

Fragmentation of Wayfinding Systems in Medium-sized Heritage Cities: Cultural Navigation Within the Batik Tourism Network

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Abstract

In medium-sized heritage cities, urban tourism often relies on cultural districts that are spatially dispersed and poorly organized. In such contexts, navigation is not merely about reaching a particular place; rather, it involves maintaining continuity in travel flows across fragmented urban spatial networks. Although numerous studies have examined wayfinding and urban legibility, limited attention has been paid to how navigation systems operate across cultural destinations in smaller cities. This study investigates the integration of wayfinding systems within the batik tourism network of Surakarta, Indonesia. It employs a qualitative evaluative methodology combining route-based observations and semi-structured interviews with non-local visitors to examine the sequential orientation process, from city access points to transitions between destinations. The findings reveal three forms of systemic fragmentation: local fragmentation within individual destinations, functional fragmentation between mobility systems and cultural sites, and referential fragmentation between formal and informal information sources. These forms of fragmentation complicate movement across routes, disrupt visitor experiences, and obscure the narrative coherence of the urban cultural landscape. This study extends wayfinding research, which has largely focused on cognitive mapping and urban legibility, by framing wayfinding as relational and narrative infrastructure rather than merely a collection of visual elements. It offers a systemic perspective relevant to medium-sized heritage cities and outlines practical implications for integrated tourism planning and inter-destination coordination.

Keywords: Heritage Tourism, Inter-destination Mobility, Medium-sized Heritage Cities, Systemic Fragmentation, Wayfinding Systems.

Introduction

Cultural tourism in heritage cities depends not only on the attractiveness of individual sites but also on visitors' ability to navigate and interpret complex urban environments. Tourism experiences are shaped by spatial relationships among destinations, route cues, and cultural narratives embedded in the urban landscape (1-3). The United Nations World Tourism Organization (UNWTO) similarly identifies navigation as infrastructure supporting tourists' experience of a city (4). Wayfinding therefore extends beyond reaching destinations to shaping orientation, place connections, and understanding of the city as a cultural whole. Wayfinding research originated in studies of spatial cognition and the built environment, defining wayfinding as the process of recognising, interpreting, and using environmental information to reach a destination (5). Signage,

maps, typography, landmarks, and route configuration enhance spatial legibility and informational continuity, while environmental graphic design emphasises clear information hierarchies and consistent directional guidance (6, 7). Heritage tourism research further shows that places communicate identity and meaning, making wayfinding both a navigational and interpretative process (8). Existing studies commonly examine wayfinding within individual buildings, single destinations, or large cities with comparatively centralised governance and infrastructure. This emphasis provides limited explanation of how navigation operates across dispersed cultural destinations. Medium-sized heritage cities, often classified as secondary cities, typically have fewer resources and less integrated information infrastructure than metropolitan tourism centres

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(9). Their cultural districts frequently develop incrementally and are managed by multiple actors, producing uneven connections among destinations, transport systems, and information sources (10, 11). Tourism studies have examined destination planning, management, and branding, but have paid less attention to how visitors maintain orientation and integrate experiences while moving across a network of cultural sites (1, 2, 10).

Surakarta, Indonesia, provides a relevant setting for examining this problem. Its batik tourism network includes historically and culturally significant areas such as Kampung Batik Laweyan, Kampung Batik Kauman, and Kampung Blangkon. Existing research has documented the cultural significance and preservation of Kauman's batik heritage (11), but it does not explain how visitors navigate connections among Surakarta's batik destinations. Information available at city access points generally directs visitors towards individual destinations rather than explaining relationships among them. During movement between sites, visitors may therefore need to combine signage, public transport information, digital maps, and verbal directions. This fragmented process can make mobility more difficult and weaken visitors' understanding of the batik areas as an interconnected cultural network.

The challenge cannot be explained solely by the visibility or legibility of individual signs. Spatial cognition research has shown that navigation depends on the relationship between cognitive processes and the spatial configuration of an environment (12). Paths, nodes, edges, districts, and landmarks help individuals form an intelligible image of urban space (9), while landmarks, maps, and other information systems support orientation when spatial familiarity is limited (13). In historic cities, organically developed street networks and inconsistent guidance can make spatial relationships more difficult to interpret. The problem becomes more pronounced when cultural destinations are dispersed across several clusters: without information connecting one site to another, visitors may experience each location as an isolated attraction rather than as part of a coherent cultural landscape.

This study consequently treats wayfinding fragmentation as a systemic condition rather than simply a shortage of signs or maps. Fragmentation

occurs when otherwise functional components—physical signage, mobility information, digital navigation, and informal guidance—operate according to different spatial references and fail to support continuity across a journey. This perspective shifts the analytical focus from the quality of isolated elements to the relationships among wayfinding subsystems. It also conceptualises wayfinding as narrative infrastructure because the continuity of navigation influences whether visitors can connect destinations and interpret them as parts of a broader regional cultural story.

Four gaps guide the study, given as below:

- a) Previous research has generally approached wayfinding as a collection of separate navigation elements rather than as an integrated system.
- b) Most empirical studies focus on navigation within individual buildings or destinations, leaving movement across cultural networks underexamined.
- c) Evidence is concentrated in large cities, while the institutional and spatial conditions of medium-sized heritage cities remain comparatively neglected.
- d) Limited attention has been paid to how inconsistencies among wayfinding subsystems disrupt both visitor mobility and the construction of coherent cultural narratives.

Addressing these gaps requires a route-based perspective that follows orientation from city access points through transitions between destinations.

This study evaluates the integration of wayfinding systems within Surakarta's batik tourism network through a route-based qualitative approach involving non-local visitors. It asks:

- (a) How does systemic fragmentation emerge throughout the wayfinding network connecting cultural destinations in a medium-sized heritage city? and
- (b) How does systemic fragmentation influence tourists' navigation experiences and their construction of regional cultural narratives?

The study contributes by identifying systemic fragmentation as a disruption in the continuity of interconnected wayfinding subsystems, extending wayfinding from an element-centred to a relational framework, and conceptualising it as narrative infrastructure connecting mobility, destinations,

and cultural meaning. These contributions also provide a practical basis for integrated tourism planning and inter-destination coordination in medium-sized heritage cities.

Research Questions

- a) How does systemic fragmentation manifest across the wayfinding network connecting batik tourism destinations in Surakarta?
- b) How does systemic fragmentation shape non-local visitors' navigation experiences and their understanding of Surakarta's shared cultural narrative?

Research Aim

This study examines how systemic fragmentation manifests across the wayfinding network connecting batik tourism destinations in Surakarta and how it shapes non-local visitors' navigation experiences and understanding of the city's shared cultural narrative.

Methodology

Research Design and Approach

This study adopted a qualitative methodology within an evaluative–interpretative framework to analyse the operation of wayfinding systems as tourists navigated a network of cultural destinations in a medium-sized heritage city. A qualitative approach was selected to enable a comprehensive understanding of navigation experiences as sequential and contextual processes shaped by interactions among spatial information, mobility patterns, and cultural meaning, which cannot be adequately captured through quantitative metrics alone (14). These experiential components are central to wayfinding research because they help explain how navigation systems operate across different stages of a journey (5, 12).

The evaluative design was not intended to assess individual signage components in isolation, but rather to examine wayfinding as an integrated system experienced throughout a journey. Wayfinding consists of a sequence of experiences that begins when visitors enter a city, continues as they change routes, and extends to their movement between cultural destinations. This evaluative perspective helps bridge the gap between designed navigation systems and visitors' actual experiences (1, 2).

This approach was selected because the study sought to understand how visitors experienced

orientation throughout their journeys, from entering the city to travelling between cultural tourism destinations. The study focused on continuity in navigation, interactions among wayfinding subsystems, and the ways in which these experiences shaped visitors' understanding of the cultural tourism area. An interpretative qualitative approach was therefore considered appropriate for addressing the study's contextual, evaluative, and relational research questions.

Time and Location of the Study

This study was conducted in Surakarta, Central Java, Indonesia (approximate GPS coordinates 7°34'0" S, 110°49'0" E), from September to October 2025. This period was selected because tourism activity in the city tends to be relatively stable, without major cultural festivals that might temporarily alter visitor movement patterns or the functioning of information systems. Observations were carried out on both weekdays and weekends in order to capture variations in user density and mobility patterns.

The research locations include the network of major batik tourism destinations in Surakarta consisting of Batik Laweyan Village, Batik Kauman Village and Blangkon Village (approximate GPS coordinates 7°34'12.18" S, 110°47'52.08" E; 7°34'23.57" S, 110°49'34.90" E; 7°34'53.19" S, 110°48'56.84" E respectively). The study area also covers railway stations, intercity bus terminals and other major public transportation stops that serve as key mobility nodes within the city. These sites were selected because they function as critical entry and transition points for non-local visitors navigating between different parts of the city and represent the structural characteristics of a medium-sized cultural city (9).

Surakarta was selected because as an exceptional or unique city. Instead, it is examined as a case that illustrates structural attributes commonly found in medium-sized heritage cities. As a secondary city with historically established cultural clusters and a decentralized governance structure, Surakarta provides an empirical framework for examining how fragmented urban tourism networks operate in contexts characterized by limited integrative planning mechanisms. The selection of this case is explanatory rather than purely descriptive. This approach aligns with analytical case-based research that seeks theoretical insight through

contextual explanation rather than statistical generalization (15).

Surakarta was selected because it represents the characteristics of a medium-sized heritage city. The city contains several interconnected cultural tourism areas, which were selected as study sites in this research : Kampung Batik Laweyan, Kampung Batik Kauman and Kampung Blangkon (approximate GPS coordinates 7°34'12.18" S, 110°47'52.08" E; 7°34'23.57" S, 110°49'34.90" E ; 7°34'53.19" S, 110°48'56.84" E respectively). These three destinations are managed by different stakeholders, creating the potential for fragmentation in the coordination of wayfinding systems. This condition makes Surakarta a relevant case for examining how integration and disconnection within wayfinding systems occur across a network of cultural destinations.

Research Subjects and Objects

The research participants consisted of domestic tourists from outside the Surakarta region who visited several batik destinations in the city and used the available wayfinding system. These participants were selected to represent individuals who do not possess prior spatial familiarity with

the city's configuration and therefore rely on navigation information available in public spaces. The study focuses on the wayfinding system that connects urban entry points to the network of batik tourism destinations. These destinations include:

- (a) physical wayfinding elements such as signage, markers, area maps and orientation indicators,
- (b) information regarding mobility through public transportation,
- (c) transition points between destinations that require navigation-related decision-making,
- (d) the narrative continuity constructed throughout the visitor's journey.

To provide an overview of the study participants, Table 1 presents the demographic and travel characteristics of the eight informants included in this study. The table summarizes participants' age, gender, education, purpose of travel, visit status, familiarity with digital navigation, travel mode, and destinations visited. These characteristics demonstrate the diversity of visitor profiles and travel experiences represented in the study. Such variation provides an appropriate basis for exploring navigation experiences across interconnected batik tourism destinations.

Table 1: Participant Information

Code	Age	Gender	Education	Purpose of Travel	First/Repeat Visit	Digital Navigation Familiarity	Travel Mode	Destinations Visited
I1	25	Male	Bachelor's degree	Cultural tourism	First-time visitor	High	Public transportation + walking	Batik Laweyan Village, Batik Kauman Village
I2	34	Male	Bachelor's degree	Cultural tourism	Repeat visitor	High	Public transportation	Batik Laweyan Village, Batik Kauman Village, Blangkon Village
I3	31	Female	Diploma	Shopping and Cultural tourism	First-time visitor	Moderate	Public transportation + walking	Batik Kauman Village, Blangkon Village
I4	28	Female	Bachelor's degree	Cultural tourism	First-time visitor	High	Walking + informal directions	Batik Laweyan Village, Blangkon Village
I5	30	Female	Diploma	Shopping and	Repeat visitor	Low	Public transportation	Batik Laweyan

Code	Age	Gender	Education	Purpose of Travel	First/Repeat Visit	Digital Navigation Familiarity	Travel Mode	Destinations Visited
				Cultural tourism				Village, Batik Kauman Village
I6	45	Male	Diploma	Cultural tourism	First-time visitor	Low	Public transportation + walking	Batik Kauman Village, Blangkon Village
I7	36	Male	Bachelor's degree	Cultural tourism	Repeat visitor	High	Public transportation	Batik Laweyan Village, Batik Kauman Village,
I8	33	Male	Bachelor's degree	Cultural tourism	First-time visitor	Moderate	Walking + public transportation	Batik Kauman Village, Blangkon Village

As presented in Table 1, eight purposively selected informants participated in this study, representing diverse travel characteristics relevant to the research objectives. The participants varied in age, travel mode, familiarity with digital navigation, and visit status (first-time or repeat visitors), providing a broad range of navigation experiences across Surakarta's batik tourism network. This variation enabled the study to capture different patterns of orientation, route selection, and adaptive navigation strategies while maintaining a common contextual background. Table 1 demonstrates that the findings are derived from information-rich cases rather than a homogeneous participant group. This study does not emphasize the number of participants as the unit of analysis but focuses on their navigation experiences. Each informant visited at least two batik destinations during a single trip, providing multiple route experiences that could be explored in greater depth. Therefore, the richness of this study is not determined only by the number of informants, but also by the variation of navigation experiences across different routes.

Data collection was stopped when no new themes emerged related to orientation, route disconnection, navigation strategies, or interactions between wayfinding subsystems. The final informants served to confirm that the identified themes had reached data saturation and demonstrated consistent patterns. Domestic visitors were selected because they share a similar cultural and linguistic background, allowing the study to focus on navigation experiences within

the local environment without excessive variation caused by external cultural factors. This study focuses on evaluating the integration of wayfinding systems without being influenced by cross-cultural factors that are beyond the scope of the research. In addition, domestic visitors represent the majority of tourists in Surakarta. This is consistent with tourism data reported by the Sub-Coordinator of Tourism Promotion and Marketing at the Surakarta Department of Culture and Tourism, Terry Sulistyaningrum, as cited by Antara News. The data show that until July 2023, Surakarta recorded 3,096,854 domestic tourist visits and 10,541 international tourist visits.

This number of informants is considered adequate for an evaluative qualitative study that emphasizes depth of experience and cross-route analysis rather than statistical generalization (information-rich cases) (16, 17). The study participants represent varying visit statuses, travel modes and navigation strategies to ensure the inclusion of diverse experiences across different routes and destinations.

Data Collection Techniques

Data were collected through participant route observation and semi-structured interviews. Participant observation followed the travel routes typically taken by non-local visitors, extending from city entry points to intersections between batik destinations. This method enabled researchers to directly document navigation experiences, including how visitors interacted with signage, maps, transportation information

and the adaptive strategies they employed when encountering disorientation or uncertainty (5, 18). Observations focused on the primary routes connecting the city's entry points to each batik village as well as the routes linking one village to another. Structured field notes were used to document each journey. These records included information regarding signage legibility, consistency of directional information, route continuity and instances in which visitors experienced navigational confusion while following available guidance. Following the route observations, semi-structured interviews were conducted to explore informants' experiences of orientation, the information sources they relied upon and their perceptions of the spatial relationships among different destinations. This method allowed triangulation between users' actual navigation experiences and their subjective interpretations (17). The use of route observations and interviews allows the researcher to compare visitors' perceptions during interviews with actual conditions in the field. This comparison strengthens the credibility of the data because each finding can be verified through more than one source of information.

Data Analysis Approach

The data were analyzed using interpretative thematic analysis. This analytical approach aims to identify patterns within navigation experiences across different routes rather than merely categorizing descriptive accounts. The analysis began with open coding of observation notes and interview transcripts to identify meaningful units related to orientation, route confusion, transitions between destinations and navigation strategies (19).

The next phase involved axial coding to examine relationships among codes and to formulate themes that describe the sequential operation of the wayfinding system. The final stage consisted of selective coding, in which the key themes were integrated to construct a theoretical framework for understanding wayfinding in medium-sized cultural cities. The analysis was conducted iteratively, involving cross-comparisons among routes and informants to ensure that the identified themes represented consistent systemic patterns rather than isolated experiences (20). During the analysis, the coding results were continuously compared between informants and travel routes.

This process helped identify whether the fragmentation patterns appeared consistently or only occurred in certain situations.

Validity and Research Limitations

Data validity was maintained through source triangulation among observations, interviews and supporting documents, including transportation maps and official destination information (18). In addition, researcher reflexivity was applied by documenting assumptions and positional considerations during both the data collection and analysis stages (21). This study is limited by the relatively small number of informants and the observation period, which does not capture seasonal variations in tourism patterns. These limitations are consistent with the objectives of qualitative case study research, which prioritize in-depth contextual understanding rather than broad statistical generalization (17).

The validity of the data was strengthened by comparing observation results with interview findings, as well as through cross-route analysis. The interpretation was conducted repeatedly until consistent patterns were identified across different informants and travel routes. This approach ensured that the findings represented systemic patterns rather than individual experiences.

Results

Fragmented Initial Orientation at Urban Entry Points

The analysis of observation and interview results shows that visitors did not consider creating connections between destinations from the beginning of their journey into the city. Their initial orientation was mostly local and focused only on reaching the first destination. Among the eight visitors involved as informants, this pattern appeared consistently across different points of the journey, which indicated that fragmentation occurred from the early stage of entering the city. Observation records indicate that non-local tourists in Surakarta often encounter difficulties in establishing orientation at the beginning of their journeys. Railway stations and bus terminals function as primary entry points; however, they provide limited information that helps visitors understand how cultural sites across the city are spatially connected. At this stage, orientation tends to be restricted and usually focuses only on

identifying the first destination perceived as the most accessible.

In most cases, tourists rely on general markers and area maps to determine their initial direction upon arrival. While this information assists in identifying a starting point, it does not clearly explain how routes are structured or how visitors can transition from one destination to another. As one informant stated,

"I saw the map at the station, but I only knew where to go first." (I2)

Initial orientation is therefore shaped primarily by practical considerations rather than by a comprehensive understanding of the regional destination network.

Some travelers assume that they can decide on their next destinations after they begin their journey. As one informant explained:

"We just need to reach one village first... we can decide the next place later." (I5)

This approach facilitates the beginning of the journey but does not immediately establish a reliable navigation structure. The pattern appeared consistently across different entry points, indicating that it was not limited to the experience of a single visitor. Arrival points do not function as thematic transition spaces that connect multiple destinations; instead, they serve merely as starting points for reaching the nearest and most accessible location. As a result, the orientation that emerges is not systematic but rather local and situational.

From an analytical perspective, this condition weakens the navigation process. Travelers experience difficulty maintaining a clear travel trajectory and understanding the broader spatial structure because city access points do not provide adequate orientation frameworks. This fragmented initial orientation creates informational gaps along navigation routes and increases the likelihood that the overall travel experience will become discontinuous.

Based on these findings, fragmentation does not begin when visitors move between destinations, but rather from the initial orientation process at the city's entry points. Limited information at this early stage becomes the starting point for information gaps that continue to appear throughout the following stages of the journey.

Information Discontinuity Along Navigation Routes

The analysis shows that the starting orientation was local and gradually developed into information gaps throughout the journey. The information received by visitors did not form a continuous sequence but appeared separately at each travel segment, requiring visitors to repeatedly rebuild their orientation.

Route-based observation records indicate that after leaving the city access points, the navigation information encountered by visitors is not structured as a continuous flow. At certain points during the journey, helpful directional signs disappear and the format as well as the content of information changes without clear connections to previous orientation cues. Information tends to appear in isolation rather than as part of a logical sequence.

This pattern was repeatedly observed along several routes leading to cultural destinations and was reported by multiple informants. One participant explained,

"Initially there were directions, but then they suddenly disappeared" (I4).

Another informant stated,

"I wasn't sure if I was still on the right path because the signage had changed" (I6).

From an analytical perspective, these incidents do not represent isolated occurrences but rather a sequence of small disruptions that persist along the route. When these indicators are examined collectively, it becomes evident that the wayfinding system does not maintain consistent directional continuity from one segment of the route to the next. Previously established orientation must frequently be reconstructed because the available information does not connect with earlier reference points.

This condition becomes particularly visible during transition moments, such as when travelers change modes of transportation or move from public circulation spaces into destination areas. As one informant noted,

"I had to start figuring everything out again as soon as I got off the bus" (I1).

Temporary navigation strategies observed in interviews further illustrate this situation.

Travelers often rely on one source of information for a specific segment of the journey and then shift to another source when conditions change. One informant explained,

“If there’s no signage, I just open the map. If the signal is bad, then I ask someone nearby” (I3).

Although these adjustments allow the journey to continue, they do not provide a coherent understanding of the overall route. From an analytical standpoint, this informational gap indicates that navigation difficulties arise not from a lack of information but from how information is

structured and connected along the route. This pattern of sequential discontinuity links the weak initial orientation at city entry points with the gaps between different components of the wayfinding system. To summarize these findings, Table 2 presents the thematic analysis of information discontinuity derived from participant observations and interviews, illustrating how empirical indicators were progressively interpreted through open, axial, and selective coding to construct the overarching theme of sequential information discontinuity.

Table 2: Thematic Analysis of Information Discontinuity Along Navigation Routes

Empirical Indicators (Initial Data)	Initial Codes (Open Coding)	Analytical Categories (Axial Coding)	Main Themes (Selective Coding)
Directional markers do not reappear after intersections	Lost signal	Disruption of visual continuity	Information that does not follow a pattern
Lack of details explaining how routes change across different segments of the journey	No connection between information	Unstable route references	Non-sequential information
Absence of instructions for changing transportation modes	Transition disruption	Unclear transition points	Non-sequential information
Tourists suddenly switch their information sources	Temporary adaptive strategies	Unstable direction	Discontinuity in sequential information

As shown in Table 2, visitors experienced disconnected information during their journey across tourism destinations. Inconsistent sign systems, unrelated route information, the lack of guidance for changing transportation modes and visitors’ tendency to use other information sources show that the available information is still fragmented. This condition does not immediately stop visitors from continuing their journey, but it makes it harder for them to develop a complete understanding of the tourism area. This difficulty is not only caused by limited information, but also because the available information is not connected as a system, causing each piece of information to stand alone. Therefore, information disconnection is a direct result of the starting orientation process that fails to create continuous navigation. This condition then affects how different wayfinding components interact throughout the visitor journey.

Fragmentation Among Components of the Wayfinding System

Further analysis shows that information disconnection does not only occur along travel routes, but also results from the relationship between components within the wayfinding

system. Fragmentation occurs because each navigation component operates differently without a mechanism that connects the system as a whole. The analysis indicates that the information discontinuities experienced by tourists along navigation routes cannot be understood as isolated events. These instances of disorientation arise because different components of the wayfinding system do not operate cohesively. Various navigation mechanisms such as signage, transportation information and digital or informal references function according to different logics within the same journey.

In this context, fragmentation does not result from the absence of specific elements but from the lack of coordination among their operational frameworks. Three distinct yet interconnected patterns emerge from the data analysis: local fragmentation, functional fragmentation and referential fragmentation.

In the case of signage and maps, navigation information typically functions only within a limited spatial context. Wayfinding signage in public areas generally directs tourists toward a particular destination without explaining how that location relates to other nearby cultural sites. Most

regional maps primarily present spatial layouts visually but lack a reference structure that enables travelers to understand how routes connect across different segments of the journey.

Observational records indicate that signage appearing in one location does not always continue in subsequent areas. One informant explained, “The directions only go up to a certain point... after that, there are no more signs” (I4).

Another participant noted,

“I saw a sign pointing to a village, but I didn’t know where to go from there” (I2).

The orientation produced in this context is therefore short-term and primarily focused on reaching the first destination. This pattern reflects localized fragmentation, where signage effectively supports navigation within a specific area but does not connect different segments of the travel route. The fragmentation does not arise from flaws in the design of individual signage elements; rather, it results from the absence of linking functions that connect one destination to the next within a coherent route structure.

In contrast to signage, transportation information generally demonstrates a higher level of technical consistency. Route networks, schedules and stopping points are relatively easy for users to identify and understand. However, these systems are not always directly connected to the network of cultural destinations visited by tourists.

As a result, travelers must interpret mobility information independently in order to determine how to reach specific destinations. One participant explained,

“I know where to get off, but I get confused again about which way to go after that” (I1).

Another informant stated,

“The route is clear in public transportation, but nothing tells you how to reach the batik village from there” (I6).

After changing modes of transport, travelers must often rebuild their orientation from the beginning because there is no mechanism linking the transportation system with the on-site wayfinding structure. This situation illustrates what can be described as functional fragmentation. While the transportation system effectively supports movement, it does not operate in coordination with destination-oriented navigation systems. Mobility and spatial orientation function as

separate domains and consequently the continuity of the journey does not occur automatically.

Digital and informal sources of information tend to emerge when formal navigation systems fail to provide sufficient guidance. In such situations, travelers frequently rely on navigation applications or ask local residents for directions when they are uncertain about their route. As one informant explained,

“I immediately open the map when there is no signage anymore” (I3).

Another participant noted,

“I ask people more often, but the answers are different” (I8).

Navigation applications often recommend the fastest route without considering the cultural structure of the area. One traveler stated,

“The map took me through a small road... it was fast, but I didn’t know which part of the area I was in” (I5).

Informal directions also do not always correspond with each other and may contradict existing signage.

These inconsistencies create referential fragmentation, a condition in which different orientation sources provide references that do not support one another. At this stage, travelers are required not only to interpret directional information but also to decide which system they should rely on. This decision-making process is highly situational and is often made without considering how the suggested routes relate to one another within the broader spatial network. These findings indicate that the success of a wayfinding system is not determined by the quality of each individual component, but by how well the subsystems work together as an integrated system throughout the visitor journey.

Interrelations Among Components and Their Impacts

The three forms of fragmentation identified in this study do not operate independently. Localized fragmentation restricts navigation to individually defined destinations, functional fragmentation separates mobility systems from the broader regional orientation framework and referential fragmentation creates inconsistencies among information sources. When these three conditions occur within a single journey, travelers do not receive a unified and stable navigation framework.

Instead, they are required to repeatedly adjust their orientation strategies throughout the trip.

One participant explained,

“If you follow the signboards, it’s different from what the app shows. You just have to pick one” (17). This statement indicates that fragmentation emerges not only at a technical level but also at a relational level. The wayfinding system is composed of several parallel subsystems that lack clear mechanisms for integration. As a result, information sources operate independently rather than forming a coordinated guidance structure. This pattern demonstrates how information gaps at the route level can gradually develop into broader navigation problems between destinations. When subsystems such as signage, transportation information and digital navigation do not function within a shared spatial logic, travelers must continuously reinterpret their position and direction. Consequently, the absence

of coordination among wayfinding components amplifies the discontinuities already present along navigation routes, reinforcing the fragmented character of the overall travel experience.

Table 3 summarizes the thematic analysis of fragmentation across the three principal wayfinding components identified in this study. The analysis demonstrates that fragmentation occurs in different forms depending on the operational characteristics of each component, namely localized fragmentation in signage and maps, functional fragmentation in transportation information, and referential fragmentation in digital and informal navigation sources. Although these forms of fragmentation emerge from different empirical conditions, they collectively disrupt navigation continuity and reinforce systemic fragmentation across interconnected cultural destinations.

Table 3: Thematic Analysis Process of Fragmentation Among Wayfinding System Components

Wayfinding Component	Empirical Indicators	Analytical Codes (Open Coding)	Relational Categories (Axial Coding)	Layered Themes (Selective Coding)
Signage and Maps	Directions are not always consistent and maps do not show how places are connected	Internal fragmentation	Local information not connected to other routes	Localized Fragmentation
Transportation Information	Technical routes are clear but not connected to cultural destinations	Functional fragmentation	Mobility systems and destination systems are not aligned	Functional Fragmentation
Digital / Informal Sources	Differences occur between application directions and on-site signage	Referential fragmentation	Information sources conflict with each other	Referential Fragmentation

Figure 1 presents an analytical diagram illustrating the relationships among the key components of systemic wayfinding fragmentation identified in this study. The diagram shows how limited initial orientation at city access points, inconsistent route-based information, and conflicts among wayfinding subsystems (signage, transportation information, and digital or informal navigation) collectively contribute to fragmented navigation experiences. Rather than depicting isolated navigation problems, the Figure synthesizes the empirical patterns identified through thematic analysis and demonstrates how these interrelated fragmentation processes influence visitor movement across interconnected cultural destinations.

Figure 1 illustrates how fragmentation operates within the context of this study. Orientation begins at city access points with limited support for understanding spatial connections and information subsequently flows across route segments in a discontinuous manner. Signage, transportation information and digital or informal navigation operate as separate subsystems with poorly coordinated mechanisms, making cross-route navigation difficult. These structural disruptions reduce the cohesiveness of tourist experiences and contribute to a less coherent urban narrative.

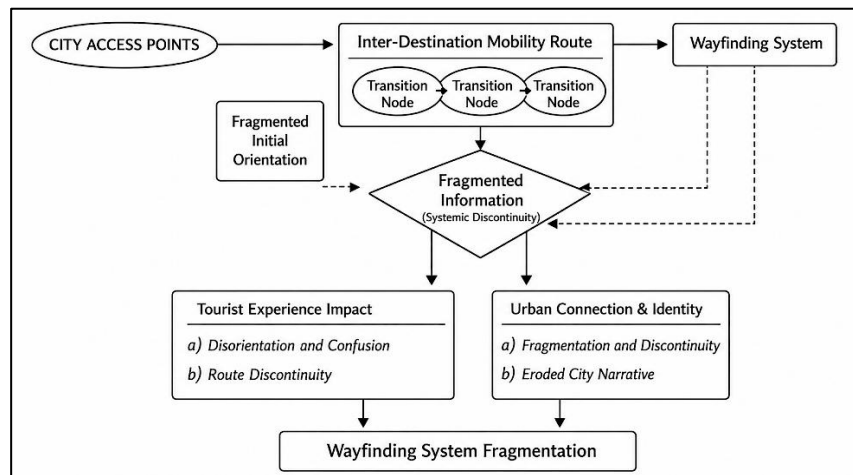


Figure 1: Systemic Wayfinding Fragmentation Across Access Points, Routes and Cultural Destinations

When orientation established in one segment of a journey cannot be maintained in the next, cross-route navigation becomes unstable. At the final stage, fragmentation appears both at the level of information and between system components. This condition becomes particularly visible in the continuity of travel between cultural destinations. Movement no longer occurs as a single integrated route but unfolds in episodic segments, each requiring the traveler to re-establish orientation. During route-based observations, disruptions became evident when visitors left one destination and attempted to reach the next. Orientation previously established through local signage, transportation systems, or digital applications did not provide a stable reference point for subsequent movement. As one informant explained, “I had to start over to find my way again after leaving the village” (I1).

Another participant stated,

“The route feels broken; there are no signs pointing to the next place” (I4).

These statements indicate that disruption occurs not only when directional cues are absent, but also when travelers are unable to maintain orientation across different contexts. In response, travelers adopt situational strategies to continue their journeys. One participant noted, “Just follow the crowded road” (I6). While such strategies allow the trip to continue, they remain temporary solutions and do not establish a stable navigation structure. Orientation thus shifts from a systemic form to an adaptive one.

These disruptions also reshape the overall structure of the journey. When travelers perceive movement between destinations as a continuous

cognitive burden, they begin to modify their travel sequence or cancel planned visits. One participant explained,

“I actually wanted to go to another village, but I didn’t because I wasn’t sure where to go” (I3).

In this context, disruption is not merely a problem of directional guidance; it becomes a factor that reconfigures regional exploration patterns. From an analytical perspective, cross-route navigation disruption can be interpreted as the convergence of the previously identified forms of fragmentation: localized fragmentation, functional fragmentation and referential fragmentation. When local orientation is inconsistent, mobility systems are disconnected from destination networks and reference sources are misaligned, journeys between destinations lose their structural continuity. Rather than perceiving routes as an interconnected network, travelers experience them as fragmented segments that must be renegotiated repeatedly. At this point, the travel experience begins to break down at a broader spatial scale, as will be discussed in the following section.

Fragmented Tourism Experience

When routes are not interconnected, the consequences extend beyond navigational difficulty and reshape the overall tourism experience. When the flow of movement between destinations ceases to be continuous, the journey is no longer perceived as a unified process. Each destination becomes an isolated unit, disconnected from others through the surrounding spatial context.

Observations indicate that travelers often adjust their plans when they experience disorientation

along the route. Cultural destinations are visited individually without consideration of how the areas relate to one another. One informant stated, "Just go to one village... finish, then move to another." (12)

Another participant explained, "I felt like I was visiting each place separately." (15)

In such situations, movement between locations is not regarded as part of the tourism experience but rather as a necessary logistical step. Travelers therefore tend to make pragmatic decisions regarding the use of time and energy. Some visitors choose to shorten or cancel subsequent visits when they become uncertain about the route. As one informant noted,

"In the end, I just visited one village so it wouldn't be too complicated." (16)

These decisions are not determined solely by personal preference but also represent responses to unstable navigation conditions. Fragmented orientation simplifies travel choices by encouraging visitors to reduce their routes.

Fragmentation influences not only the routes chosen by travelers but also the ways in which they remember and describe their experiences. During interviews, participants rarely described spatial or thematic connections between the places they visited. One informant explained, "I remember each place, but it didn't feel like one continuous trip." (17)

As a result, travel narratives are constructed as collections of individual experiences rather than as a single trajectory through space. From an analytical perspective, this fragmented travel experience indicates the structural role of mobility continuity in shaping tourism perception. When wayfinding systems fail to maintain connections between destinations, transitional spaces no longer function as integrative elements within the experience. The journey does not develop as a layered spatial process but instead appears as a series of separate episodes. Under these conditions, navigation fragmentation constrains cross-destination exploration and contributes to the weakening of regional narratives, which will be discussed in the following section. These findings show that mobility continuity plays an important role in shaping visitor experiences. When connections between destinations cannot be understood as a whole through the wayfinding

system, the journey loses its integrated character and becomes a series of separate experiences.

Weakening of Regional Narratives and Area Identity

The next impact of fragmentation is its influence on the formation of the overall cultural narrative of the area. When visitors are unable to understand the connections between destinations as a whole, they experience difficulties in developing an understanding of the tourism identity as an integrated entity.

The fragmentation of experiences described above extends beyond individual perception and affects the collective interpretation of cultural spaces. When movement between destinations does not occur as part of a coherent trajectory, tourists' experiences fail to reveal how places are interconnected. A spatial structure linking different areas does not emerge. Instead, visitors travel to each location separately and experience them as distinct destinations.

Descriptions provided by tourists during observations and interviews confirm this pattern. Cultural destinations are generally perceived as independent places rather than as components of a broader regional narrative. One informant stated, "I know this is a batik city, but each village has its own vibe." (17)

Another participant explained,

"It doesn't feel like one large area; it feels more like several small areas located next to each other." (13)

These statements indicate that the relationships between places are not perceived as part of a cohesive entity. A disconnection appears both spatially and narratively. When tourists cannot easily move from one part of the city to another, they struggle to organize their experiences into a coherent narrative about the city as a whole. As one informant noted,

"I remember each place, but I cannot describe the city as a whole." (15)

The narratives formed through these experiences tend to be short-lived and localized, applying only to individual destinations rather than supporting broader regional understanding. In this situation, regional identity exists but does not integrate into a unified experience. Each location possesses its own distinctive character and attraction, yet the travel route does not communicate how these elements relate to one another.

Discontinuous wayfinding prevents visitors from perceiving the cultural area as an integrated whole. Transitional spaces that should function as connectors between destinations do not contribute to cultural interpretation; instead, they are experienced merely as logistical intervals without contextual meaning.

From an analytical perspective, the erosion of regional narratives can be understood as the cumulative outcome of localized fragmentation, functional fragmentation and referential fragmentation. When local orientation is inconsistent, mobility systems are disconnected from destinations and reference sources contradict one another, travel experiences fail to form a stable spatial structure. Without such continuity, regional identity does not emerge as a unified construct but instead appears as a collection of separate and unrelated images. At this point, wayfinding fragmentation does not merely affect movement; it also reshapes how visitors conceptualize the city as a cultural space.

Based on the overall findings from the field, wayfinding fragmentation is not only a navigation problem but also relates to the disruption of the regional cultural narrative. Therefore, the continuity of wayfinding systems plays a strategic role in connecting the regional cultural narrative and supporting visitor mobility.

Discussion

This study shows that wayfinding fragmentation does not occur suddenly at a single navigation point, but develops through a series of processes throughout the visitor journey. The fragmentation begins with limited orientation at the city entry point and then develops into information gaps when visitors move between destinations. This situation is further increased by the lack of integration between different wayfinding subsystems, such as physical signage, transportation information and digital navigation. The accumulation of these different forms of disconnection eventually creates a fragmented travel experience and limits the formation of a regional cultural narrative. Therefore, fragmentation is understood as a systematic process that develops gradually, rather than a failure of a single navigation element.

This study demonstrates that wayfinding

problems in cultural areas arise from a series of interrelated difficulties experienced by travelers throughout their journeys. The lack of initial orientation at city entry points makes navigation more challenging and this condition is further exacerbated by missing information along routes and conflicts between different components of the wayfinding system. These findings indicate that navigation experiences are increasingly shaped by the interaction among elements rather than being determined solely by the presence of a single sign or piece of information. This perspective views wayfinding as a process that unfolds over time rather than as a rapid reaction to a specific sign. Orientation is created and negotiated throughout the journey through a combination of visual cues, contextual choices and spatial navigation experiences. This perspective aligns with the conventional understanding of urban structure as a product of interactions among perception, movement and users' cognitive representations (14). The findings of this study support Lynch's view that legibility is an important element in spatial orientation. However, this study shows that visual legibility alone is not enough to ensure continuous navigation. Unlike previous studies that mainly focused on the effectiveness of individual navigation elements, this study found that visitors can still experience fragmentation even when several wayfinding elements function well. This occurs because the relationships between wayfinding subsystems are not fully integrated. Therefore, this study extends wayfinding research from evaluating individual elements to examining the connections between navigation subsystems.

The findings regarding route fragmentation and the erosion of regional narratives indicate that wayfinding failures produce impacts that extend beyond technical navigation issues. When wayfinding systems fail to maintain orientation continuity, journeys are experienced as a series of discrete segments rather than as a cohesive spatial experience. This situation demonstrates that wayfinding functions as a cohesive link between mobility, spatial understanding and the construction of place meaning, supporting the perspective that wayfinding is a fundamental component of experiencing the built environment (16).

Wayfinding as a Systemic Issue Rather Than a Single-Element Problem

Wayfinding difficulties in the cultural areas examined in this study are not caused by a single factor such as poorly designed signage or unclear maps. The problem lies in how different sources of information function, or fail to function, together during the journey. Tourist orientation is shaped by a sequence of interrelated decisions, meaning that a lack of integration at one stage directly influences subsequent stages.

This approach conceptualizes wayfinding as a layered and continuous process. Orientation does not emerge from a single moment of decision making. Instead, it develops through ongoing interactions with visual and spatial cues that must be referenced from one segment of a route to the next. When this continuity is disrupted, individuals navigating the space must repeatedly reorient themselves, even when individual components appear to function independently. This perspective is consistent with research on spatial cognition that emphasizes the importance of maintaining continuous information flow during navigation (22).

In cultural contexts, fragmentation often occurs because each information subsystem is developed with different objectives. Transportation information is intended to facilitate efficient movement, physical signage is designed to guide direction and orientation and digital navigation applications usually prioritize the fastest route to a destination. When these subsystems are not designed to operate in coordination, conflicts between reference frameworks inevitably emerge. This condition supports the argument that navigational failures are relational rather than simply the result of insufficient individual information media (23).

The conceptual diagram proposed in this study illustrates how systemic fragmentation operates. Rather than presenting navigation as a linear path, the diagram emphasizes transition points and connections between segments, which are often the primary sources of orientation problems. This interpretation shifts the evaluation of wayfinding from visual clarity toward the comprehensibility of the overall navigation experience.

Spatial legibility therefore involves not only the ability to find one's way but also the capacity to construct a logical sequence of spatial experiences

while moving through the city. This perspective aligns with urban design theory, which views visual and spatial experiences as interconnected rather than separate elements (24). By framing wayfinding as a systemic challenge, the findings of this study can be interpreted as a critique of fragmented methodologies in navigation planning within cultural contexts. Orientation fragmentation and route disruptions are therefore understood not as isolated technical failures but as consequences of the absence of an integrative framework that connects multiple sources of information. This framework provides the basis for examining how wayfinding fragmentation influences traveler experiences and shapes cultural interpretation in subsequent analysis.

Fragmentation, Experience and Cultural Meaning

The fragmented navigation patterns identified in this study affect not only navigational effectiveness but also the organization of travel experiences. When movement between locations is not perceived as a continuous line, the travel experience does not develop as a coherent spatial trajectory. Tourists do not move in ways that reveal how places are interconnected; instead, each location appears as an isolated point. This finding is further supported by the background characteristics of the research participants. The participants were visitors from outside Surakarta City who visited at least two batik tourism areas during a single trip, used public transportation and/or walked and were not accompanied by official tour guides. These characteristics were selected because they placed participants in situations where they needed to develop their own spatial orientation when moving between destinations. The participants included both first-time and repeat visitors, with different levels of familiarity with digital navigation. However, fragmentation experiences were found across all groups of informants. This indicates that navigation discontinuity is not only influenced by previous visiting experience or the ability to use digital navigation, but also reflects the lack of integration within the wayfinding system connecting Batik Laweyan, Batik Kauman and Kampung Blangkon as a unified cultural destination network in Surakarta's batik tourism area.

Mobility in tourism experiences functions not only as a means of navigation but also as a mechanism for meaning-making. Traveling from one location to another enables tourists to perceive connections among places, themes and regions. The findings of this study indicate that when orientation continuity is disrupted, transitional spaces cease to facilitate experiential connections. The journey no longer forms a layered spatial structure; instead, it becomes fragmented into episodic movements that are redefined with each transition. This finding reinforces the argument that mobility practices constitute an essential dimension of tourism experiences rather than merely a technical framework for movement (25). Mobility fragmentation also shapes the formation of cultural meaning. Local fragmentation confines orientation to the scale of a single destination, functional fragmentation separates mobility from the destination system and referential fragmentation produces conflicts between reference sources. As a result, tourists lack a stable spatial framework for integrating experiences across multiple locations. Culture is therefore perceived as an inherent attribute of individual places rather than as part of an integrated regional landscape. In such contexts, regional imagination becomes only partially constructed and is instead associated with specific localized experiences (26). This separation also alters the way tourists interact with cultural areas. Rather than encouraging cross-destination understanding, fragmented experiences reinforce the perception of places as discrete entities. Transitions between spaces do not contribute to a broader narrative of the region; instead, they reveal gaps that remain unconnected. This condition illustrates the challenges involved in developing cultural tourism destinations that are both experientially engaging and structurally coherent (27).

Discontinuities in wayfinding can therefore be interpreted as structural barriers to the formation of regional significance. Consistent orientation is necessary for integrative trans-spatial experiences to emerge. Without such continuity, cultural identity does not function as an interconnected system of meaning; rather, it appears as a collection of localized representations lacking spatial cohesion. From this perspective, wayfinding extends beyond simple navigation and becomes a system that shapes the epistemic

conditions through which cultural spaces are understood and constructed within tourism experiences.

This research calls for a redefinition of wayfinding within the framework of spatial and cultural tourism studies. Wayfinding is conceptualized not merely as a practical navigational instrument concerned with efficiency or visual clarity, but as a relational practice encompassing orientation, mobility and the attribution of regional significance. The study emphasizes journey continuity by shifting the evaluative focus from the performance of discrete components to systemic integration among navigation subsystems.

The first contribution lies in framing wayfinding fragmentation as a systemic phenomenon. Most wayfinding studies examine the effectiveness of signage, the clarity of maps, or individuals' ability to construct mental images of surrounding spaces. These approaches often isolate navigational elements from their contextual associations. This study proposes an analytical typology that categorizes disruptions emerging from interactions among subsystems into local fragmentation, functional fragmentation and referential fragmentation. The typology suggests that navigation failures arise not only from the absence of individual elements but also from inadequate integration among simultaneous orientation frameworks.

The second contribution analyzes the interaction between wayfinding and the formation of cultural significance. The findings indicate that orientation continuity is not merely a technical requirement for mobility but also a structural prerequisite for developing integrated cross-destination experiences. When this continuity is disrupted, regional identities fail to align along travel trajectories; instead, they appear as a series of disconnected local representations. In this sense, wayfinding can be understood as symbolic infrastructure that facilitates the conceptualization and construction of cultural space within tourism experiences (28, 29).

This study expands the investigation of wayfinding by shifting emphasis from element-based evaluation toward relational dynamics among orientation systems. The proposed framework facilitates dialogue among scholars and practitioners working in wayfinding, mobility and cultural tourism. It also provides a basis for

reconsidering how navigation systems shape spatial experiences and the interpretation of medium-sized heritage cities.

The findings indicate that improving individual components alone will not necessarily enhance navigability in cultural districts. Wayfinding operates as a system that should function consistently from the moment visitors enter a city to the moment they transition between destinations. Adjusting a sign or map may have limited impact if the overall travel sequence remains unclear. Urban planning should therefore ensure that visitors can move between locations through coherent and continuous routes. Such routes facilitate mobility by linking different pathways, cultural sites and access points within a single travel experience. Area maps, transportation information and directional signage should operate cohesively to maintain orientation continuity. This approach aligns with user-centered design principles that emphasize the importance of clear information and coherent spatial experiences (30).

Another policy implication relates to the operation of digital information systems. The study indicates that digital platforms often function as separate systems that are poorly integrated with physical wayfinding infrastructure. Policies should therefore encourage consistency in destination naming, location references and intermodal transition information across both digital and physical systems to avoid conflicting references. In this way, technology can support not only efficient travel but also deeper engagement with the surrounding environment.

Tourism planning should also recognize mobility between destinations as part of the cultural heritage experience. Routes connecting streets, transit stops and cultural sites can serve as interpretive pathways through which visitors learn about the city. This approach is consistent with cultural tourism policies that emphasize sustainability and holistic experiences, where mobility and orientation are essential components of a positive tourism experience (3). The practical and policy implications of this study highlight the importance of cross-sector collaboration in improving navigation within cultural heritage environments. Integrating physical design, transportation systems and digital information

into a unified orientation strategy can enhance navigability while also enabling visitors to gain a deeper understanding of the city's heritage identity.

The three types of fragmentation identified in this study are not viewed as separate categories, but as interconnected dimensions that explain how navigation disruptions emerge throughout the visitor journey. Therefore, this study proposes the Systemic Fragmentation Framework as a conceptual framework to explain the relationship between initial orientation, information continuity, wayfinding subsystem integration, visitor experience and the formation of regional cultural narratives. This framework extends previous wayfinding studies, which have mainly focused on evaluating individual elements, by shifting the focus toward the integration of the navigation system as a whole.

Theoretically, this study contributes to a deeper understanding of wayfinding through three main perspectives. First, it introduces the concept of systemic fragmentation, explaining that navigation difficulties are caused by disconnected relationships between wayfinding subsystems rather than only by weaknesses in individual navigation elements. Second, this study develops the idea of relational wayfinding by viewing navigation as a process that connects different locations within an integrated tourism network. Third, this study conceptualizes wayfinding as a narrative infrastructure, expanding its role from a mobility support tool into an infrastructure that connects destinations and strengthens regional cultural narratives. Practically, the findings of this study show that improving wayfinding quality in heritage cities cannot be achieved simply by adding separate signs or maps. Local governments need to develop integrated wayfinding systems by aligning information from physical signage, transportation systems and digital navigation platforms to create continuous orientation from the moment visitors enter the city until they move between destinations. In addition, collaboration between local governments, destination managers, transportation providers and digital navigation service developers is needed to create an orientation system that not only improves visitor mobility but also strengthens the identity and cultural narrative of the region.

Conclusion

The study demonstrates that navigational difficulties within cultural networks do not primarily stem from the absence of individual navigation elements, but rather from the malfunctioning of multiple orientation systems operating simultaneously. Through thematic analysis of route observations and traveler interviews, the research identifies three categories of fragmentation local, functional and referential which collectively shape travel routes and influence the structure of visitor journeys. These findings underline that orientation continuity serves purposes beyond the technical aspects of navigation. When local orientation is unclear, mobility systems are disconnected from destinations and reference sources are inconsistent, travel routes fail to form coherent spatial pathways. Under such conditions, travel experiences become fragmented and regional identity does not emerge as a unified construct within visitors' mobility practices.

This research redefines wayfinding from an element-centered perspective toward a relational framework that emphasizes coordination among subsystems as the primary analytical focus. By outlining a typology of systemic fragmentation, the study establishes a conceptual framework for understanding navigation as infrastructure that supports both mobility and the construction of meaning in cultural contexts. This perspective expands the discourse on wayfinding, mobility and cultural tourism research, particularly in relation to medium-sized heritage cities.

The findings also highlight the importance of interdisciplinary collaboration in the development of effective wayfinding systems. Physical design, transportation networks and digital platforms must operate cohesively in order to support integrated navigation experiences. Addressing only one component in isolation may improve specific elements but will not resolve systemic fragmentation. Although the analytical framework of this study is based on Surakarta, it is applicable to other medium-sized heritage cities facing similar challenges. Future research may examine this fragmentation typology through comparative studies or integrated design interventions in order to evaluate how orientation continuity influences the development of coherent visitor experiences

and holistic cultural interpretation across urban heritage landscapes.

Despite these contributions, this study has several limitations. It is based on a single case study in Surakarta and focuses exclusively on domestic visitors within a specific cultural tourism context. Consequently, the findings provide analytical rather than statistical generalization and may not fully represent the navigation experiences of other heritage cities or international visitors. Future research could examine the proposed systemic fragmentation framework through comparative studies across different heritage cities, include more diverse visitor groups, or evaluate integrated wayfinding interventions using mixed-method or longitudinal approaches to further explore their effects on navigation continuity and regional cultural narratives.

Abbreviations

None.

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Author Contributions

Nadia Sigi Prameswari: Conceptualisation, Methodology, Data Collection, Supervision, Resource, Muhammad Nasirul Umam: Conceptualisation, Methodology, Review, Editing, Maharani Intan Andalas: Writing, Formal Analysis, Resources, Maria Krisnawati: Original Draft Preparation, Data Curation.

Conflict of Interest

The authors declare that there is no conflict of interest.

Data Availability

The data supporting the findings of this study are available from the corresponding author upon reasonable request. The data are not publicly available due to privacy and confidentiality considerations.

Declaration of Artificial Intelligence (AI) Assistance

The authors acknowledge the use of generative AI to assist in paraphrasing selected sections of the

manuscript. All AI-generated content was critically reviewed, edited, and verified by the authors to ensure its accuracy, originality, and compliance with academic standards. The authors take full responsibility for the integrity and validity of the manuscript. Generative AI was also used to assist in the initial development of Figure 1. The Figure was subsequently reviewed, refined, and validated by the authors to ensure that it accurately represents the findings and conceptual framework of this study.

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