhou's urban canal corridor and provide urban leisure and public service functions, making them comparable as daily-use public squares. At the same time, they differ clearly in cultural association, spatial scale, environmental conditions, and modes of cultural display. Yongfu Square is associated with Liu Yongfu (1837–1917) and local historical memory, whereas Tingyin Square is closely related to the Gulong Kiln context and Qinzhou Nixing pottery culture. This combination of functional comparability and cultural-spatial contrast gives the two cases strong comparative value. The seven squares were used to define the broader observation scope rather than to form a full quantitative sample. They differ in spatial scale, public function, cultural association, facility condition, and modes of cultural display. Including all seven sites in the same quantitative comparison would have increased site heterogeneity and reduced the comparability required for a focused case study. Accordingly, the findings should be understood as case-based comparative evidence rather than as a statistical generalization to all canal-side public spaces in Qinzhou. Existing studies have shown that case selection in public space research should ensure consistency in basic functions

while preserving differences in spatial conditions and use patterns, thereby enabling more effective identification of the key factors shaping spatial performance (Carmona, 2021; Ma *et al.*, 2023).

2.2. Overview of the study area

Qinzhou is located in southeastern Guangxi and is historically associated with the Maritime Silk Road. With the advancement of the Pinglu Canal project, the city has acquired renewed significance in regional spatial development (Cheshmehzangi & Tang, 2022; Feng *et al.*, 2025). Against this background, canal-side urban squares have become important places where cultural display and public life overlap.

Yongfu Square covers approximately 12,000 sqm and is associated with Liu Yongfu and local historical memory, whereas Tingyin Square covers approximately 4,000 sqm and is connected with the Gulong Kiln context and Qinzhou Nixing pottery culture. Both are situated within the relevant public space system of Qinzhou's urban section, yet they differ in spatial scale, cultural association, and environmental conditions. These differences provide a useful basis for case-based comparison, but they are treated as site conditions rather than as direct explanations of cultural integration effectiveness.

Based on existing site information and preliminary field observations, both squares contain cultural or site-specific elements related to local history and canal-side public life. However, the visibility, readability, and everyday use of these elements differ between the two sites. These conditions provide a practical basis for examining how canal-related cultural content is perceived in daily-use public spaces.

2.3. Research design and data collection

This study adopted a comparative case study design and combined field observation with a structured questionnaire survey. A comparative case study is suitable for identifying both shared problems and differentiated characteristics across cases that belong to the same general type while varying in specific spatial conditions, and is therefore appropriate for examining the relationships among cultural expression, spatial experience, and public use (Yin, 2018). The empirical comparison therefore focused on Yongfu Square and Tingyin Square, two daily-use squares with comparable public functions but different cultural associations and spatial conditions. Field observation was conducted on Wednesday, Friday, Saturday, and Sunday, covering three daily time periods: 8:00–9:00, 14:00–15:00, and 18:00–19:00. This schedule was designed to include both weekday and weekend use

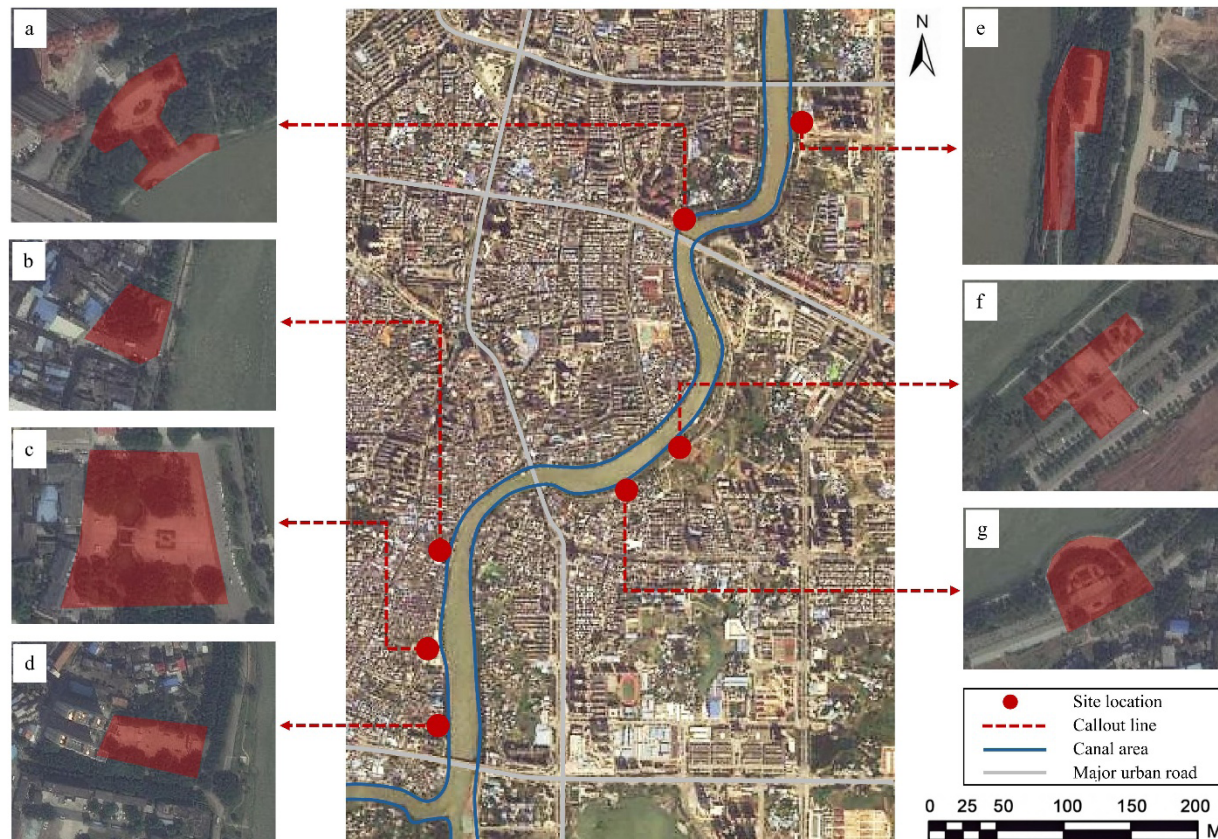


Figure 1. Spatial distribution of the seven canal-side squares and the two selected core cases in urban Qinzhou. (a) Jinxi Square. (b) Song Dynasty City Wall Relics Square. (c) Yongfu Square. (d) Martyrs' Memorial Square. (e) Youth Square. (f) Tingyin Square. (g) Xianyin Square. Source: Base map from Google Earth, site annotations and diagram by the authors

and to capture variations in morning, afternoon, and evening activity patterns. During each observation period, the study recorded activity types, staying patterns, facility use, distribution of cultural elements, and forms of spatial interaction in the two squares. Compared with relying solely on questionnaire results, field observation provides contextual support by capturing behavioral patterns in real-world situations (Gehl & Svarre, 2013). In this study, the observation records were used as contextual material for interpreting the questionnaire results, especially in relation to cultural display, spatial use, and environmental conditions.

For the questionnaire survey, the study employed on-site convenience intercept sampling, a non-probability sampling approach, to distribute structured questionnaires to residents and visitors engaged in activities in the two squares and their surrounding areas at the time of the

survey. A total of 150 questionnaires were distributed. After invalid responses were excluded, 127 valid questionnaires were obtained, including 65 from Yongfu Square and 62 from Tingyin Square, serving as the basic dataset for the subsequent comparative analysis.

The basic characteristics of respondents from the two survey sites are summarized in Table 2. Respondent characteristics were recorded using the predefined categories in the questionnaire, including gender, age group, residence status, visit purpose, and prior knowledge of the Pinglu Canal.

The two respondent groups showed no statistically significant differences in gender, age group, residence status, visit purpose, and prior knowledge of the Pinglu Canal. Most respondents in both squares reported prior knowledge of the Pinglu Canal, but this prior knowledge did not differ significantly between the two survey sites.

Table 1. Basic characteristics of the seven canal-side squares in urban Qinzhou

Square	Approx. area	Function/spatial type	Cultural association
Jinxi Square	4,300 sqm	Neighborhood leisure and daily open-space use	General canal-side public-space use
Song Dynasty City Wall Relics Square	2,500 sqm	Heritage viewing and short-term staying	Song Dynasty city wall remains and old-city memory
Yongfu Square	12,000 sqm	Urban leisure, public gathering, and public service use	Liu Yongfu and local historical memory
Martyrs' Memorial Square	3,000 sqm	Commemorative and public education space	Revolutionary memory and commemorative culture
Youth Square	4,200 sqm	Daily recreation and community activity	Contemporary urban leisure culture
Tingyin Square	4,000 sqm	Daily leisure, cultural viewing, and community use	Gulong Kiln context and Qinzhou Nixing pottery culture
Xianyin Square	3,700 sqm	Waterfront leisure and daily open-space use	General canal-side public-space use

Notes: The information is based on preliminary field observation and site interpretation. The areas of Yongfu Square and Tingyin Square are reported according to the study's field records

This indicates that respondents from Yongfu Square and Tingyin Square were broadly comparable in their basic demographic and visit-related characteristics. Given the use of convenience intercept sampling, this comparability is understood at the sample level and is not used to claim population-level representativeness.

The purpose of the questionnaire survey was not to construct a causal model, but to identify the public's basic judgments of canal culture expression, spatial experience, and public use, and to compare the two cases across these dimensions. Given the use of a non-probability sample, the findings are intended to support case-based comparison rather than statistical generalization to the wider population (Baker *et al.*, 2013).

As shown in Figure 2, the research design includes delineating the observation scope, selecting the core case, conducting field observations, administering a structured questionnaire survey, screening the questionnaire, applying four analytical dimensions, and using descriptive statistics with appropriate between-group tests for the variable type.

2.4. Questionnaire design and analytical dimensions

The questionnaire was structured around four dimensions closely related to the effectiveness of cultural integration in urban public space, namely cultural identity, perceived value, experience quality, and public use. These dimensions were used to organize the questionnaire items and the subsequent comparison, rather than to construct a single

overall score for cultural integration. Existing studies have shown that, in contexts where cultural heritage overlaps with public space, cultural recognition, conservation value cognition, environmental quality, user satisfaction, and use-related behavior are closely interrelated and can jointly reflect the actual effectiveness of cultural expression in public space (Dai *et al.*, 2021; Ji Li *et al.*, 2020; Yinong Li *et al.*, 2025; Roberts *et al.*, 2019).

Among these dimensions, cultural identity primarily examines the public's recognition and understanding of the canal theme and the related cultural content in the squares. It therefore includes two items: cultural awareness, referring to recognition of the canal theme, and heritage perception, referring to the perceived importance of canal-related cultural content. The dimension of perceived value reflects the public's evaluation of the relationship between cultural content and everyday life, and includes two items: cultural value and everyday-life value. These items correspond to prior discussions of heritage landscape perception and conservation value cognition (Jie Li *et al.*, 2025).

The dimension of experience quality focuses on the basic environmental conditions and spatial experience through which cultural expression takes place and was examined through four items: hygiene conditions, seating provision, vegetation landscape, and spatial layout. These items were originally collected using Likert-type responses and were recoded into positive and non-positive evaluations for

Table 2. Respondent characteristics by survey site

Variable	Category	Yongfu Square (<i>n</i> = 65)	Tingyin Square (<i>n</i> = 62)	<i>p</i> -value
Gender	Male	31 (47.7%)	30 (48.4%)	0.623
	Female	31 (47.7%)	31 (50.0%)	
	Other/Prefer not to say	3 (4.6%)	1 (1.6%)	
Age group	<18	10 (15.4%)	10 (16.1%)	0.998
	18–30	13 (20.0%)	11 (17.7%)	
	31–45	20 (30.8%)	20 (32.3%)	
	46–60	12 (18.5%)	11 (17.7%)	
	>60	10 (15.4%)	10 (16.1%)	
Residence status	Local resident	48 (73.8%)	41 (66.1%)	0.342
	Non-local visitor	17 (26.2%)	21 (33.9%)	
Visit purpose	Leisure/Recreation	21 (32.3%)	19 (30.6%)	0.995
	Physical exercise	19 (29.2%)	19 (30.6%)	
	Social gathering	13 (20.0%)	12 (19.4%)	
	Cultural activity	12 (18.5%)	12 (19.4%)	
Prior knowledge of the Pinglu Canal	Knows the Pinglu Canal	52 (80.0%)	48 (77.4%)	0.722
	Does not know the Pinglu Canal	13 (20.0%)	14 (22.6%)	

Notes: Respondent characteristics were recorded using the predefined categories in the questionnaire. Percentages are based on valid responses for each item. The *p*-values report between-site comparisons of respondent characteristics. No statistically significant difference was found between the two respondent groups at the 0.05 level

comparative presentation. Public use was assessed using four items: weekly frequency of use, participation initiative, willingness to participate, and duration of stay. These items were used to capture both reported use intensity and the public's attitude toward further participation. This grouping is consistent with existing research linking environmental features, user satisfaction, and use behavior in public open spaces (Roberts *et al.*, 2019). The overall configuration of questionnaire items is consistent with the variable coding scheme and statistical presentation adopted in Section 3.

2.5. Methods of data processing

After the questionnaire data were entered into SPSS Statistics 27.0 (IBM, United States of America), the number of valid responses for each item was first checked. Frequency counts, percentage calculations, and between-group tests were then conducted according to the response format and the coding of each item. Descriptive statistics were used to present the response distributions for Yongfu

Square and Tingyin Square across all questionnaire items, to show the overall tendency in public evaluation. For Likert-type items treated as ordinal variables, Mann–Whitney *U* tests were used to compare responses between the two squares (Mann & Whitney, 1947). For binary variables and binary recoded variables, Pearson's chi-square tests were used to examine between-group differences (McHugh, 2013; Agresti, 2018). The significance level was set at 0.05. Effect sizes were reported together with *p*-values. Mann–Whitney *r* was used for ordinal items, while phi/Cramér's *V* was used for binary comparisons. No formal multiple-comparison correction was applied to the item-level tests, which were interpreted as exploratory case-comparison results. All percentages reported in Section 3 were calculated using the number of valid responses for the corresponding item as the denominator. The statistical tests were conducted using the same category definitions as those reported in the tables. The same coding logic was applied consistently to the tabulated results and the textual interpretation of the findings.

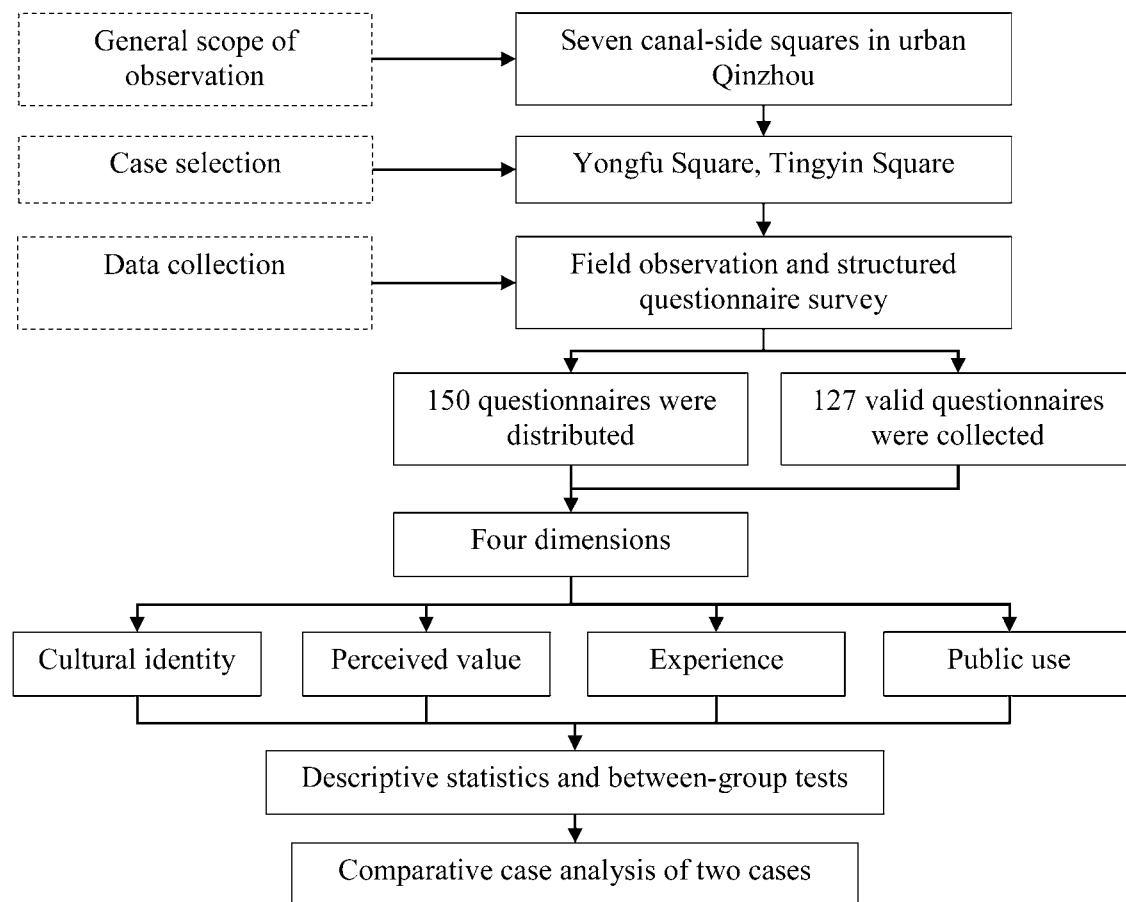


Figure 2. Research design and case selection process. Source: Diagram by the authors

The statistical procedures followed the coding structure of the questionnaire items. Each item was examined separately because the four analytical dimensions describe different aspects of canal culture integration, including cultural recognition, value judgment, spatial experience, and public use. Categorical and ordinal responses were compared at the item level, allowing the analysis to retain the original response structure and identify differences between Yongfu Square and Tingyin Square. This item-level approach also ensured that the statistical analysis was consistent with the descriptive tables and the comparative case-study design. The questionnaire wording, variable coding scheme, corrected supplementary statistical tables, and effect-size calculations are provided in Tables S1–S4.

3. Results

A total of 127 valid questionnaires were obtained in this

study, including 65 from Yongfu Square and 62 from Tingyin Square. No missing values were identified for any survey item. The results are presented according to the four analytical dimensions of cultural identity, perceived value, experience quality, and public use. Percentages reported for the questionnaire items are based on the valid responses for each corresponding item, and the response distributions are presented in the following tables.

Before reporting the questionnaire results, a field observation was briefly introduced to clarify the spatial context of the two cases. In Yongfu Square, cultural references related to Liu Yongfu and local historical memory appeared more closely connected to walking routes, open activity areas, shaded edges, and staying spaces. Its larger scale, clearer spatial order, and better vegetation experience also supported staying and viewing. In Tingyin Square, cultural references related to the Gulong Kiln

context and Qinzhou Nixing pottery culture were present, but their connection with the Pinglu Canal theme, main movement routes, and staying spaces was less direct. These observations suggest that cultural elements alone did not ensure public readability. Canal-related cultural expression became more perceptible when cultural clues were linked with daily movement, staying spaces, and environmental comfort.

3.1. Cultural identity

Both squares showed a high proportion of negative evaluations in relation to the recognition of canal-themed cultural content (Table 3). The proportion of negative evaluations was 75.4 percent for Yongfu Square and 72.6 percent for Tingyin Square. In terms of heritage perception, the proportion of respondents selecting “extremely important” was 30.8 percent in Yongfu Square, higher than the 17.7 percent recorded in Tingyin Square. By contrast, Tingyin Square showed higher proportions than Yongfu Square in the categories of “relatively important” and “important,” accounting for 32.3 percent and 41.9 percent, respectively, compared with 27.7 percent and 33.8 percent in Yongfu Square. The between-group differences in cultural theme recognition and heritage perception were not statistically significant. The results therefore suggest that weak recognition of canal-themed content was a shared condition in both squares, while the difference in heritage perception should be interpreted only as a proportional tendency.

3.2. Perceived value

For the item of cultural value, the proportion of respondents who selected “strongly agree” was 53.8 percent in Yongfu Square, higher than the 27.4 percent recorded in Tingyin Square (Table 4). By contrast, Tingyin Square showed higher proportions than Yongfu Square in the categories of “somewhat agree” and “neutral,” accounting for 48.4 percent and 24.2 percent, respectively, compared with 30.8 percent and 15.4 percent in Yongfu Square. For the item of everyday-life value, the proportion of respondents selecting “extremely important” was 41.5 percent in Yongfu Square, higher than the 25.8 percent recorded in Tingyin Square. In Tingyin Square, the proportions for the categories of “somewhat important” and “neutral” were 35.5 percent and 38.7 percent, respectively. Cultural value showed a statistically significant difference between the two squares, while everyday-life value did not. Therefore, Yongfu Square showed a stronger evaluation of cultural value, whereas the difference in everyday-life value should be interpreted more cautiously.

3.3. Experience quality

The four items under the dimension of experience quality were collected using Likert-type responses and were recoded into positive and non-positive evaluations for comparative presentation (Table 5). In Yongfu Square, the proportions of positive evaluations for hygiene conditions, seating provision, vegetation landscape, and spatial layout were 44.6 percent, 32.3 percent, 60.0 percent, and 66.2 percent, respectively. The corresponding proportions in Tingyin Square were 11.3 percent, 9.7 percent, 22.6 percent, and 22.6 percent, respectively. The p -values for the between-group differences in these four indicators were <0.001 , 0.002, <0.001 , and <0.001 , respectively.

3.4. Public use

The results for public use show that the two squares displayed different response patterns in frequency of use, participation initiative, willingness to participate, and duration of stay, although only willingness to participate showed a statistically significant difference (Table 6). The proportion of respondents using the square three times or more per week was 21.5 percent in Yongfu Square and 11.3 percent in Tingyin Square, but the between-group difference was not statistically significant ($p = 0.120$). The proportion of respondents reporting that they were “always proactive” was 30.8 percent in Yongfu Square and 17.7 percent in Tingyin Square, while the proportion of respondents reporting that they were “occasionally proactive” was 27.7 percent and 50.0 percent, respectively. However, the difference in participation initiative was not statistically significant. By contrast, willingness to participate showed a statistically significant between-group difference: the proportion of respondents who were “very willing” to participate was 64.6 percent in Yongfu Square and 30.6 percent in Tingyin Square, whereas the proportion who were “moderately willing” to participate was 27.7 percent and 50.0 percent, respectively ($p < 0.001$). In terms of duration of stay, the proportion of respondents with a longer length of stay was 47.7 percent in Yongfu Square and 33.9 percent in Tingyin Square, but this difference did not reach statistical significance ($p = 0.113$).

3.5. Summary of results

Taken together, the results reveal three main patterns. First, public recognition of canal-themed content remained weak in both squares, and the difference between the two cases was not statistically significant. Second, Yongfu Square received significantly higher evaluations in cultural value and in all four experience-quality indicators, while the differences in heritage perception and everyday-life value should be interpreted as proportional tendencies. Third,

Table 3. Comparison of cultural identity between Yongfu Square and Tingyin Square

Item	Level coding and meaning	Yongfu Square (<i>n</i> = 65)	Tingyin Square (<i>n</i> = 62)	<i>p</i> -value	Effect size
Cultural awareness	1 = Positive	1 (1.5%)	3 (4.8%)	0.651	<i>r</i> = 0.040
	2 = Neutral	15 (23.1%)	14 (22.6%)		
	3 = Negative	49 (75.4%)	45 (72.6%)		
Heritage perception	1 = Extremely important	20 (30.8%)	11 (17.7%)	0.186	<i>r</i> = 0.118
	2 = Relatively important	18 (27.7%)	20 (32.3%)		
	3 = Important	22 (33.8%)	26 (41.9%)		
	4 = Not very important	2 (3.1%)	2 (3.2%)		
	5 = Not important at all	3 (4.6%)	3 (4.8%)		

Notes: Frequencies and percentages are based on the verified questionnaire counts. Likert-type items were treated as ordinal variables. *p*-values are based on Mann–Whitney *U* tests. Effect sizes are reported as Mann–Whitney *r*

Table 4. Comparison results for the perceived value dimension between the two squares

Item	Level coding and meaning	Yongfu Square (<i>n</i> = 65)	Tingyin Square (<i>n</i> = 62)	<i>p</i> -value	Effect size
Cultural value	1 = Strongly agree	35 (53.8%)	17 (27.4%)	0.006	<i>r</i> = 0.245
	2 = Somewhat agree	20 (30.8%)	30 (48.4%)		
	3 = Neutral	10 (15.4%)	15 (24.2%)		
	4 = Somewhat disagree	0 (0.0%)	0 (0.0%)		
	5 = Strongly disagree	0 (0.0%)	0 (0.0%)		
Everyday-life value	1 = Extremely important	27 (41.5%)	16 (25.8%)	0.138	<i>r</i> = 0.132
	2 = Somewhat important	17 (26.2%)	22 (35.5%)		
	3 = Neutral	21 (32.3%)	24 (38.7%)		
	4 = Not very important	0 (0.0%)	0 (0.0%)		
	5 = Not at all important	0 (0.0%)	0 (0.0%)		

Notes: Frequencies and percentages are based on the verified questionnaire counts. Likert-type items were treated as ordinal variables. *p*-values are based on Mann–Whitney *U* tests. Effect sizes are reported as Mann–Whitney *r*. Categories with zero counts were retained to show the full response scale

Table 5. Comparison results for the experience quality dimension between the two squares

Item	Level coding and meaning	Yongfu Square (<i>n</i> = 65)	Tingyin Square (<i>n</i> = 62)	<i>p</i> -value	Effect size
Hygiene conditions	1 = Positive evaluation	29 (44.6%)	7 (11.3%)	<0.001	$\phi = 0.370$
	0 = Non-positive evaluation	36 (55.4%)	55 (88.7%)		
Seating provision	1 = Positive evaluation	21 (32.3%)	6 (9.7%)	0.002	$\phi = 0.276$
	0 = Non-positive evaluation	44 (67.7%)	56 (90.3%)		
Vegetation landscape	1 = Positive evaluation	39 (60.0%)	14 (22.6%)	<0.001	$\phi = 0.379$
	0 = Non-positive evaluation	26 (40.0%)	48 (77.4%)		
Spatial layout	1 = Positive evaluation	43 (66.2%)	14 (22.6%)	<0.001	$\phi = 0.438$
	0 = Non-positive evaluation	22 (33.8%)	48 (77.4%)		

Notes: Experience-quality items were originally collected using Likert-type responses and were recoded into positive and non-positive evaluations for comparative presentation. Positive evaluation refers to the most positive response category or the predefined positive category group, while non-positive evaluation combines the remaining response categories. Pearson's χ^2 tests were used for the binary comparisons. Effect sizes are reported as phi (ϕ)

the differences in frequency of use, participation initiative, and duration of stay were not statistically significant, while willingness to participate showed a significant difference between the two squares. Overall, the main differences between the two cases lay in cultural value, experience quality, and willingness to participate, rather than in reported use intensity.

4. Discussion

The discussion centers on the two main findings reported above. The first is the shared weakness of canal-theme recognition in both squares. The second is the stronger performance of Yongfu Square in cultural value and experience quality. The third is the significant difference in willingness to participate, while reported use frequency, participation initiative, and duration of stay showed no significant between-square differences. These findings suggest that the main difference between the two cases did not lie simply in how often the spaces were used, but in how canal-related cultural information was perceived under different spatial conditions. The following discussion therefore focuses on three closely related issues: the readability of cultural information, the role of spatial

quality in shaping public evaluation, and the relationship between participation willingness and everyday use.

4.1. Weak public recognition of canal culture in daily-use squares

The most important shared finding of this study is the consistently high proportion of negative evaluations regarding canal theme recognition in both squares. The negative evaluation rate reached 75.4 percent in Yongfu Square and 72.6 percent in Tingyin Square, indicating that although canal culture has entered canal-side public space in certain forms, its recognizability in everyday use remains limited. More importantly, weak recognition does not mean that the public rejects cultural content itself. On the contrary, for the item of heritage perception, a considerable proportion of respondents in both squares rated the relevant cultural content as “extremely important,” “relatively important,” or “important.” Together with the respondent profile, which showed that most respondents reported prior knowledge of the Pinglu Canal, this pattern points to a gap between general canal awareness and the site-based readability of canal-related expressions. Users may recognize the value of cultural content in principle,

Table 6. Public use comparison between Yongfu Square and Tingyin Square

Item	Level coding and meaning	Yongfu Square (<i>n</i> = 65)	Tingyin Square (<i>n</i> = 62)	<i>p</i> -value	Effect size
≥3 times/week	1 = ≥ 3 times/week	14 (21.5%)	7 (11.3%)	0.120	φ = 0.138
	0 = < 3 times/week	51 (78.5%)	55 (88.7%)		
Participation initiative	1 = Always proactive	20 (30.8%)	11 (17.7%)	0.904	<i>r</i> = 0.011
	2 = Occasionally proactive	18 (27.7%)	31 (50.0%)		
	3 = Never proactive	27 (41.5%)	20 (32.3%)		
Willingness to participate	1 = Very willing	42 (64.6%)	19 (30.6%)	<0.001	<i>r</i> = 0.336
	2 = Moderately willing	18 (27.7%)	31 (50.0%)		
	3 = Unwilling	5 (7.7%)	12 (19.4%)		
Duration of stay ≥ 1 h	1 = ≥ 1 h	31 (47.7%)	21 (33.9%)	0.113	φ = 0.140
	0 = < 1 h	34 (52.3%)	41 (66.1%)		

Notes: Public use includes reported use frequency, participation initiative, willingness to participate, and duration of stay. Ordinal items were analyzed using Mann–Whitney *U* tests, with effect sizes reported as *r*. Binary items were analyzed using Pearson's χ^2 tests, with effect sizes reported as phi (ϕ)

yet the squares do not provide a sufficiently stable spatial sequence through which that content can be perceived, located, and understood during everyday use.

This finding has direct implications for canal-related public spaces. In daily-use settings such as urban squares, cultural expression can only be transformed into stable public recognition when it can be continuously perceived through walking, staying, viewing, and everyday activity. If cultural information remains confined to scattered decorative symbols, localized landscape cues, or thematic expressions that lack continuous spatial organization, it is difficult to establish a clear path of thematic reading, even where the site already contains an intention of cultural insertion. The recognition results reported here indicate that the canal-side squares in Qinzhou are still at a stage where culture has been placed into space, but has not yet been effectively read by the public. For Qinzhou, which is currently undergoing spatial restructuring as part of the Pinglu Canal development, this is not a minor issue of local landscape treatment. Rather, it bears directly on whether the new canal-side urban interface can genuinely enter the everyday experience of the public.

4.2. Factors contributing to the superior performance of Yongfu Square compared with Tingyin Square

The two squares were comparable in terms of their basic functional attributes, as both are urban leisure squares within Qinzhou's canal-side public space system. However, the comparative results did not show a uniform advantage across all dimensions. Yongfu Square showed clearer strengths mainly in cultural value, experience quality, and willingness to participate. This pattern was not confined to a single item but was concentrated in cultural value, environmental evaluation, and participation willingness. In terms of heritage perception, the proportion of respondents rating the relevant cultural content as “extremely important” was 30.8 percent in Yongfu Square, higher than the 17.7 percent in Tingyin Square, although the difference between the two squares was not statistically significant. For cultural value, the proportion selecting “strongly agree” reached 53.8 percent in Yongfu Square, significantly higher than the 27.4 percent in Tingyin Square. For everyday-life value, the proportion rating it as “extremely important” was 41.5 percent in Yongfu Square, compared with 25.8 percent in Tingyin Square.

These results indicate that the advantage of Yongfu Square should be understood mainly in terms of cultural value and experience quality, rather than as a general advantage across all cultural-identity and value items.

The clearer advantage of Yongfu Square is most evident in the results for experience quality. In Yongfu Square, the proportions of positive evaluations for hygiene conditions, seating provision, vegetation landscape, and spatial layout were 44.6 percent, 32.3 percent, 60.0 percent, and 66.2 percent, respectively, whereas the corresponding proportions in Tingyin Square were only 11.3 percent, 9.7 percent, 22.6 percent, and 22.6 percent. These results suggest that the advantage of Yongfu Square was neither abstract nor achieved through a single cultural symbol. Rather, it was grounded in a more complete combination of environmental comfort, landscape perception, and spatial order. In everyday public space, users do not separate cultural content from the user experience. Whether a place is worth staying in, whether it feels comfortable, and whether it is easy to recognize and use often directly shape the degree to which its cultural content is accepted. For this reason, the stronger performance of Yongfu Square in cultural value and experience quality is unlikely to be explained simply by the presence of “more culture.” It is more plausibly associated with a more stable alignment between cultural expression and spatial use. Although this interpretation should remain within the limits of what the current data can support, the parallel pattern between cultural value and the four experience-quality indicators suggests that Yongfu Square’s advantage was not an incidental fluctuation in isolated indicators.

4.3. Canal culture integration depends on readability, spatial comfort, and everyday usability

The results of this study indicate that the actual integration of canal culture does not depend simply on whether symbols are placed within a site, but on whether cultural information is readable, whether the spatial environment is comfortable, and whether the site is supported by stable everyday use. The significant difference in cultural value, together with the descriptive tendency in everyday-life value, suggests that public evaluation of cultural content is closely related to the conditions of everyday spatial use. The higher ratings of Yongfu Square for both cultural value and everyday-life value correspond closely to its better performance in vegetation landscape, spatial layout, and hygiene conditions (S. Luo *et al.*, 2023). This suggests that cultural expression is more likely to move from being merely seen to being accepted only when it is embedded in a spatial environment that is comfortable, legible, and suitable for staying (Bazrafshan *et al.*, 2023).

The results for public use further support this interpretation. Of the four public use indicators, the only one that showed a statistically significant difference was willingness to participate. The proportion of respondents who were “very willing” to participate was 64.6 percent in Yongfu Square, compared with only 30.6 percent in Tingyin Square ($p < 0.001$), whereas the between-group differences in the proportion of respondents using the square three times or more per week and in duration of stay were not statistically significant. This result suggests that the relationship between cultural integration and public use was more clearly reflected in willingness to participate than in reported use frequency or duration of stay. If a square can generate stronger recognition of cultural value, more stable evaluations of experience quality, and more positive willingness to participate, then it has already established a relatively strong everyday-use basis for cultural integration. From this perspective, the spatial incorporation of canal culture should not be understood as a static landscape arrangement, but as an integrated mechanism in which cultural information, spatial experience, and use processes operate together.

4.4. Implications for canal-side public space renewal in Qinzhou

Based on the two-case comparison, the implications for canal-side square renewal in Qinzhou can be understood as case-based recommendations. Renewal work in comparable daily-use squares should give greater attention to the spatial readability of cultural information, the environmental conditions that support its perception, and the continuity of everyday use. First, canal culture expression in comparable daily-use squares needs clearer spatial organization rather than scattered cues. The shared weakness of the two squares in theme recognition suggests that the placement of cultural elements within a site does not, in itself, produce effective communication. Future renewal should pay greater attention to the organization of cultural clues within walking routes, staying nodes, sightlines, and activity interfaces, so that users can form a clearer understanding of the theme through continuous spatial experience (Birer & Çalırsır Adem, 2022; Zhang *et al.*, 2024). In practical renewal, canal-culture interpretation should be placed at main entrances, shaded resting edges, and high-frequency activity nodes, rather than concentrated in isolated decorative areas. Seating, shade, planting, and cultural explanation boards should be arranged as a continuous route-based experience, so that users encounter canal-related information while walking, resting, and socializing.

Second, cultural renewal should be coordinated with improvements in basic spatial quality, since heritage-related renewal outcomes are often conditioned by environmental performance and site-specific optimization (Alraouf, 2024; J. Luo *et al.*, 2022; Zhou *et al.*, 2025). The comparison between Yongfu Square and Tingyin Square suggests a close association between cultural evaluation and experience quality. Hygiene conditions, seating provision, vegetation landscape, and spatial layout are not merely supporting facilities; they shape the conditions under which cultural content is perceived and accepted. A site that lacks comfortable conditions for staying, has weak spatial order, or provides a poor environmental experience is unlikely to generate stable value recognition even if clear cultural symbols are present. For comparable renewal work in Qinzhou, cultural display and environmental improvement should be treated as connected tasks, and cultural expression should be incorporated into the broader process of enhancing overall spatial quality.

Finally, cultural integration in comparable daily-use canal-side squares should place greater emphasis on moving from visibility to public use. In this study, the clearest difference within the public use dimension appeared in willingness to participate, indicating that willingness may be an important early signal of cultural acceptance in daily-use public space. For comparable public spaces along the Pinglu Canal, renewal should help users connect canal-related cultural content with staying, resting, socializing, and everyday activity. Only when cultural expression establishes a stable connection with everyday use can canal-side squares shift from passive display interfaces to public living spaces in which cultural meaning is continuously produced (Yinong Li *et al.*, 2025). This point has practical relevance for Qinzhou because canal-side squares are important components of the emerging canal-side urban interface. Their renewal may shape how the public understands the contemporary position and cultural significance of the Pinglu Canal in everyday urban life.

5. Conclusion

Taking seven canal-side squares in urban Qinzhou as the overall observational background, this study selected Yongfu Square and Tingyin Square as the core cases and, through a combination of field observation and a structured questionnaire survey, comparatively analyzed 127 valid responses. Across four dimensions—cultural identity, perceived value, experience quality, and public use—it examined how canal culture integration was perceived in daily-use urban squares. The results show that canal culture expression in Qinzhou's canal-side urban squares has already entered the process of public

space production, but public recognition in everyday use remained weak in the two selected squares. Both squares showed a high proportion of negative evaluations in canal theme recognition, indicating that the cultural information currently embedded in these sites has not yet been stably transformed into a spatial experience that the public can clearly recognize and continuously understand. The results point to a gap between the spatial presence of canal-related cultural elements and their effective public readability in everyday use.

Beyond this shared limitation, the two cases showed clear differences in selected dimensions. Yongfu Square showed stronger performance in cultural value, all four experience-quality indicators, and willingness to participate. The higher proportions observed for heritage perception and everyday-life value remain descriptive tendencies and serve as supplementary context for the main findings. These results suggest that the perceived effectiveness of canal culture integration is closely associated with spatial environmental quality, landscape perception, and conditions of use. In this study, cultural value and experience quality appeared together in the public evaluation pattern of canal culture expression. The findings therefore suggest that cultural integration in daily-use squares requires more than the addition of cultural symbols. It requires attention to the coordinated improvement of cultural readability, spatial comfort, and everyday usability.

The significance of this study lies mainly at two levels. At the research level, it shifts the discussion of canal culture expression from design intention and conceptual judgment to a comparative examination of public perception in actual use contexts. It shows that canal culture integration can be assessed through public recognition, value evaluation, experiential response, and public use, together with the spatial presence of cultural elements. At the practical level, the study provides case-based empirical support for the renewal of comparable canal-side public spaces in Qinzhou. The findings suggest that future renewal in comparable daily-use squares should give greater attention to the organization of cultural clues, the improvement of basic spatial quality, and the continuity between staying, viewing, understanding, and public use, so that canal culture can become part of everyday spatial experience.

The applicability of the conclusions also needs to be clearly delimited. The in-depth comparison in this study focused on two cases, Yongfu Square and Tingyin Square, while the seven canal-side squares served primarily as the broader background and the basis for case selection. The study is therefore more suitable for identifying problem types and comparative differences between the two selected

cases than for directly generalizing to all canal-side public spaces. At the same time, the data were drawn from field observation and questionnaire surveys conducted within a specific period and mainly reflect the public's immediate judgments under current use conditions. They cannot substitute for longer-term behavioral tracking or continuous spatial observation. Because the experience-quality items were dichotomized from Likert-type responses, some ordinal information may have been lost, and the apparent between-site contrasts may appear sharper. These results should therefore be interpreted as simplified comparative indicators. Future research could expand the range of cases and incorporate behavioral path records, staying-node analysis, and spatial mapping data to further examine how canal culture expression operates across different sites.

Overall, canal culture integration in Qinzhou's canal-side urban squares has a practical foundation, but it still needs to move from spatial placement toward continuous recognition, understanding, and public use. This remains an important issue for the future renewal of public spaces related to the Pinglu Canal. Canal-side squares can convey canal-related cultural meaning more effectively when signs, routes, seating, shade, vegetation, and daily activities are organized as a continuous-use experience.

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Conflict of interest

The authors declare that they have no competing interests.

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Ethics approval and consent to participate

The study was conducted in accordance with UCSI

University's ethical requirements for low-risk research. Informed consent was obtained from all participants prior to their participation in the questionnaire survey.

Consent for publication

Participants gave consent for publication their anonymous data.

Availability of data

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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