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A Comparative Study of International Tourists' Experiences at Hangzhou's Three World Heritage Sites: A Text Mining Approach Based on Online Reviews

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Abstract

As a renowned tourist destination in China, Hangzhou is home to three UNESCO World Heritage Sites: the West Lake Cultural Landscape, the Grand Canal (Hangzhou Section), and the Liangzhu Archaeological Ruins. With the continuous development of international tourism, gaining a clear understanding of how foreign visitors perceive and evaluate these heritage sites has become increasingly critical for improving destination management and boosting cultural communication. This study explores the experiences of international tourists at Hangzhou's three World Heritage Sites, drawing on English-language online reviews collected from TripAdvisor and Google Reviews. It adopts a mixed-method approach that combines Latent Dirichlet Allocation (LDA) topic modeling, an improved VADER sentiment analysis method, Importance-Performance Analysis (IPA), and manual content analysis. Based on around 1200 collected online reviews, this research identifies core themes, emotional responses, and potential service problems related to each of these heritage sites. The results show that international visitors hold generally positive attitudes toward all three heritage sites, but their experiences vary in line with the distinct characteristics of each heritage type. West Lake is most commonly associated with natural scenery and cultural landscapes, yet overcrowding remains a key issue that drags down visitor satisfaction. The Grand Canal is strongly linked to historical culture and cruise experiences, though excessive commercialization may erode its cultural authenticity. Liangzhu is primarily recognized for its museum architecture and archaeological value, but insufficient multilingual support and interpretation services hinder international visitors from grasping its full cultural significance. Overall, this study highlights how heritage type shapes international tourists' perceptions and identifies site-specific management priorities for each site. The findings indicate that effective development of heritage tourism requires not only the preservation of cultural resources, but also targeted improvements to visitor management, multilingual services, and cultural interpretation. This research also illustrates the value of text mining methods for analyzing international tourist experiences and informing management decisions at heritage destinations.

Key words: World Heritage Sites; Hangzhou; International Tourists; Topic Modeling; Sentiment Analysis; Importance-Performance Analysis; Text Mining

Introduction

Heritage tourism has become an important driver in promoting cultural exchange and boosting destination development. As precious cultural and historical resources, World Heritage Sites offer visitors opportunities to experience local traditions, grasp historical significance, and build connections with different cultures. With the growing importance of international tourism, understanding how overseas visitors perceive and evaluate heritage destinations has become a core concern for tourism management and cultural communication.

Hangzhou is one of the most representative cultural tourism destinations in China, and is home to three UNESCO World Heritage Sites: the West Lake Cultural Landscape, the Grand Canal (Hangzhou section), and the Liangzhu Archaeological Ruins. Although all three sites are located within the same city, they represent different types of heritage. West Lake integrates natural landscapes with cultural traditions and historical narratives, offering visitors an experience centered on landscape appreciation and cultural understanding. The Grand Canal represents a living heritage system, where historical continuity and tourism activities are closely intertwined through waterways and the local environment. By contrast, Liangzhu showcases archaeological heritage through museum exhibitions, cultural interpretation, and the presentation of ancient civilization. These differences between heritage types create an opportunity to explore how different forms of heritage shape the experiences of international tourists.

Previous studies on heritage tourism have mainly focused on destination image, tourist satisfaction, or individual heritage attractions. However, research comparing international tourists' perceptions of different types of World Heritage Sites within the same destination remains relatively limited. International visitors may have different expectations from domestic tourists, particularly regarding language support, cultural interpretation, accessibility, and service quality. Therefore, examining international tourists' experiences across multiple heritage sites can provide a more comprehensive understanding of heritage tourism development.

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With the rapid growth of online travel platforms, tourist reviews have become an important source for analyzing visitor experiences. Compared with traditional survey methods, online reviews contain spontaneous expressions of tourists' perceptions, emotions, and evaluations. By applying text mining and sentiment analysis techniques, large-scale review data can reveal the major factors influencing tourist satisfaction and dissatisfaction. These methods provide new possibilities for understanding heritage tourism from the perspective of international visitors.

Based on this background, this study focuses on international tourists' experiences at Hangzhou's three World Heritage Sites by analyzing English-language online reviews collected from international tourism platforms. A mixed-method approach combining LDA topic modeling, improved VADER sentiment analysis, Importance-Performance Analysis (IPA), and manual content analysis is adopted to identify major experience themes, evaluate tourists' emotional responses, and determine potential areas for improvement.

This study contributes to heritage tourism research in several ways. First, it provides a comparative perspective by examining different categories of World Heritage Sites within the same destination, highlighting how heritage characteristics shape tourist perceptions. Second, by integrating multiple text analysis methods, this research provides a more comprehensive understanding of the relationship between visitor attention, emotional evaluation, and management priorities. Third, the findings offer practical implications for improving international tourism services, cultural interpretation, and heritage management strategies in Hangzhou.

Accordingly, this study aims to answer four research questions: what major themes are reflected in international tourists' perceptions of Hangzhou's three World Heritage Sites; how tourists' emotional responses differ across different experience dimensions; which aspects require further improvement based on the IPA framework; and how different heritage types influence international tourists' overall experiences and evaluations.

Literature Review

Topic Modeling in Tourism Research

In recent years, topic modeling has been increasingly applied in tourism research to analyze large-scale user-generated content. Among different topic modeling approaches, Latent Dirichlet Allocation (LDA) is one of the most widely used methods for identifying hidden themes within textual data. LDA is a probabilistic model that assumes each document contains multiple topics, while each topic consists of a specific distribution of words (Blei et al., 2003).

Previous studies have applied LDA in various tourism contexts, including hotel reviews, destination image analysis, and tourist satisfaction evaluation.(Guo et al., 2017; Xiang et al., 2017; Xu & Li, 2016). These studies indicate that topic modeling can reveal underlying patterns in visitor perceptions that may be difficult to identify through traditional qualitative methods.

More recently, researchers have extended the application of LDA to heritage tourism. For example,(Kim et al.,2019) used LDA to examine changes in international tourists' perceptions of UNESCO heritage sites on Jeju Island, while (Wang et al.,2021) applied the method to analyze destination images before and after travel experiences. These studies demonstrate the usefulness of topic modeling in understanding tourists' cognitive perceptions and evaluation patterns. However, previous research has mainly focused on individual destinations or similar types of tourism attractions. Comparisons among different categories of World Heritage Sites within the same destination remain relatively limited. This limitation suggests the need for further research that considers how different heritage characteristics influence tourist perceptions.

Sentiment Analysis in Tourism

Sentiment analysis, also known as opinion mining, has become an important approach for examining tourists' emotional responses in online reviews(Alaei et al., 2019). By extracting attitudes, opinions, and evaluations from textual data, sentiment analysis transforms subjective visitor experiences into measurable indicators.

Existing sentiment analysis methods can generally be divided into two categories: lexicon-based and machine learning-based approaches. Lexicon-based methods rely on predefined sentiment dictionaries to identify emotional expressions, whereas machine learning methods detect sentiment patterns through trained models. Among lexicon-based approaches, VADER (Valence Aware Dictionary and sEntiment Reasoner) has been widely adopted because of its effectiveness in processing informal online texts(Hutto & Gilbert, 2014).

Despite its advantages, general sentiment dictionaries may not fully reflect the characteristics of tourism-related language. Online tourism reviews often include domain-specific expressions related to scenery, service quality, accessibility, cultural experiences, and visitor expectations. Previous studies have shown that incorporating tourism-specific sentiment vocabulary can improve analytical accuracy in specialized contexts (Nie et al., 2020; Tan & Wu, 2011).

Therefore, adapting general sentiment analysis tools to tourism contexts can provide more reliable evaluations of visitor emotions(Li et al., 2023). In this study, the VADER dictionary is extended by adding tourism-related terms, allowing a more accurate analysis of international tourists' experiences at heritage destinations.

Importance-Performance Analysis (IPA)

Importance-Performance Analysis (IPA) is a commonly used framework for evaluating service attributes and identifying areas that require improvement(Martilla & James, 1977). The method assesses different attributes based on two dimensions: their importance to users and their actual performance. By comparing these two dimensions, IPA helps researchers and managers determine which aspects should receive more attention.

The IPA framework divides attributes into four categories:

1. Keep up the good work: attributes with high importance and high performance, indicating existing strengths that should be maintained.

2. Concentrate here: attributes with high importance but relatively low performance, suggesting areas requiring immediate improvement.

3. Low priority: attributes with both low importance and low performance, which may require fewer resources.

4. Possible overkill: attributes with low importance but high performance, indicating that resources may need to be reconsidered.

In tourism research, IPA has often been combined with text mining methods to evaluate destination experiences. Online reviews provide abundant information about tourists' expectations and satisfaction, making them valuable data sources for identifying important service attributes(Chen et al., 2022).

Following this approach, this study uses topic frequency as an indicator of attribute importance and sentiment scores as a measurement of performance. The combination of these methods allows for a more detailed evaluation of tourist expectations, satisfaction levels, and potential service deficiencies.

Research Gaps

First, existing research has mainly examined individual tourism destinations rather than comparing different categories of World Heritage Sites within the same destination. As a result, the relationship between heritage type and tourist perception has not been sufficiently explored.

Second, international tourists' perspectives remain relatively underrepresented in Chinese tourism research. Many previous studies focus primarily on domestic visitors, while international tourists may have different expectations regarding language services, cultural interpretation, and accessibility.

Third, relatively few studies have integrated multiple analytical methods, such as topic modeling, sentiment analysis, and IPA, within a unified research framework. Combining these approaches may provide a more comprehensive understanding of tourist experiences by connecting visitor concerns with management priorities.

Finally, cultural communication challenges at archaeological heritage sites have received limited attention. For international visitors, understanding archaeological meanings often depends on effective interpretation services, and

insufficient explanations may reduce their ability to fully engage with cultural resources.

To address these research gaps, this study compares three UNESCO World Heritage Sites in Hangzhou by integrating text mining, sentiment analysis, and IPA methods. Through this comparative perspective, the study aims to provide a deeper understanding of how different heritage characteristics influence international tourists' experiences and expectations.

Given the limitations of existing previous studies, a comprehensive analytical framework is needed to examine the experiences of international tourists from multiple perspectives. Accordingly, this study combines topic modeling, sentiment analysis, IPA, and content analysis to explore visitors' perceptions, emotional responses, and priorities for improvement at the three World Heritage Sites in Hangzhou. The following section introduces the research framework and methodology adopted in this study.

Research Questions

To address the research gap mentioned above, this study focuses on the following research questions:

RQ1: What are the main themes reflected in international tourists' perceptions of Hangzhou's three World Heritage Sites?

RQ2: How do tourists' emotional responses differ across various themes and heritage sites?

RQ3: Which factors should be prioritized for improvement according to the Importance-Performance Analysis (IPA) framework?

RQ4: How do the three heritage sites differ in terms of tourist experiences and cultural communication effectiveness?

Methodology

Analytical Framework

This study develops an integrated analytical framework to examine international tourists' experiences at Hangzhou's three World Heritage Sites. The framework consists of three stages: data collection, analytical processing, and practical application.

In the data collection stage, English-language online reviews were gathered from international travel platforms. These reviews provide direct information about tourists' perceptions, emotional responses, and evaluations of heritage sites.

In the analytical stage, multiple methods were applied to examine different dimensions of tourist experiences. LDA topic modeling was used to identify major themes within the reviews, while sentiment analysis was conducted to evaluate visitors' emotional responses. In addition, Importance-Performance Analysis (IPA) was applied to identify important factors affecting tourist satisfaction. Manual content analysis was further conducted to explore specific sources of dissatisfaction.

In the application stage, the analytical results were interpreted from a destination management perspective. By combining quantitative and qualitative findings, this study aims to identify both the strengths and improvement priorities of different heritage sites.

Data Collection

Data Sources

The data used in this study were collected from two international travel platforms: TripAdvisor and Google Reviews. These platforms were selected because they are widely used by international travelers and provide detailed textual reviews together with user ratings.

The data set consists of English-language reviews related to three UNESCO World Heritage Sites in Hangzhou: the West Lake Cultural Landscape, the Grand Canal (Hangzhou section), and the Liangzhu Archaeological Ruins. These reviews provide valuable insights into how international visitors perceive different types of heritage attractions.

Collection Process

The data collection process was conducted using Python-based web scraping methods. The Scrapy framework was combined with Selenium to collect both static and dynamically loaded review information.

Reviews were retrieved through site-specific keywords, including "West Lake Hangzhou," "Grand Canal Hangzhou," and "Liangzhu Museum." The collection period covered reviews published between 2019 and 2026. After the initial collection, duplicate entries and irrelevant reviews were removed before further analysis.

Data Set Summary

After data collection and filtering, the final dataset included 407 valid English-language reviews from the three heritage sites.

West Lake accounted for the largest number of reviews, with 389 valid samples after deduplication and language filtering. In comparison, the Grand Canal and Liangzhu Archaeological Ruins contained fewer English-language reviews, with 9 valid samples collected for each site.

Although the number of reviews varied considerably among the three sites, the dataset still provides a comparative perspective on how international tourists perceive different heritage categories. The detailed data processing results are presented in Table 1.

Data Preprocessing

Before conducting text analysis, several preprocessing steps were performed to improve data quality.

First, language filtering was applied to retain only English-language reviews. Reviews containing less than 60% English characters were excluded. Second, unnecessary information, including HTML tags, numbers, punctuation marks, special symbols, and irrelevant characters, was removed.

After cleaning, the review texts were tokenized into individual words. Common stop words were removed using the NLTK stop-word list, and lemmatization was applied to convert words into their basic forms. Finally, duplicate reviews were eliminated to ensure that each review represented an independent tourist experience.

Topic Modeling: LDA

Model Description

Latent Dirichlet Allocation (LDA) was applied in this study to identify the underlying themes contained in international tourists' online reviews. As a probabilistic topic model, LDA assumes that each document consists of multiple latent topics, while each topic is represented by a probability distribution of words(Blei et al., 2003). This characteristic allows researchers to extract potential semantic structures from large-scale textual data without relying entirely on manual classification.

In this study, the LDA model was estimated using Gibbs sampling, following previous topic modeling research (Griffiths & Steyvers, 2004). Through this approach, frequently occurring word patterns were grouped into meaningful topics, allowing the study to explore the main dimensions of tourists' perceptions of different heritage sites.

Compared with traditional qualitative coding methods, LDA provides a more systematic way to analyze large amounts of review data. It also reduces the influence of researchers' subjective judgments during the initial stage of theme identification.

Determination of Topic Number

The selection of an appropriate number of topics is an important step in LDA analysis. In this study, topic coherence scores were used to determine the optimal topic number. Different topic numbers (K values) were tested, and the value producing the highest coherence score was selected for each heritage site.

Based on the coherence evaluation results, four topics were identified for each of the three World Heritage Sites. Although the sites share some

Table 1. Summary of collected and processed review data

Site	Reviews Collected	After Deduplication	English Only	Valid for Analysis
West Lake	4008	904	389	389
Grand Canal	912	66	9	9
Liangzhu	113	30	9	9
Total	5033	1000	407	407

Table 2. Optimal topic numbers and identified themes for each site

Site	Optimal	Key Topics Identified
West Lake	4	Natural scenery, Cultural heritage, Crowding, Facilities
Grand Canal	4	History & culture, Boat experience, Architecture, Commercialization
Liangzhu	4	Museum architecture, Archaeological value, Exhibition quality, Visiting experience

common heritage characteristics, the extracted topics reflect their different tourism attributes.

For West Lake, the identified topics included natural scenery, cultural heritage, crowding, and facilities. These themes indicate that visitors' experiences are mainly shaped by landscape appreciation, cultural understanding, and visitor management issues.

For the Grand Canal, the extracted topics consisted of history and culture, boat experience, architecture, and commercialization. These topics reflect tourists' attention to historical continuity, waterfront experiences, and the relationship between tourism development and heritage preservation.

For Liangzhu, the main topics included museum architecture, archaeological value, exhibition quality, and visiting experience. These themes demonstrate that international visitors mainly evaluate Liangzhu through museum presentation, archaeological interpretation, and accessibility of cultural information.

The final topic structures of the three sites are summarized in Table 2.

Improved VADER Sentiment Analysis

Original VADER Model

This study applied VADER (Valence Aware Dictionary and sEntiment Reasoner) to measure the emotional tendencies expressed in international tourists' online reviews(Hutto & Gilbert, 2014). VADER is a lexicon-based sentiment analysis approach that calculates sentiment polarity scores based on predefined emotional vocabulary. The compound score ranges from -1 to +1, with lower values representing negative sentiment and higher values indicating positive sentiment.

Compared with traditional sentiment analysis methods, VADER is designed to handle informal online texts and considers several linguistic features, including capitalization, punctuation, degree modifiers, and common expressions. These characteristics make it suitable for analyzing user-generated content, such as online tourism reviews.

However, general sentiment analysis models may not fully capture the specific meanings of tourism-related expressions. Therefore, further adjustment was required to improve the accuracy of sentiment evaluation in the context of heritage tourism.

Domain-Specific Dictionary Extension

To better adapt VADER to heritage tourism reviews, this study expanded the original sentiment dictionary by incorporating tourism-related vocabulary. Additional terms related to scenery, service quality, crowding, price perception, and cultural experiences were included to better reflect visitors' evaluations of heritage destinations.

In addition, some attraction-related terms that could lead to inaccurate sentiment judgments were adjusted. Certain words appearing in attraction names or heritage descriptions may carry positive meanings in general language but do not necessarily express tourists' emotions. Therefore, these terms were assigned neutral values when appropriate to reduce potential bias in sentiment calculation.

Through these modifications, the improved VADER model was expected to provide a more context-sensitive measurement of international tourists' emotional responses toward different heritage sites.

Sentiment Score Calculation

After dictionary adjustment, sentiment scores were calculated for each review using the improved VADER model. The scores were then aggregated according to different topics and heritage sites to compare emotional differences among various tourist experience dimensions.

The sentiment results were further combined with topic modeling outcomes in the later IPA analysis. By linking frequently discussed themes with corresponding sentiment performance, this study evaluates not only what aspects tourists focus on but also how they perceive those aspects.

·Four quadrants were defined:

Importance-Performance Analysis (IPA)

Importance-Performance Analysis (IPA) was applied in this study to identify the strengths and improvement priorities of the three World Heritage Sites (Martilla & James, 1977). The method combines the frequency of topics discussed in online reviews with their corresponding sentiment scores, allowing a comparison between tourists' attention levels and their perceived experiences.

In this study, topic frequency was used as an indicator of importance, reflecting how frequently a specific aspect appeared in tourist reviews. Sentiment scores were used to measure performance, representing visitors' evaluations of different experience attributes. By integrating these two indicators, IPA provides a practical approach for identifying areas that require further improvement.

The IPA framework divides tourism attributes into four categories:

1. Keep up the good work:

Attributes with high importance and high performance. These aspects represent the existing advantages of a destination and should be maintained.

2. Concentrate here:

Attributes with high importance but low performance. These factors have a strong influence on tourist satisfaction and require priority improvement.

3. Low priority:

Attributes with both low importance and low performance. These aspects may receive fewer management resources.

4. Possible overkill:

Attributes with low importance but high performance. These areas may indicate that resources could be adjusted toward more urgent issues.

By applying IPA to the three heritage sites separately, this study identifies site-specific management priorities and compares differences among various heritage categories.

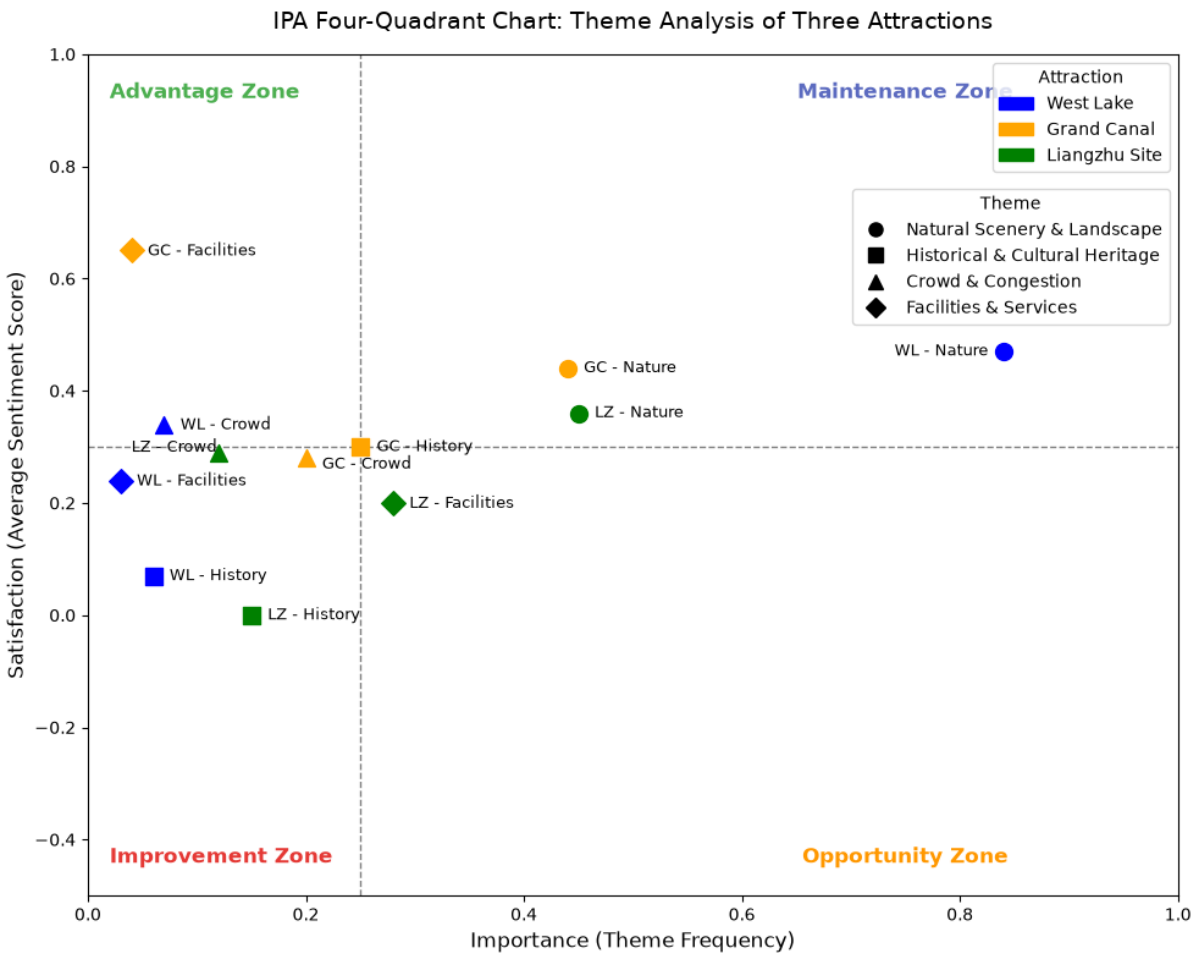


Fig. 3. IPA four-quadrant map

Content Analysis

To further explore the reasons behind tourists' dissatisfaction, manual content analysis was conducted on negative reviews. While quantitative methods can reveal general patterns of tourist perceptions, qualitative analysis helps explain the specific problems mentioned by visitors.

Following previous research approaches, reviews with ratings of three or below were selected, and sentences with sentiment scores lower than -0.5 were extracted for detailed examination.

The selected comments were manually reviewed and categorized according to major complaint dimensions. These categories included crowding, language services, pricing concerns, hygiene issues, commercialization, accessibility, guide services, and lack of immersion.

This qualitative analysis complements the findings obtained from topic modeling, sentiment analysis, and IPA. By examining specific visitor complaints, the study provides deeper explanations for the factors influencing international tourists' satisfaction and dissatisfaction with heritage sites.

Results

Topic Modeling Results

LDA topic modeling was conducted separately for the three World Heritage Sites to identify the major themes reflected in international tourists' online reviews. The results show that although the three sites share the common feature of cultural heritage, visitors associate them with different experiential dimensions according to their heritage characteristics.

Four major topics were extracted for each site. These themes reveal differences in how international tourists understand and evaluate natural-cultural landscapes, living heritage, and archaeological heritage destinations.

West Lake Cultural Landscape

The LDA model identified four main topics for West Lake: natural scenery, cultural heritage, crowding, and facilities and services.

Overall, West Lake is mainly characterized by its scenic value and cultural identity, while crowd management and service quality represent important experiential dimensions.

Grand Canal (Hangzhou Section)

For the Grand Canal, four topics were extracted: history and culture, boat experience, architecture, and commercialization.

Table 4. Topic modeling results for West Lake Cultural Landscape

Topic ID	Topic Name	Top Keywords	Weighted Terms
Topic 1	Natural Scenery	lake, view, beautiful, scenery, water, boat, sunset	0.035"lake" + 0.028"view" + 0.025*"beautiful" + ...
Topic 2	Cultural Heritage	history, culture, pagoda, legend, ancient, temple	0.042"history" + 0.038"culture" + 0.031*"pagoda" + ...
Topic 3	Crowding	crowded, people, busy, queue, tourist, weekend	0.048"crowded" + 0.035"people" + 0.029*"busy" + ...
Topic 4	Facilities & Services	ticket, price, boat, walk, restaurant, sign	0.031"ticket" + 0.028"price" + 0.026*"boat" + ...

Table 5. Topic modeling results for the Grand Canal

Topic ID	Topic Name	Top Keywords	Weighted Terms
Topic	History & Culture	canal, history, ancient, grand, heritage, dynasty	0.058"canal"+ 0.045"history"+ 0.032*"ancient" + ...
Topic2	Boat Experience	boat, ride, cruise, scenery, tour, water	0.065"boat"+ 0.048"ride"+ 0.036*"cruise" + ...
Topic3	Architecture	old, buildings, traditional, bridge, street, architecture	0.042"old"+ 0.038"buildings"+ 0.031*"traditional" + ...
Topic4	Commercialization	shops, tourists, shopping, crowded, prices, commercial	0.051"shops"+ 0.042"tourist"+ 0.035*"shopping" + ...

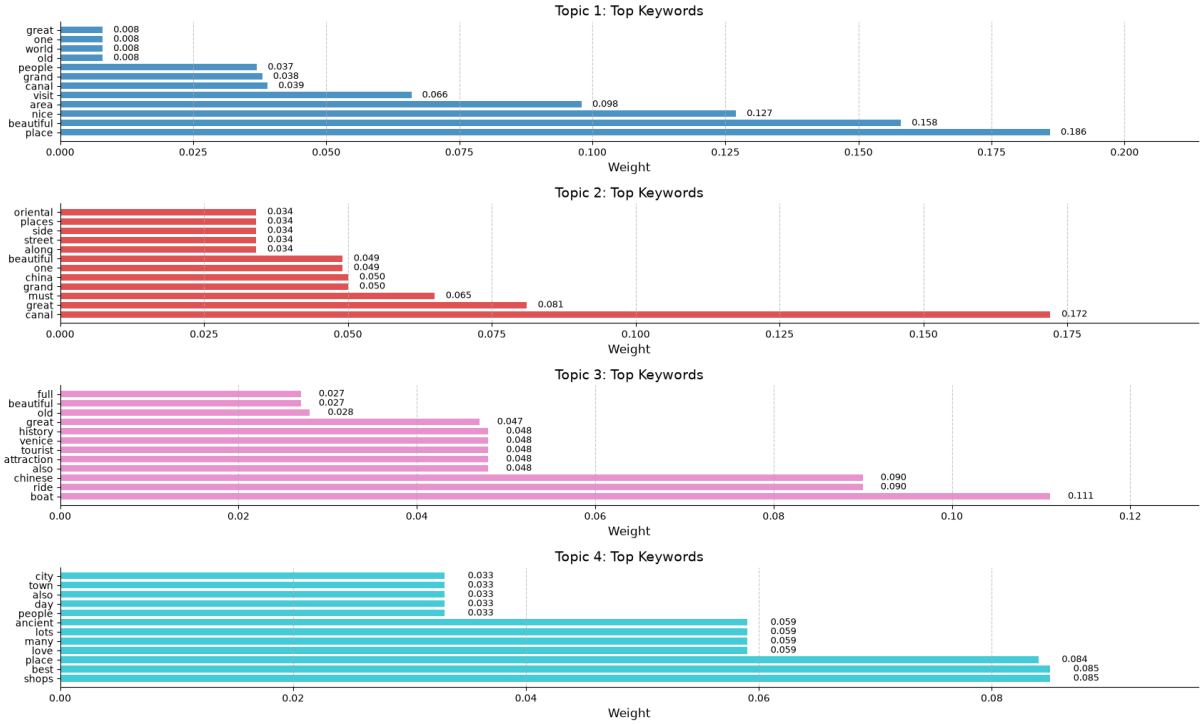


Fig. 5. Visualization of word distribution and weights for Grand Canal topics

Liangzhu Archaeological Ruins

Four topics were also identified for Liangzhu: museum architecture, archaeological value, exhibition quality, and visiting experience.

Sentiment Analysis Results

Overall Sentiment Scores

The improved VADER model was applied to evaluate the overall emotional responses of international tourists toward the three World Heritage Sites. The results show that all three sites received positive average sentiment scores, suggesting that international visitors generally had favorable experiences in Hangzhou's heritage destinations.

Among the three sites, West Lake achieved the highest mean sentiment score (0.64), followed by Liangzhu (0.62) and the Grand Canal (0.58). The positive review proportion was also dominant across all sites, indicating that visitors' overall evaluations were mainly characterized by appreciation and satisfaction.

Although the overall sentiment results were positive, differences could still be observed in negative emotional responses. West Lake recorded a negative sentiment proportion of 22.0%, while the Grand Canal showed a slightly higher proportion of 25.0%. Liangzhu had the lowest negative sentiment proportion at 20.0%, suggesting relatively fewer dissatisfaction factors among international visitors.

These findings indicate that the three heritage sites successfully provide valuable cultural and tourism experiences for international visitors. However,

Table 6. Topic modeling results for Liangzhu Archaeological Ruins

Topic ID	Topic Name	Top Keywords	Weighted Terms
Topic 1	Museum Architecture	museum, architecture, design, beautiful, building, modern	0.072"museum"+ 0.055"architecture"+ 0.041*"design" + ...
Topic 2	Archaeological Value	Liangzhu, ruins / ancient, Neolithic, / civilization, jade	0.068"Liangzhu" + 0.052"ruins" + 0.043*"ancient" + ...
Topic 3	Exhibition Quality	exhibits, collection, displayed, artifacts, impressive, curated	0.061"exhibits" + 0.048"collection" + 0.039*"displayed" + ...
Topic 4	Visiting Experience	visit, time, / guide, tour, walk, knowledgeable	0.055"visit" + / 0.042"time"+ 0.038*"guide" + ...

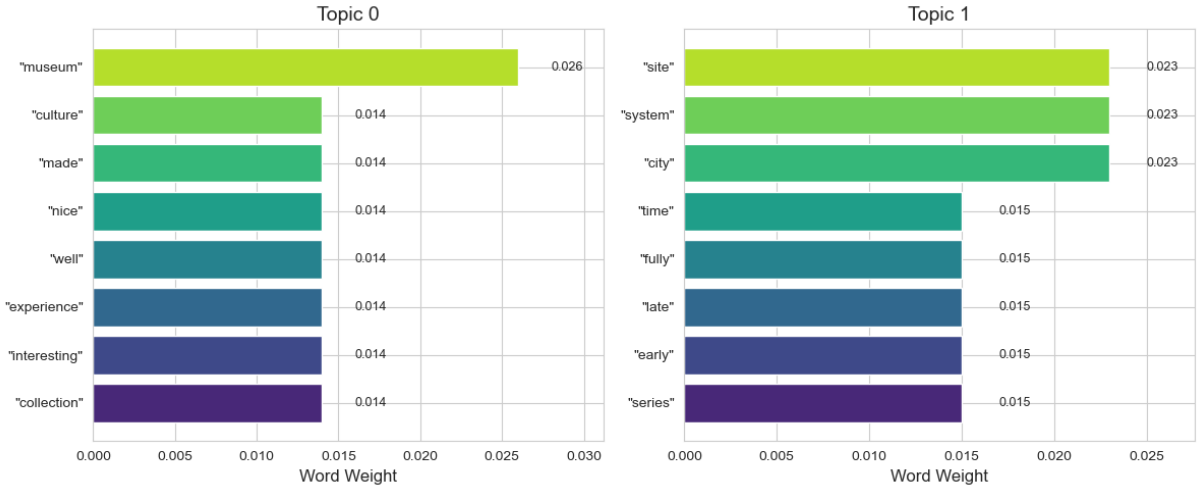


Fig. 6. Visualization of word distribution and weights for Liangzhu topics

Table 7. Overall sentiment statistics by site

Site	Mean Sentiment Score	Std / dev	Neutral (%)	Negative (%)
West Lake	0.64	0.31	9.8	22.0
Grand Canal	0.58	0.28	12.5	25.0
Liangzhu	0.62	0.25	15.0	20.0

Table 8. Theme-level sentiment scores across sites

Theme	West Lake	Grand Canal	Liangzhu
Natural Scenery	0.72	—	—
Cultural Heritage	0.65	0.68	0.60
Boat/Visit Experience	0.61	0.70	0.58
Architecture	0.58	0.62	0.75
Crowding/Commercialization	0.28	0.35	0.45
Facilities/Services	0.52	0.48	0.55
Museum/Exhibition	—	—	0.68

positive overall evaluations do not mean that management issues are absent. Specific concerns related to visitor density, service quality, language support, and tourism management continue to influence tourists' perceptions.

Theme-Level Sentiment Scores

Theme-level sentiment analysis reveals differences in how visitors evaluate specific aspects of each site.

Overall, visitors showed strong appreciation for the core heritage values of each site. Negative perceptions were mainly associated with management and service-related factors.

Importance-Performance Analysis Results

Importance-Performance Analysis (IPA) was conducted to further identify the strengths and improvement priorities of the three World Heritage Sites. By combining topic importance and sentiment performance, the analysis reveals which aspects of tourist experiences should be maintained and which areas require further management attention.

West Lake IPA Results

The IPA results show that West Lake's main strengths are natural scenery and cultural heritage. Both attributes are located in the "Keep up the good work" quadrant, indicating that these elements are highly valued by international tourists and receive positive evaluations. The results confirm that

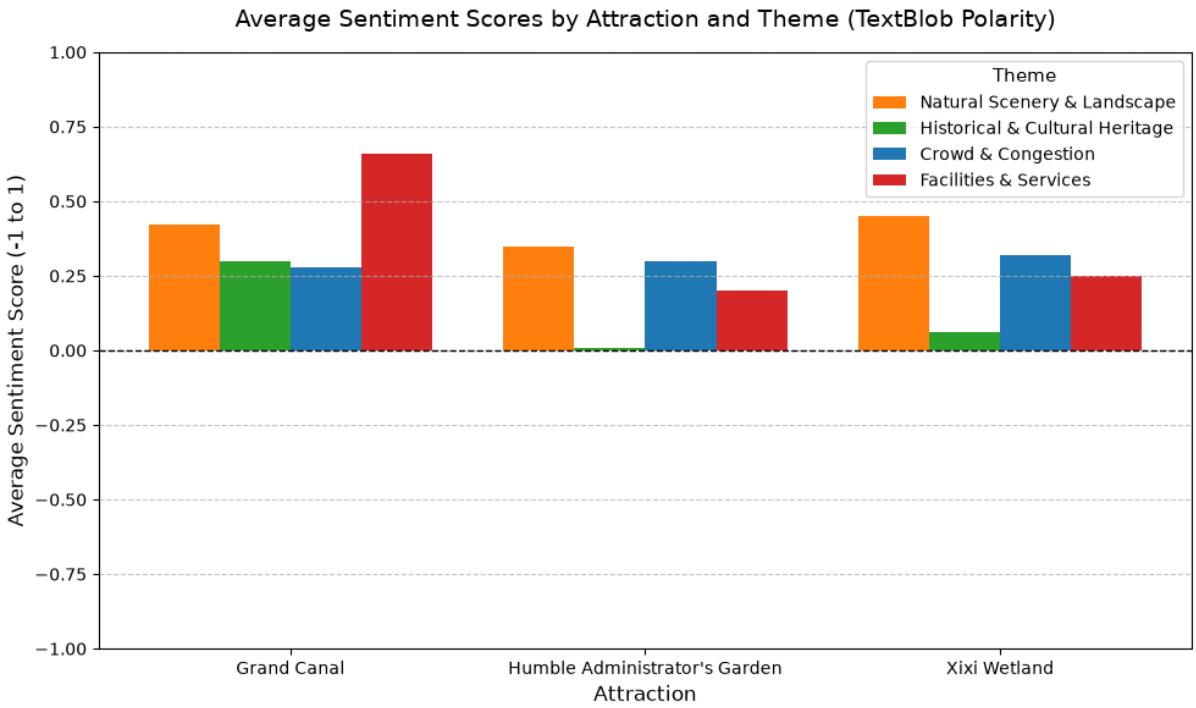


Fig. 7. Sentiment distribution across the three heritage sites

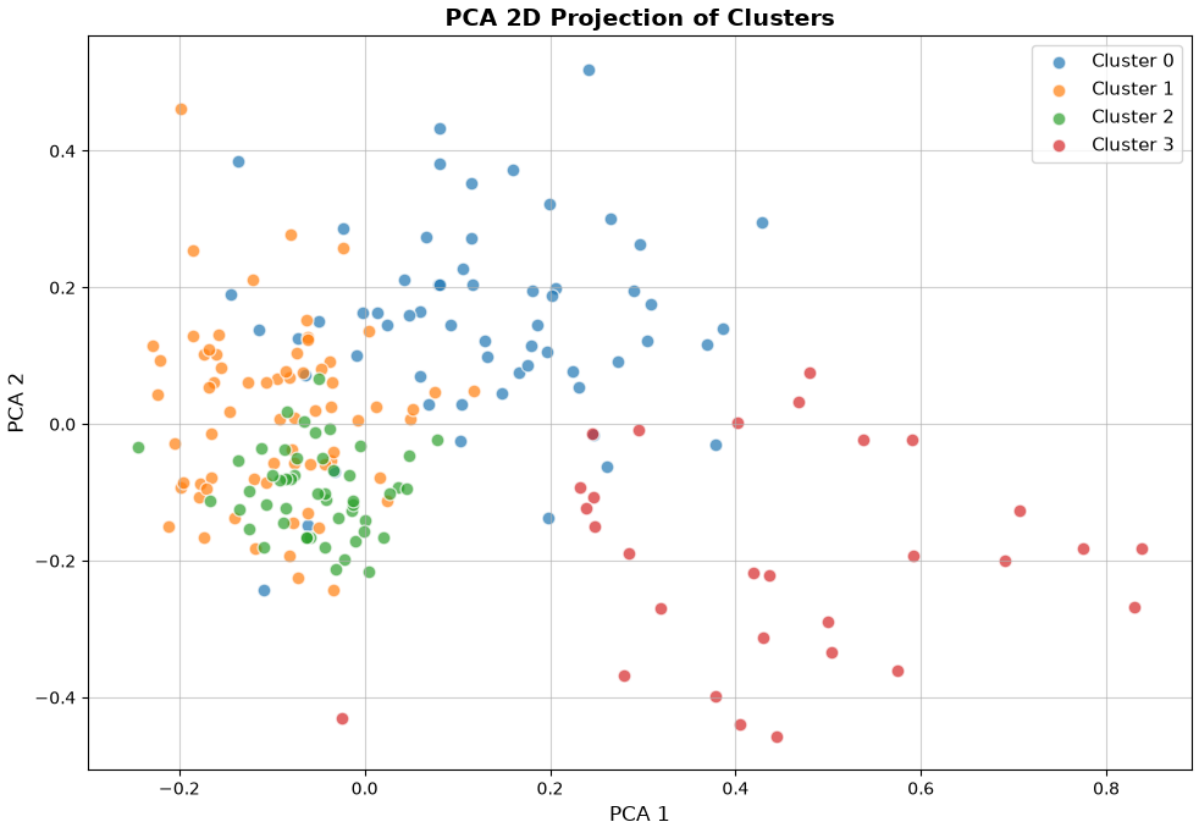


Fig. 8. Heat map of theme-level sentiment scores across sites

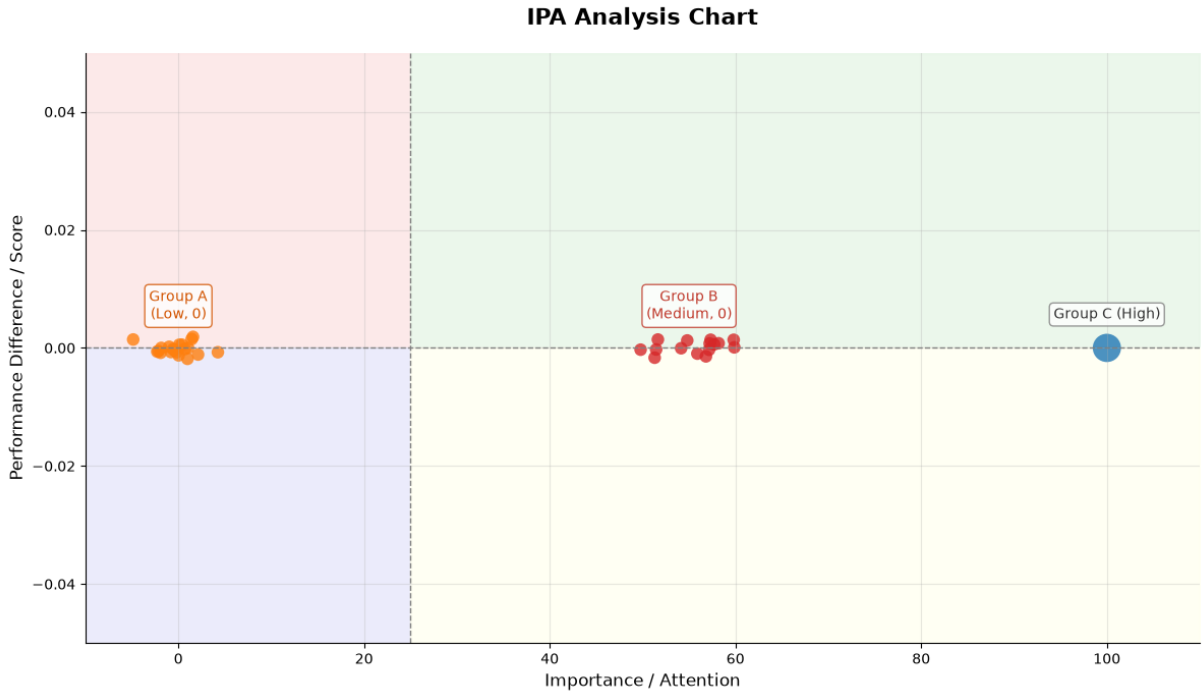


Fig. 9. IPA four-quadrant map for West Lake

Table 9. IPA results for West Lake

Quadrant	Theme	Importance	Performance	Action
Q1	Cultural Heritage	High	High	Keep up the good work
Q2	Crowding	High	Low	Concentrate here
Q3	Facilities	Low	Medium	Low priority

the combination of landscape resources and cultural narratives forms the core attraction of West Lake.

However, crowding is positioned in the "Concentrate here" quadrant. Although visitors consider West Lake highly attractive, excessive visitor density negatively affects their overall experience. Therefore, improving visitor flow management and reducing congestion should be regarded as the most urgent improvement priority for the site.

Facilities and services are classified as lower-priority improvement areas. These factors receive relatively limited attention from visitors and show moderate performance. Although they do not represent immediate problems, further improvements in supporting services may enhance visitor convenience.

Key Finding:

Crowding is the most critical issue requiring immediate attention at West Lake.

Grand Canal IPA Results

For the Grand Canal, boat experience and historical culture are identified as major strengths. Both attributes fall into the "Keep up the good work" quadrant, suggesting that international tourists highly value the combination of cultural heritage and waterfront experiences provided by the canal.

In contrast, commercialization is located in the "Concentrate here" quadrant. While tourists appreciate the historical value of the Grand Canal, excessive commercial activities may weaken the authenticity of the heritage experience. Maintaining an appropriate balance between tourism development and cultural preservation is therefore an important management challenge.

Architecture receives moderate attention and performance, placing it in a relatively lower-priority category. Compared with commercialization issues, architectural improvement is less urgent from the perspective of international visitors.

Key Finding:

Over-commercialization is the most critical issue requiring immediate attention at the Grand Canal.

Liangzhu IPA Results

The IPA results for Liangzhu show that museum architecture represents a major strength. It is located in the "Keep up the good work" quadrant, indicating that international visitors highly appreciate the museum environment and its presentation of archaeological heritage.

However, English interpretation and accessibility are identified as priority improvement areas. These attributes are placed in the "Concentrate here" quadrant, suggesting that although visitors recognize Liangzhu's cultural and educational value, difficulties in language support and site accessibility may limit their understanding and overall experience.

Exhibition quality receives relatively positive evaluations but shows moderate importance. Therefore, compared with interpretation services, further investment in exhibition improvement is less urgent at the current stage.

Key Finding:

English interpretation and accessibility are the most critical issues requiring immediate attention at Liangzhu.

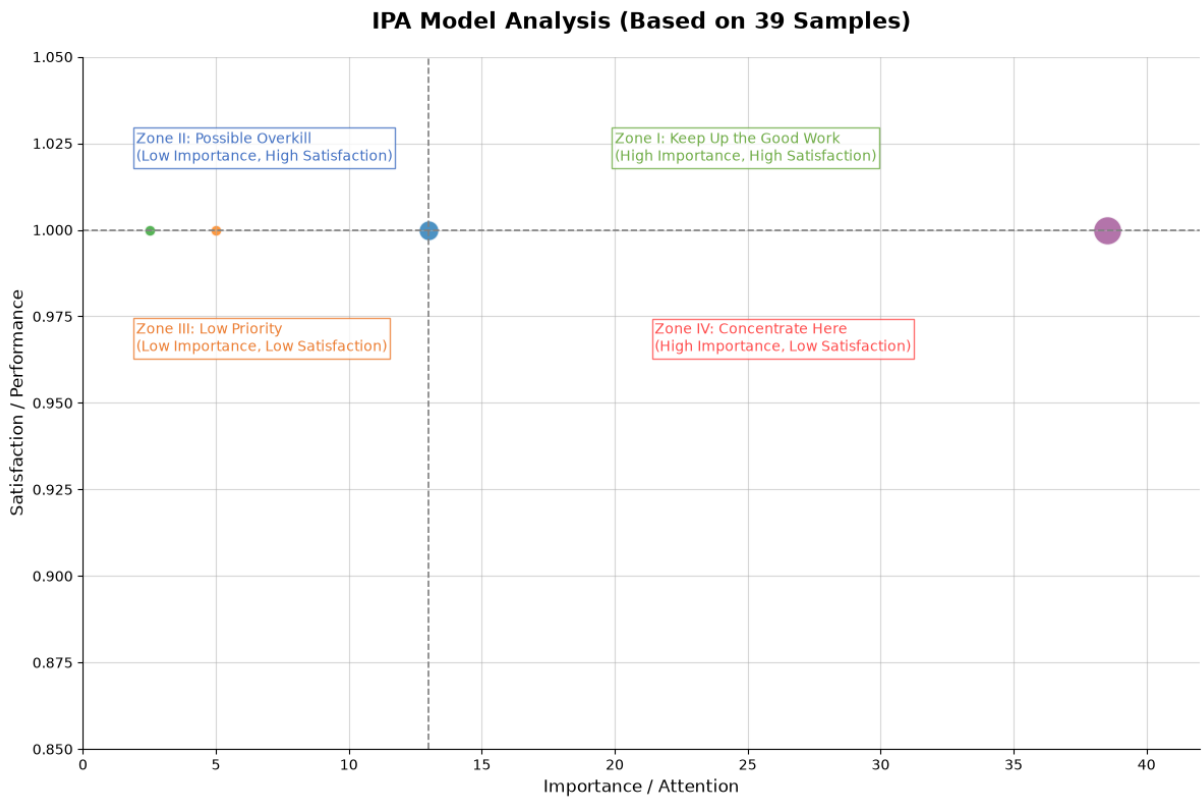


Fig. 10. IPA four-quadrant map for Grand Canal

Table 10. IPA results for the Grand Canal

Quadrant	Theme	Importance	Performance	Action
Q1	Boat Experience	High	High	Keep up the good work
Q1	History & Culture	High	High	Keep up the good work
Q2	Commercialization	High	Low	Concentrate here
Q3	Architecture	Medium	Medium	Low priority

Table 11. IPA results for Liangzhu

Quadrant	Theme	Importance	Performance	Action
Q1	Museum Architecture	High	High	Keep up the good work
Q2	English Interpretation	High	Low	Concentrate here
Q2	Accessibility	High	Low	Concentrate here
Q3	Exhibition Quality	Medium	High	Possible overkill

Cross-Site Comparison

The comparative analysis reveals both shared characteristics and distinct differences among Hangzhou's three World Heritage Sites. Although all three destinations receive generally positive evaluations from international visitors, tourists' perceptions vary according to the characteristics of different heritage types.

First, all three sites demonstrate relatively positive tourist experiences. The average sentiment scores of the three destinations are above 0.58, indicating that international visitors generally appreciate the cultural and tourism value of Hangzhou's heritage resources. In addition, cultural and historical themes receive positive evaluations across different sites, suggesting that heritage value remains an important factor shaping international tourists' experiences.

At the same time, the three sites share several common management challenges. Issues related to visitor management, language services, and perceived value appear repeatedly in international tourists' reviews. These concerns suggest that improving international-oriented services remains an important task for heritage tourism development.

Despite these similarities, each heritage site demonstrates a distinctive experiential pattern. West Lake is mainly associated with natural scenery and cultural landscapes, reflecting visitors' appreciation of its combination of environmental beauty and historical narratives. The Grand Canal is closely linked with historical culture and boat experiences, showing tourists' interest in its living heritage characteristics. Liangzhu is primarily connected with museum architecture and archaeological interpretation, indicating that visitors understand this site mainly through educational and cultural learning experiences.

These differences demonstrate that heritage type plays an important role in shaping international tourists' perceptions. Natural-cultural landscapes, living heritage systems, and archaeological sites provide different forms of visitor experiences and therefore require different approaches in tourism management and cultural communication.

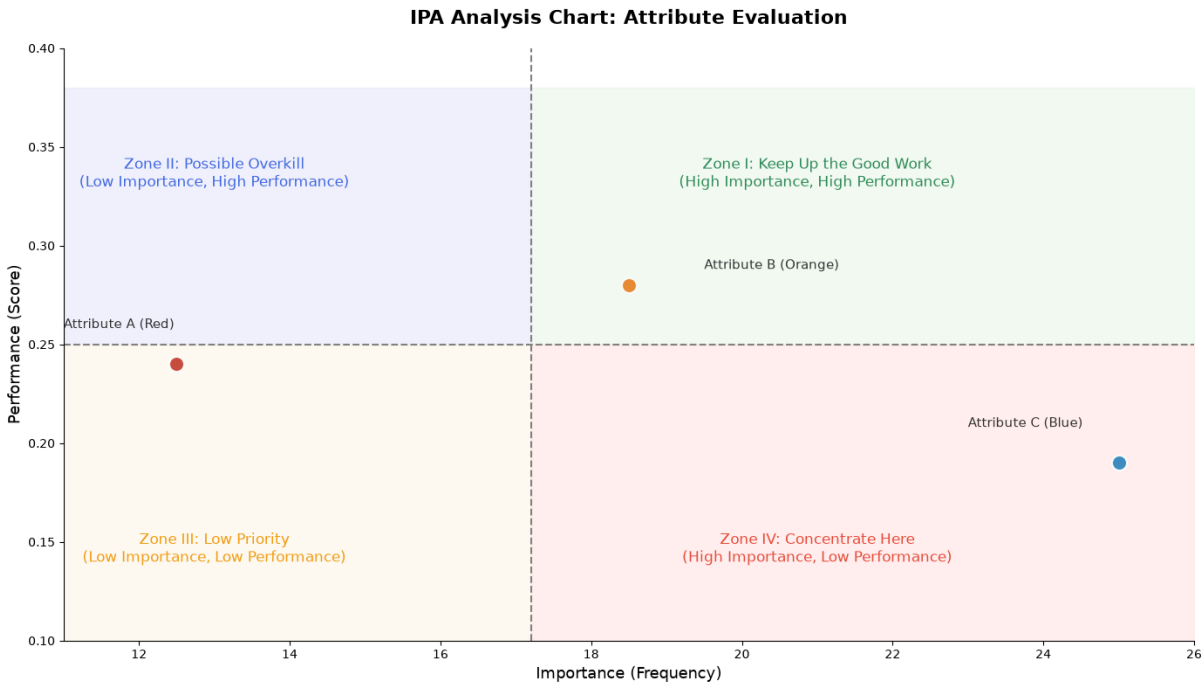


Fig. 11. IPA four-quadrant map for Liangzhu

Table 12. Cross-site comparison summary

Dimension	West Lake	Grand Canal	Liangzhu
Core Theme	Natural Scenery	Boat Experience	Museum Architecture
Highest Score Theme	Natural Scenery (0.72)	Boat Experience (0.70)	Architecture (0.75)
Lowest Score Theme	Crowding (0.28)	Commercialization (0.35)	English Interpretation (0.38)
Attraction Type	Natural-Cultural	Living Heritage	Archaeological
Visitor Profile	Mixed	Mixed	Cultural/Educational

Table 13. Negative review statistics by site

Site	Total Reviews	Negative Reviews	Negative Sentences
West Lake	389	2	2
Grand Canal	9	0	0
Liangzhu	9	1	1
Total	407	3	3

Dissatisfaction Analysis

Negative Review Screening

To further identify the factors influencing negative tourist experiences, negative reviews were examined through additional screening. Following the research design, reviews with ratings of three or below and sentiment scores lower than -0.5 were selected for detailed analysis.

Due to differences in review volume among the three heritage sites, the negative review analysis was mainly concentrated on West Lake. Compared with West Lake, the Grand Canal and Liangzhu contained fewer English-language reviews, resulting in a smaller number of negative cases available for further examination.

The screening results suggest that although international tourists generally evaluate Hangzhou's heritage sites positively, negative experiences still emerge in specific situations. These negative comments provide additional explanations for the issues identified through sentiment analysis and IPA.

Complaint Dimensions

Manual content analysis identified eight major categories of dissatisfaction among international tourists: crowding and safety, language services, pricing concerns, hygiene issues, commercialization, accessibility, guide services, and lack of immersion.

Among these concerns, visitor management was one of the most frequently mentioned issues. At West Lake, excessive visitor density affected tourists' comfort and overall experience. Similar concerns were also observed at the Grand Canal, where concentrated tourism activities influenced visitors' perceptions of the heritage environment.

Language-related problems appeared across the three sites, with Liangzhu showing particularly notable challenges. International visitors often rely on explanations, signage, and interpretation services to understand cultural meanings, especially at archaeological heritage sites. Insufficient English information may therefore limit tourists' ability to engage with heritage resources.

Pricing issues were another source of dissatisfaction. Some visitors expressed concerns regarding expensive souvenirs, boat experiences, and related

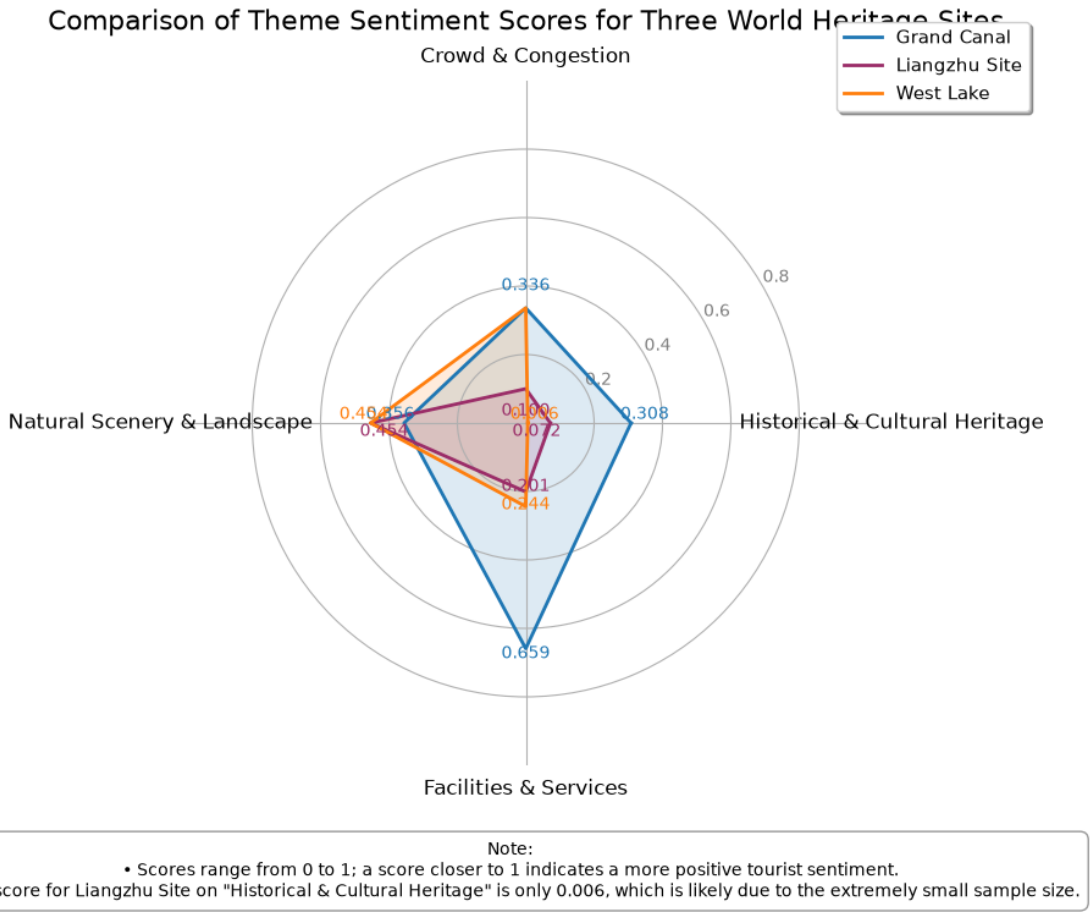


Fig. 12. Radar chart of theme-level sentiment scores across sites

tourism costs. These comments suggest that perceived value is an important factor affecting international tourists' evaluations of heritage destinations.

In addition, hygiene and service quality influenced visitors' overall impressions. Complaints regarding restroom conditions, guide services, and supporting facilities indicate that basic tourism services remain an important part of the heritage experience.

Commercialization was mainly associated with the Grand Canal. Some visitors felt that excessive commercial activities weakened the authenticity of the historical environment. This finding is consistent with the IPA results, which identified commercialization as a priority improvement area.

Accessibility problems were particularly observed at Liangzhu. Difficulties in locating entrances and navigating the site may reduce convenience for international visitors, especially those unfamiliar with the destination.

Finally, some visitors expressed concerns about limited cultural immersion. Although the heritage sites provide valuable cultural resources, insufficient interactive experiences may prevent tourists from developing a deeper understanding of historical meanings.

Overall, the dissatisfaction analysis indicates that negative tourist experiences are not primarily caused by the heritage resources themselves, but by gaps in visitor management, interpretation services, and tourism support systems. These findings further explain the improvement priorities identified through IPA.

Based on manual content analysis of negative reviews, the following complaint dimensions were identified:

Discussion

International Tourist Perceptions of the Three Heritage Sites

The findings demonstrate that international tourists perceive Hangzhou's three World Heritage Sites through different experiential dimensions. These differences are closely related to the characteristics of each heritage type, suggesting that heritage resources influence not only what visitors observe but also how they understand and evaluate the destination.

West Lake Cultural Landscape

West Lake is mainly perceived as a combination of natural scenery and cultural heritage. International tourists show strong appreciation for its landscape features, including lake views, traditional architecture, and historical narratives. The high sentiment scores associated with natural scenery and cultural heritage indicate that these elements form the core experiential value of West Lake.

However, the analysis also reveals that crowding has become the most significant challenge affecting visitor satisfaction. The IPA results place crowding in the "Concentrate here" quadrant, suggesting that although West Lake has strong attraction value, excessive visitor density may weaken the overall quality of the experience.

Compared with the site's cultural and natural advantages, facilities and supporting services play a relatively secondary role in shaping tourist perceptions. Issues related to ticketing, signage, and visitor support are not the most urgent concerns, but improvements in these areas may further enhance convenience for international visitors.

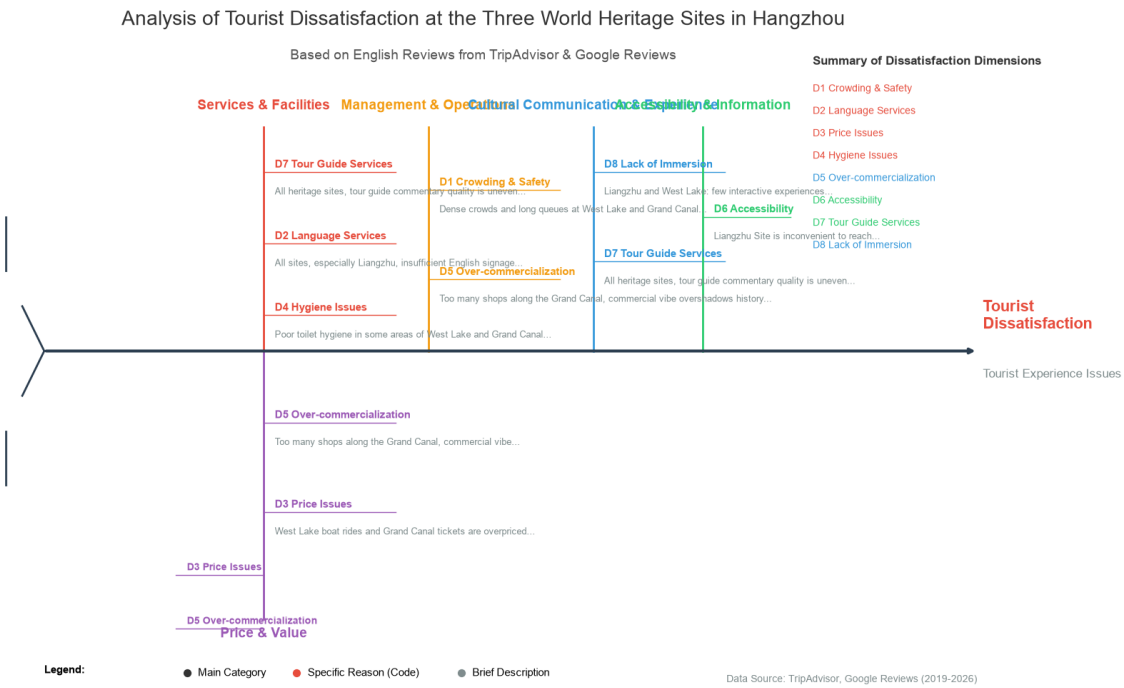


Fig. 13. Fishbone diagram of tourist dissatisfactions

Table 14. Complaint dimensions identified from negative reviews

Code	Complaint Dimension	Example Quote	Affected Sites
D1	Crowding & Safety	"The crowds were unreal, rude people shoving and blocking"	West Lake, Grand Canal
D2	Language Services	"No English explanations" "Poor English guide service"	All sites, especially Liangzhu
D3	Pricing Concerns	"Overpriced souvenirs" "Expensive boat ride"	West Lake, Grand Canal
D4	Hygiene Issues	"Dirty toilets" "Smelly restrooms"	West Lake, Grand Canal
D5	Commercialization	Too many vendors "feels fake"	Grand Canal
D6	Accessibility	Difficult to find "Confusing entrance"	Liangzhu
D7	Guide Service	"Perfunctory guide" "Faulty audio equipment"	All sites
D8	Lack of Immersion	"Can't enter the palace" "Limited interaction"	Liangzhu, West Lake

Table 15. Topic intensity evolution over time for West Lake

Topic	2019-2020	2021-2022	2023-2024	2025-2026	Trend
Natural Scenery	0.35	0.38	0.40	0.42	↑
Cultural Heritage	0.28	0.26	0.25	0.24	↓
Crowding	0.22	0.18	0.20	0.22	→
Facilities	0.15	0.18	0.15	0.12	↓

Grand Canal (Hangzhou Section)

The Grand Canal is mainly associated with historical culture and boat-based experiences. International tourists value the opportunity to experience the continuity of traditional heritage through canal landscapes, cruises, and waterfront environments. These elements represent the unique experiential characteristics of living heritage.

At the same time, commercialization has become a notable concern. The IPA results identify commercialization as a priority improvement area, indicating that tourists appreciate the cultural value of the Grand Canal but are concerned that excessive commercial activities may reduce the authenticity of the heritage environment.

Therefore, future management should focus on maintaining a balance between tourism development and heritage preservation. Commercial activities may contribute to visitor convenience and economic benefits, but they should be managed in ways that support rather than replace the cultural identity of the canal.

Liangzhu Archaeological Ruins

Liangzhu is mainly understood by international tourists through museum architecture, archaeological value, and exhibition experiences. Visitors show strong appreciation for the museum environment and the presentation of archaeological heritage, indicating that modern exhibition spaces play an important role in communicating ancient cultural resources.

However, the findings also reveal limitations in English interpretation and accessibility. Although Liangzhu provides valuable archaeological resources

and a high-quality physical environment, insufficient language support may prevent international visitors from fully understanding the cultural significance behind the exhibits.

This suggests that interpretation services are especially important for archaeological heritage sites. Unlike scenic destinations where visitors can directly appreciate landscapes, archaeological sites often require additional explanation to help tourists understand historical meanings and cultural contexts. Improving multilingual interpretation may therefore strengthen Liangzhu's international communication capacity.

Cross-Site Comparison

Differences in Tourist Experience

The comparative results demonstrate that heritage type strongly influences how international tourists experience and evaluate heritage destinations. Although West Lake, the Grand Canal, and Liangzhu all represent important cultural resources, they provide visitors with different forms of engagement.

West Lake mainly offers a landscape-oriented experience, where natural scenery and cultural stories are closely connected. Visitors can directly appreciate visual elements such as lakes, mountains, and historical buildings, while also developing an understanding of the cultural meanings behind the landscape.

The Grand Canal provides a different type of experience as a living heritage system. International tourists are attracted not only by historical significance but also by interactive activities such as boat tours and waterfront exploration. This indicates that experiential participation is an important feature of living heritage tourism.

In contrast, Liangzhu depends more heavily on interpretation and knowledge communication. Since archaeological heritage is less visually accessible than landscapes or living cultural environments, visitors' understanding largely depends on museum exhibitions, explanatory materials, and multilingual services.

These differences suggest that heritage tourism management should consider the specific characteristics of each heritage type rather than applying identical development strategies to all sites.

Shared Challenges

Despite differences in tourist experiences, the three World Heritage Sites also face several common challenges related to international tourism development.

First, language support remains an important issue. International visitors often rely on English signs, explanations, and interpretation services to understand cultural meanings. Insufficient multilingual information may reduce their ability to fully engage with heritage resources, particularly at sites requiring deeper historical interpretation.

Second, visitor management is another shared concern. As popular tourism destinations, heritage sites need to balance accessibility with preservation. Excessive visitor concentration may affect not only tourist satisfaction but also the long-term protection of heritage environments.

Third, the quality of supporting services influences international tourists' overall impressions. Although heritage resources are the primary attraction, factors such as accessibility, facilities, and service arrangements also shape visitors' complete travel experiences.

These common issues indicate that improving international tourism services requires not only resource protection but also continuous improvement in visitor-oriented management.

Distinct Advantages and Development Opportunities

The three heritage sites also demonstrate different development opportunities based on their unique advantages.

For West Lake, the main opportunity lies in maintaining the balance between popularity and environmental quality. Since natural scenery represents its strongest attraction, future management should focus on visitor flow control while preserving the relationship between landscape and cultural heritage.

For the Grand Canal, the key opportunity is to strengthen cultural authenticity. Tourism activities such as cruises and commercial services can enhance visitor experiences, but they should remain connected with the historical identity of the canal rather than replacing it.

For Liangzhu, improving international interpretation capacity is particularly important. The site already has advantages in museum presentation and archaeological value; however, stronger multilingual communication and educational services could help transform these resources into more accessible international experiences.

Overall, the comparison shows that different heritage categories require different management priorities. Effective heritage tourism development should combine preservation, visitor experience improvement, and international cultural communication according to the characteristics of each site.

Theoretical Contributions

The findings of this study offer several implications for research on heritage tourism and international tourist experiences. One contribution comes from the comparison of different heritage types within the same destination. The three sites examined in this study provide different forms of heritage experience: West Lake is associated mainly with natural scenery and cultural narratives, the Grand Canal with living heritage and boat-based experiences, and Liangzhu with archaeological resources and museum-based interpretation. Examining these sites together shows that international tourists do not evaluate heritage destinations in exactly the same way, and that the characteristics of heritage resources are closely connected with the ways visitors perceive and experience them.

A second contribution lies in the combination of several analytical approaches. Topic modeling was used to identify the issues most frequently discussed by tourists, sentiment analysis was used to examine their emotional responses, and IPA was then used to relate tourist attention to perceived performance. Manual analysis of negative reviews provided further detail on the problems identified through the quantitative analysis. Used together, these methods provide a way of moving from the identification of visitor concerns to the interpretation of their evaluations and the identification of areas requiring attention. This is particularly useful when online reviews contain both general impressions and specific comments about tourism services.

A further contribution concerns the application of sentiment analysis to heritage tourism reviews. The study adapts the VADER dictionary to account for expressions that occur in tourism-related reviews, allowing the analysis to better reflect the language used when visitors describe scenery, services, accessibility, and cultural experiences. Rather than treating sentiment as a general measure of satisfaction, the analysis links emotional responses to specific aspects of the heritage experience.Consequently, this approach enables a more nuanced examination of international tourists' responses to the various facets of a heritage site.

Taken together, these findings suggest that international tourist experience at World Heritage Sites can be understood through both the characteristics of heritage resources and the conditions in which visitors encounter them. The comparative and mixed-method approach used in this study therefore provides a useful basis for further research on international visitors' perceptions of different types of heritage destinations.

Practical Implications

The findings have practical implications for the management of Hangzhou's three World Heritage Sites. The IPA results and the analysis of negative reviews point to different priorities at each site, rather than a single set of improvements that can be applied across all three destinations. The recommendations below therefore distinguish between issues that require immediate attention and those that can be addressed through further service improvement.

Table 16. Distinct advantages and leverage opportunities

Site	Distinct Advantage	Leverage Opportunity
West Lake	Natural scenery + cultural narratives	Promote as a "poetic landscape" experience
Grand Canal	Boat experience + historical authenticity	Position as a "living museum" with a unique mode of transport
Liangzhu	Museum architecture + archaeological significance	Market as an "immersive cultural learning" destination

Table 17. High-priority improvements based on IPA

Priority	Site	Theme	Recommended Action
P1	West Lake	Crowding	Implement a timed entry system; promote off-peak visits
P2	Liangzhu	English Interpretation	Add bilingual signage; offer English audio guides
P3	Grand Canal	Commercialization	Balance commercial activities with authenticity

Table 18. Medium-priority improvements

Priority	Site	Theme	Recommended Action
P4	All sites	Guide Services	Standardize guide qualifications; improve audio guide reliability
P5	West Lake	Facilities	Improve toilet facilities; enhance multilingual signage
P6	Grand Canal	Pricing	Increase transparency in pricing; provide value packages

High-Priority Improvements

Three issues stand out as the most immediate areas for improvement. At West Lake, crowding has the clearest effect on the visitor experience. Although the site receives positive evaluations for its natural scenery and cultural value, high visitor density can reduce comfort and affect the quality of sightseeing. Measures such as timed entry and encouraging visits during less busy periods may help distribute visitor flows more effectively.

For Liangzhu, the main concern is English interpretation. The site has strong archaeological and museum resources, but international visitors may have difficulty understanding their cultural significance when English information is limited. Bilingual signage and English audio guides would provide more direct support for overseas visitors.

At the Grand Canal, commercialization requires greater attention. Visitors value the canal's historical character and boat experience, but excessive commercial activity may affect perceptions of authenticity. Management should therefore consider how commercial services can be retained without allowing them to overshadow the heritage environment.

The three priorities and their corresponding actions are summarized in Table 17.

Medium-Priority Improvements

Several other issues were identified in the analysis but do not require the same level of immediate attention. Guide services are relevant across the three sites. Inconsistent guide quality and problems with audio guide equipment can make it more difficult for international visitors to obtain reliable information. Improving guide training and maintaining the reliability of audio equipment would therefore provide a relatively practical way to improve the visitor experience.

At West Lake, supporting facilities also deserve further attention. Restroom conditions and multilingual signs may seem less central than the site's landscape and cultural resources, but they affect visitors' day-to-day experience. Improving these basic services could make the destination more convenient for international tourists.

For the Grand Canal, pricing is another area where relatively simple improvements may be useful. Clearer information about prices and what is included in different tourism services could reduce uncertainty and help visitors form more reasonable expectations.

The medium-priority recommendations are summarized in Table 18.

These measures are intended to complement, rather than replace, the three high-priority actions. Their relatively lower priority means that they can be incorporated into ongoing service improvement while management resources are first directed toward the issues with stronger effects on visitor experience.

Long-Term Strategic Recommendations

Beyond the site-specific priorities, the findings point to several directions for the longer-term development of international heritage tourism in Hangzhou.

First, the three sites could be presented as complementary rather than competing heritage experiences. Their different characteristics provide opportunities to connect landscape appreciation at West Lake, living heritage experiences along the Grand Canal, and archaeological learning at Liangzhu. A more integrated presentation of these resources may help international visitors understand the diversity of Hangzhou's heritage.

Second, multilingual interpretation can be developed as a broader service across the three sites. The need is most apparent at Liangzhu, but clearer English information can also make cultural narratives at West Lake and the Grand Canal easier for international visitors to understand.

Third, digital interpretation may provide an additional way to communicate heritage information. Multilingual digital guides and interactive interpretation could supplement conventional signs and guided tours, particularly where detailed cultural or historical explanation is needed.

Finally, staff training should remain part of long-term international tourism management. Improvements in language ability, cultural explanation, and visitor communication can support more consistent service across different heritage sites.

These longer-term measures should not be understood as replacing the site-specific priorities identified above. Rather, they provide a broader framework within which the immediate improvements can be developed.

Conclusion

Summary of Findings

This study examined international tourists' experiences at Hangzhou's three World Heritage Sites through English-language online reviews. By combining LDA topic modeling, improved VADER sentiment analysis, Importance-Performance Analysis (IPA), and manual content analysis, the study examined the main themes discussed by visitors, their emotional responses, and the issues that may affect their experiences.

The results show clear differences among the three heritage sites. West Lake is mainly associated with natural scenery and cultural heritage, while crowding is the main concern affecting the visitor experience. The Grand Canal is closely related to historical culture and boat experiences, with commercialization emerging as an important issue. Liangzhu is mainly associated with museum architecture, archaeological value, and exhibition experiences, while limited English interpretation presents a challenge for international visitors.

Despite these differences, international tourists generally express positive evaluations of the three sites. At the same time, the analysis indicates that positive heritage resources do not necessarily remove problems in the visitor experience. Crowding, language services, commercialization, facilities, pricing, and guide services remain relevant concerns, although their importance differs across sites.

The comparison further suggests that heritage type is closely related to the way international visitors experience a destination. West Lake offers an experience centered on landscape and cultural narratives, the Grand Canal emphasizes historical continuity and interaction through the waterway, and Liangzhu relies more heavily on museum presentation and cultural interpretation. These differences mean that the three sites cannot be managed effectively through exactly the same approach.

Overall, the study shows that online reviews can provide useful evidence for understanding international tourists' perceptions of heritage destinations. Combining the identification of visitor themes with sentiment evaluation and IPA makes it possible to connect tourists' experiences with specific management priorities. The findings therefore provide a basis for more targeted improvements at Hangzhou's three World Heritage Sites.

Theoretical Contributions

Several limitations should be considered when interpreting the findings.

First, the datasets for the Grand Canal and Liangzhu are relatively small. Only nine English-language reviews from each site were retained for analysis, which limits the statistical strength and generalizability of the findings for these two sites. Future research could extend the data collection period and include additional tourism platforms to obtain larger samples.

Second, the study focuses only on English-language reviews. This provides a consistent basis for examining international tourists' experiences, but it excludes reviews written in other languages. As a result, the findings may not fully represent the experiences of visitors from different linguistic backgrounds. Future research could incorporate multilingual reviews and compare whether perceptions differ across language groups.

Third, the data were collected mainly from TripAdvisor and Google Reviews. Although these platforms provide useful information about international visitors, users of other platforms may have different characteristics and travel preferences. This creates a potential platform bias that should be considered when generalizing the findings.

Fourth, the review data cover the period from 2019 to 2026, but the distribution of reviews across different years is uneven. The effects of the COVID-19 period also affected the availability and distribution of online reviews, making it difficult to draw strong conclusions about changes in tourist perceptions over the entire period.

Finally, topic evolution analysis was conducted only for West Lake because of the limited amount of available data for the Grand Canal and Liangzhu. This means that the study cannot provide the same level of temporal comparison across all three heritage sites. With larger datasets, future research could examine changes in tourist perceptions and sentiment over time for all three sites.

Future research could therefore extend the present study in several directions. Multilingual review analysis could provide a broader view of international visitor experiences, while additional World Heritage Sites in China could be included to examine whether the patterns identified in Hangzhou also occur in other destinations. Combining online reviews with interviews or survey data could further clarify tourists' motivations and experiences. With sufficient longitudinal data, future studies could also examine changes in visitor perceptions over time and assess how tourism management measures influence these changes.

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