

Original Article

An Interactive WebGIS: Mapping Tangible Cultural Tourism Destinations Using ESRI Story Maps (A Case Study in Surakarta, Indonesia)

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ABSTRACT

This research aims to develop an interactive WebGIS based on ESRI StoryMaps in mapping real cultural tourism destinations in the city of Surakarta. The research background is the limited cultural tourism information that is integrated, easily accessible and attractive to the wider community. The research uses a mixed approach through surveys, field observations, interviews, questionnaires, and spatial analysis using the Average Nearest Neighbor (ANN) method. The data collected includes destination coordinates, accessibility, facilities and environmental conditions which are then integrated into Story Maps. The results of the ANN analysis show that the destination distribution pattern is clustered with a Nearest Neighbor Ratio value of 0.616, z-score -3.028865, and p-value 0.002455, which is statistically significant. The distribution of destinations is in the historic city center area, such as the Surakarta Palace and Mangkunegaran Temple. The StoryMaps product developed received a positive response from respondents, being considered informative, interactive, easy to use, and able to introduce lesser-known destinations. This media is also considered effective in increasing interest in visiting, expanding access to information, and supporting the promotion and preservation of culture on an ongoing basis. The research concludes that the integration of GIS and StoryMaps is a strategic solution in disseminating cultural tourism information digitally, interactively and thematically, and has the potential to support equitable development of tourist destinations in Surakarta.

KEYWORDS

Surakarta City;
Web-Gis; Tangible
Cultural Tourism;
Story Maps.

Received: Februry 23, 2026

Accepted: March 01, 2026

Published: March, 31 2026

Citation:

Prayoga, S. S., & Jumadi. (2026). An interactive WebGIS: Mapping tangible cultural tourism destinations using ESRI story maps (A case study in Surakarta, Indonesia). *Jurnal Penelitian Geografi (JPG)*, 14(1), 37–52. <https://doi.org/10.23960/jpg.v14.i1.76>



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INTRODUCTION

Surakarta is famous as a cultural tourism center rich in unique and diverse tangible cultural attractions, as stated by Nur Fitria (2023), attracting both domestic and foreign tourists. One such attraction is Wayang Orang

Sriwedari (Javanese opera dance theater), a traditional art performance held every night at the Sriwedari Building in Surakarta. This performance is one of the evening entertainment options available to tourists visiting the

city (Rini, Herlinah, Nugroho, & Sutyono, 2021). In today's digital era, the dissemination of accurate cultural tourism information supported by an interactive spatial information system is important to enhance the tourist experience (Amadu, Nhamo, Benzougagh, & Turyasingura, 2025). Web-based technology Geographic Information System (WebGIS) presented as an effective solution in facilitating dynamic and interactive spatial information access, which will enable tourists to plan their trips through a visual understanding of space and location (Noviansyah, Fauzi, Bakhrun, & Lestary, 2023).

Several studies emphasize the important role of WebGIS in cultural tourism. For example, (Antoniou et al., 2023) shows that StoryMaps' ability to combine narrative text, multimedia, and interactive maps is an important tool for cultural storytelling. StoryMaps not only present narratives, but also provide clear visual descriptions with the integration of photos, videos, and thematic maps that are easily accessible online. A study in Euboea (Greece) conducted by (Lampropoulos et al., 2025) shows that WebGIS and participatory mapping help visualize cultural attractions and supporting infrastructure, supporting sustainable tourism strategies and local economic development through cultural heritage-based planning. Not only for tourism, but it can also be used for other purposes, such as research conducted by (Milinković, Dželebdžić, & Majhenšek, 2025), which emphasizes the integration of GIS tools in library services to improve data visualization and user experience, using a building architecture as an example of implementation. Research from (Howland, Liss, Levy, & Najjar, 2020) also explains that the use of ArcGIS StoryMaps to integrate digital datasets into public engagement strategies, through a 'deep mapping' approach in an archaeological project in Jordan.

Research discussing WebGIS and StoryMaps in the field of cultural tourism proves its success in various geographical and thematic contexts. (Wang et al., 2025) describes the development of WebGIS applications carrying the "local-first" concept in collaborative 3D WebGIS using CRDT (Conflict-free Replicated Data Types) that supports real-time interaction, offline access, and user data protection, as a solution to the limitations

of cloud-based WebGIS systems. Meanwhile, (Piarulli, Fantini, Gazzetti, Guarneri, & Cassola, 2021) discuss a study in Parco Nazionale Circeo (Italy), where an Open Source-based WebGIS was developed to present geo-thematic tourism information, including trekking trails and cultural tours, with an interactive interface that allows users from desktops and mobile devices to access spatial data easily and dynamically.

The purpose of this study is to develop an interactive tourist map about Cultural Tourist Attractions in Surakarta City that is more informative and interesting through WebGIS StoryMaps, analyze the distribution pattern of cultural tourist attractions in Surakarta City, and determine the existing accessibility based on the fastest route to cultural tourist attractions in Surakarta City.

There is a gap in this research, namely that there are not many studies that utilize ESRI StoryMaps-based WebGIS for mapping tangible cultural tourism destinations in Surakarta City as a whole, especially with a thematic spatial approach that combines analysis of the accessibility of main transportation routes, supporting facilities, and interactive multimedia visuals as a whole. Most research still focuses on narrative and promotional aspects without maximizing in-depth spatial features to support the accuracy of tourist travel and sustainable destination management by local stakeholders.

The strength of this research lies in the development of an interactive WebGIS-based information dissemination model using the ESRI StoryMaps platform, which specifically combines thematic spatial data on tangible cultural attractions in Surakarta with an analysis of the availability of main routes (airports, train stations, terminals) and supporting facilities, and collaborates rich and interactive multimedia content. This approach brings innovation (novelty) in the form of combining comprehensive spatial analysis with multimedia and digital narratives that make it easier for tourists to understand and access destination information in a more convenient and interesting way, while also helping local tourists in evidence-driven spatial data-based management and promotion.

METHOD

This study uses a comprehensive approach to ensure the accuracy and validity of data in assessing the dissemination of interactive WebGIS for mapping tangible cultural tourism destinations in Surakarta City. The methods section covers sampling techniques, data collection, and measures used for analysis.

Study Location

This study was conducted in Surakarta City, Central Java. Surakarta City itself offers many cultural tourist

destinations. Based on data from 2024, the number of tourist visits reached 4.52 million people, far exceeding the initial target of 1.5 million people (Youth and Sports Agency, 2024). Although the total number of domestic tourists is very large, visitor distribution remains concentrated on the main attractions. This condition reinforces the importance of research aimed at understanding the distribution and potential of other cultural destinations that are not yet crowded.

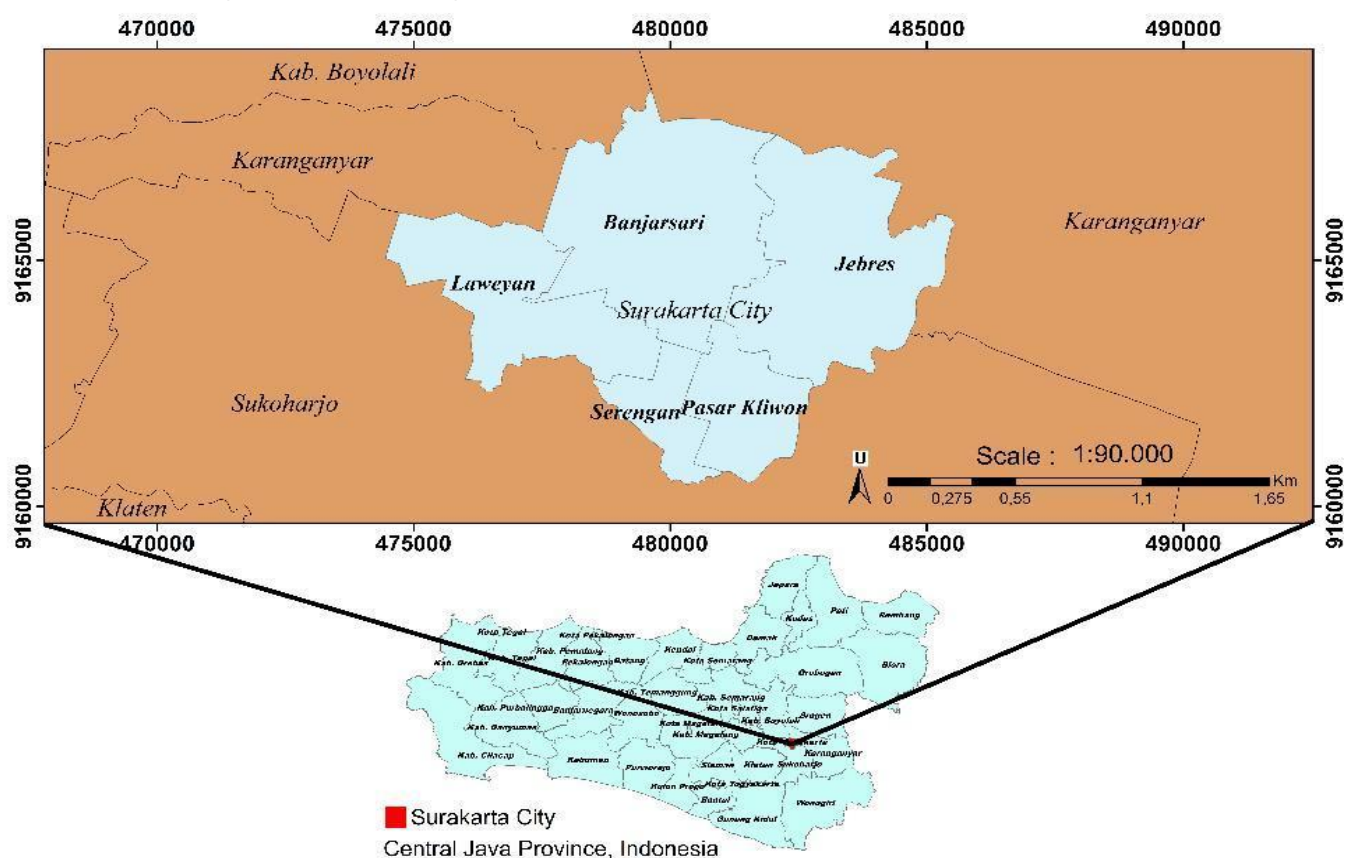


Figure 1. Study Location Map

Sampling Techniques

The sampling technique used in this study was purposive sampling, which is the selection of samples based on specific criteria that are relevant to the research objectives. The objects selected were tangible cultural tourism destinations that encompass all forms of cultural heritage that can be seen and touched, such as historic buildings, monuments, museums, and other artifacts, including temples, forts, and archaeological sites that have historical and cultural value. This technique was

chosen to ensure that the objects studied had relevant characteristics and could provide adequate data for the development of an ESRI StoryMaps-based WebGIS system.

Data Collection

Data collection was conducted using several techniques to obtain complete and valid information, namely field observations conducted directly at several cultural tourist attractions, as visualized in (Table 1).

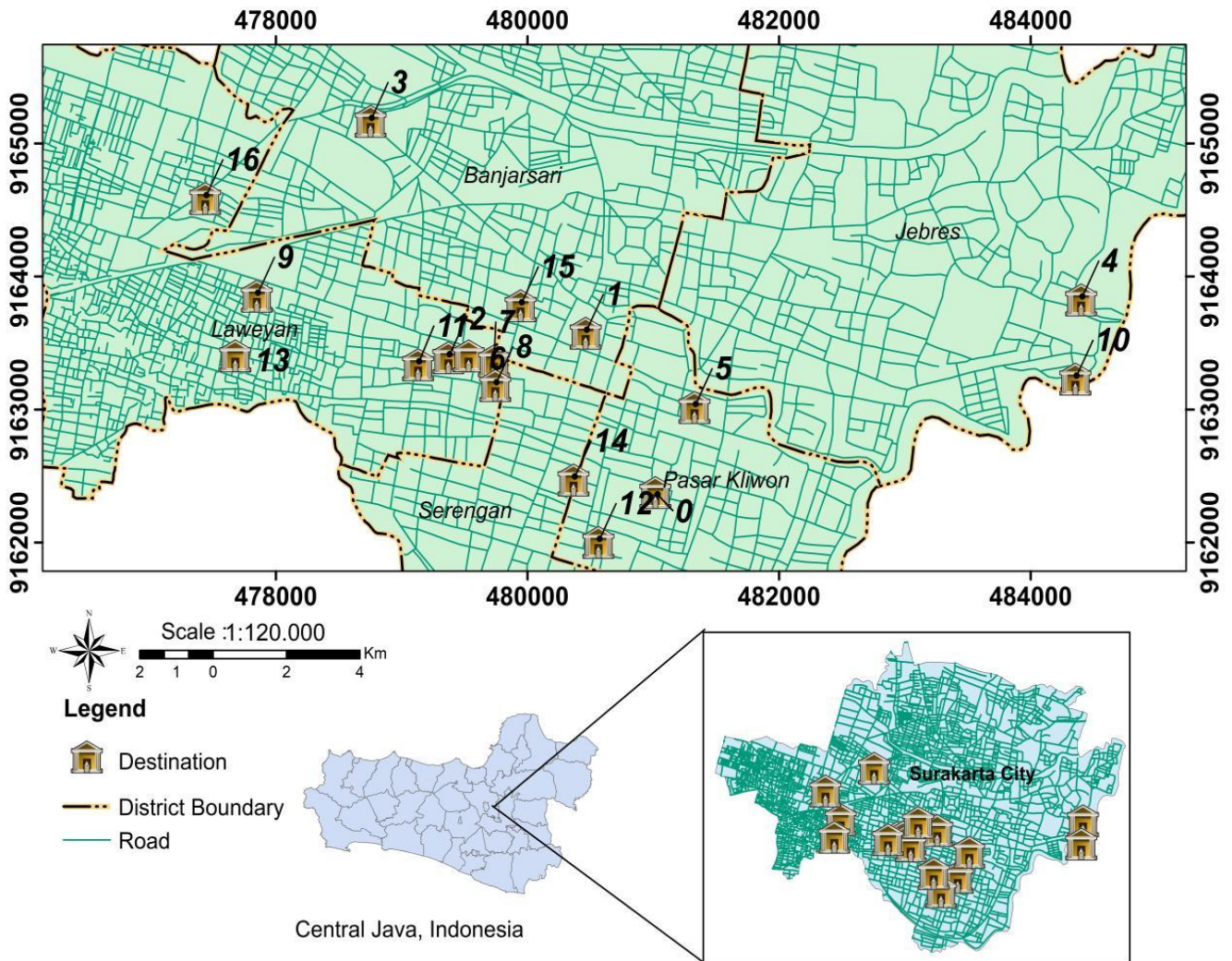


Figure 2. Tourist Destination Map

Table 1. List of Tangible Cultural Tourism Destinations in Surakarta City

Map Legend	Destination Name	Map Legend	Destination Name
0	Keraton Kesultanan Yogyakarta	8	Museum Tumurun
1	Pura Mangkunegaran	9	Heritage Batik Keris
2	Taman Sriwedari	10	Taman Sunan Jogo Kali
3	Taman Balekambang	11	Museum Keris Nusantara
4	Solo Safari	12	Ndalem Joyokusuman
5	Benteng Vastenburg	13	Ndalem Priyo Suhartan
6	Museum Radya Pustaka	14	Museum Batik Go Tik Swan
7	Museum Batik Dinar Hadi	15	Monumen Pers

The data collected includes geographic coordinates, accessibility to the location, supporting facilities, and the environmental conditions surrounding the tourist attraction. These observations are also documented with photos and videos using a DSLR camera to obtain clear and interesting visual data, which will then be processed as part of the WebGIS content.

Official Data Collection from the Surakarta City Tourism Office: The research collected official data on the number of cultural tourist destinations, tourist visitation statistics, and digital technology-based tourism development programs. This data became the basis for

the development of ESRI StoryMaps-based WebGIS.

Questionnaire: The questionnaire was provided in the form of a form to make it easier to fill out. The form was given to tourists who accessed interactive WebGIS posts or links through social media. The questionnaire aimed to determine tourist preferences in accessing tourism information, their ability to use digital technology in planning trips, and the features needed on WebGIS. The questionnaire data helped in designing the appearance and features to suit user needs.

The list of questions in the form includes the following.

Table 2. List of Questions

No.	Question	Answer Options
1	Based on the cultural heritage tourist attractions on the story maps, which ones have you visited?	Not yet / Monumen Pers / Lokananta / Museum Batik Go Ti Swan / Ndalem Priyo Suhartono / Ndalem Joyokusuman / Museum Keris Nusantara / Taman Sunan Jogo Kali / Heritage Batik Keris / Museum Tumurun / Museum Batik Danar Hadi / Museum Radya Pustaka / Solo Safari / Taman Balekambang / Kraton Surakarta / Pura Mangkunegaran / Taman Sriwedari / Wayang Orang Sriwedari
2	Are there any cultural heritage tourist attractions that you did not know about before accessing story maps?	Yes / No
3	Do story maps fully provide the information you are looking for or need regarding tangible cultural tourist attractions in Surakarta City?	Very complete / Complete / Incomplete / Less than complete
4	In your opinion, do story maps and virtual tours help you learn more about tangible cultural heritage sites in Surakarta?	Very helpful / Helpful / Not very helpful / Not helpful
5	Do story maps help you to virtually explore cultural heritage sites in Surakarta City?	Very helpful / Helpful / Not very helpful / Not helpful
6	Do story maps help you to virtually explore cultural attractions in Surakarta when you are unable to visit them in person?	Very helpful / Helpful / Not very helpful / Not helpful
7	After exploring the story maps presented, are you interested in visiting these cultural attractions in person?	Very interested / Interested / Not very interested / Not interested
8	Are these story maps products easy to use?	Very easy / Easy / Difficult / Very difficult
9	What is your assessment of the appearance of the story maps product?	Very interesting / Interesting / Not very interesting / Not interesting
10	In your opinion, is this story maps product interesting to share?	Very interesting / Interesting / Not very interesting / Not interesting

Literature Study: Used to collect references from scientific journals, research reports related to WebGIS, ESRI StoryMaps, and tourist destination mapping to strengthen the theoretical basis and compare previous research results.

Document Analysis: Conducting a review of official documents and reports from relevant tourism agencies

and academic references to clarify tourism management strategies and the application of WebGIS technology.

Data Size and Analysis

The data obtained from field observations was analyzed using descriptive methods, in which the observation results were classified and summarized to

compile spatial maps in ESRI StoryMaps. Spatial aspects were analyzed using the Average Nearest Neighbor method to determine the distribution patterns of cultural attractions in Surakarta based on coordinates collected from Google Maps.

The results from various data sources were then synthesized and integrated into the ESRI StoryMaps platform to present tourist information in an interactive and engaging manner, including digital maps with

navigation and search features, visual narratives, and multimedia such as photos and videos.

Through a combination of purposive sampling techniques, multi-method data collection, and systematic data analysis, this methodology is designed to ensure the reliability and validity of research findings in the development and evaluation of interactive WebGIS for tangible cultural tourism destinations in Surakarta.

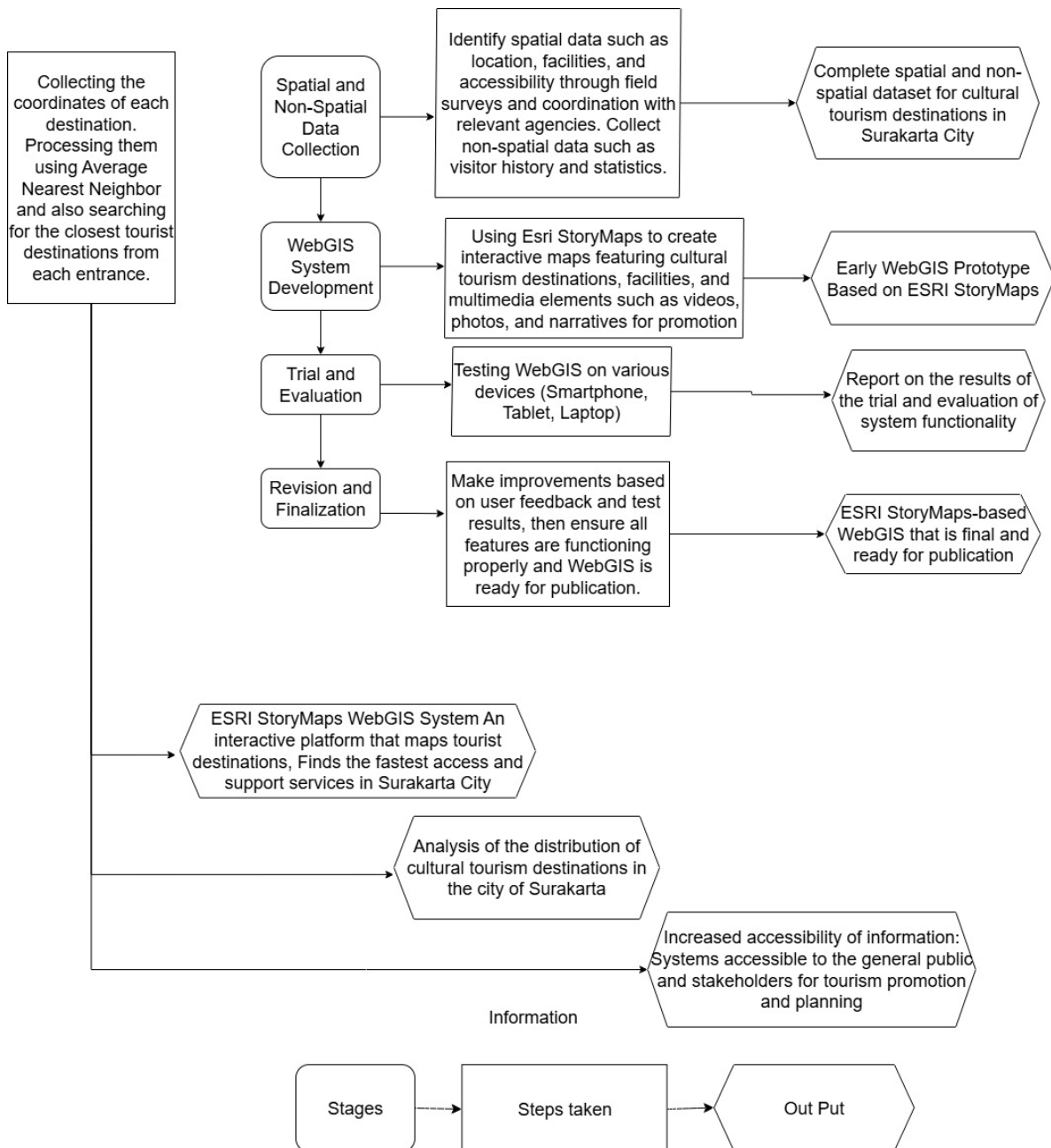


Figure 3. Research Flow Chart

RESULTS AND DISCUSSION

This study found that Solo Balapan Station, as the largest railway station in Surakarta City, serves as a strategic starting point for tourists to explore nearby cultural tourist destinations. Within the shortest distance from this station, there are three easily accessible tourist attractions, namely the Persmonumen National (green route), Mangkunegaran Palace (red route), and Dinar Hadi Batik Museum (blue route). These three tourist

attractions represent various types of attractions, ranging from the history of the Indonesian press, palace culture, to the unique batik art of Solo. The proximity of these locations to the station allows tourists to visit these attractions in a short time, even on foot or by local transportation, making Solo Balapan Station a very effective transit point, especially for tourists with limited time.

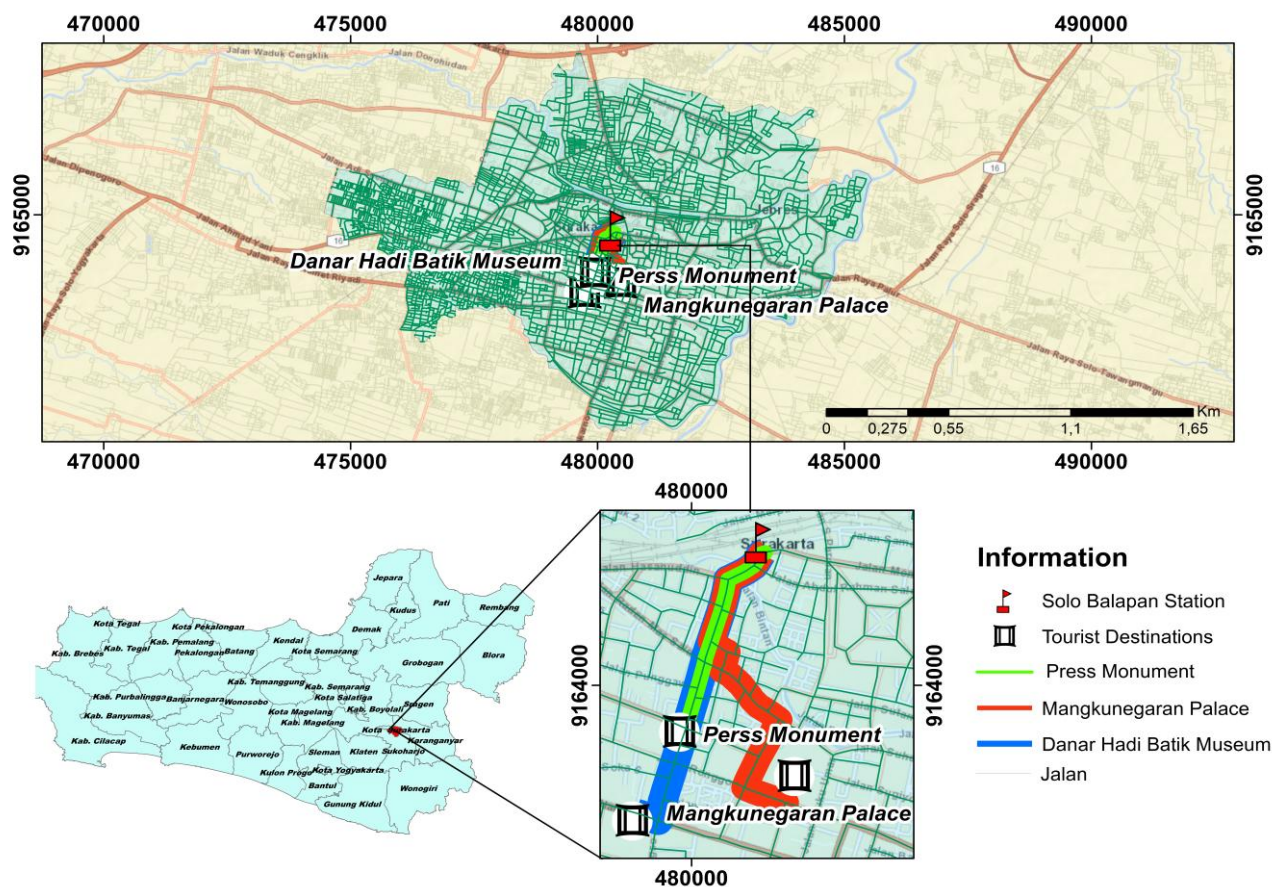


Figure 4. Fastest Route Map from Solo Balapan Station to Tourist Attractions.

From a spatial perspective, tourist attractions tend to be concentrated in the city center and cultural areas such as the

Surakarta Palace, Mangkunegaran Palace, and Dinar Hadi Batik Museum and their surroundings. This pattern shows that previous tourism destination planning and development focused more on areas with high historical and cultural value and good accessibility, especially to public transportation such as stations and terminals.

The results of the Average Nearest Neighbor (ANN) analysis show that tourist destinations in Surakarta City have a clustered distribution pattern with a nearest neighbor ratio of 0.616, a z-score of -3.028, and a p-value of 0.002. This finding means that the distribution of tourist

destinations is not random, but concentrated in certain areas with a high level of significance. This clustering pattern has strategic implications for tourism development, as it has the potential to cause tourist congestion, traffic jams, and pressure on local infrastructure in the area. These conditions can lead to a decline in the quality of the tourist experience and also create imbalances in tourism development. inter-regional, especially in relatively undeveloped suburban areas such as eastern Jebres, western Laweyan, and northern Banjarsari.

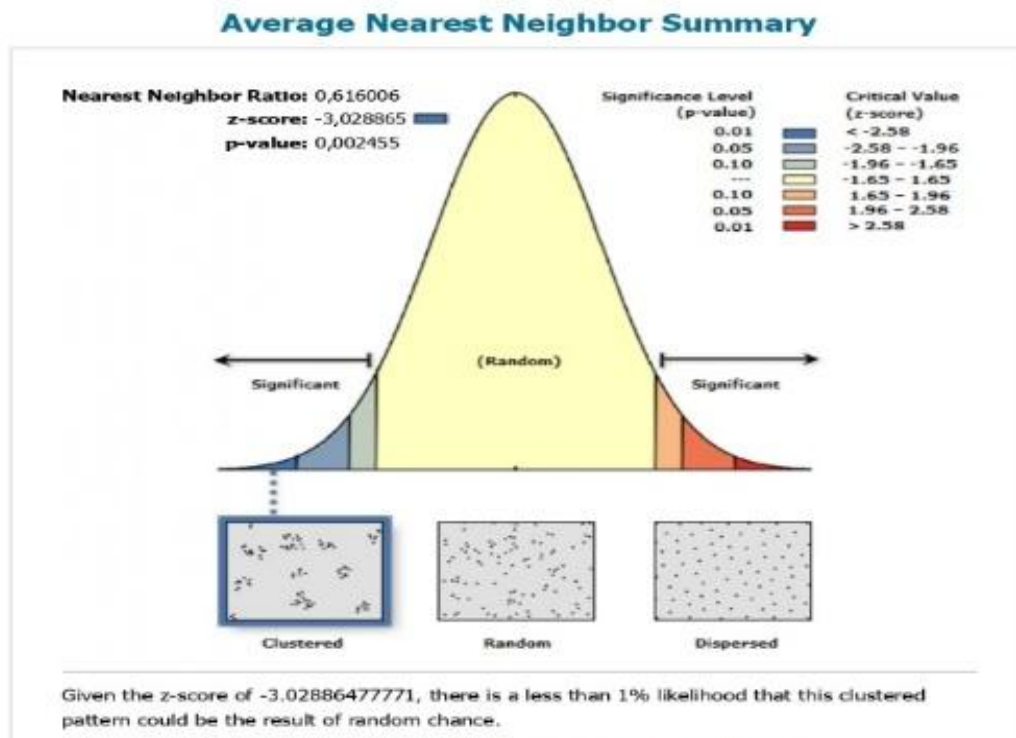
Indirectly, these results make an important contribution to sustainable tourism spatial planning. The equitable development of destinations in peripheral areas is necessary to reduce pressure on city centers and also to increase the equitable distribution of the economic benefits of tourism. This is in line with research (Fauzi, Novianti, & Budhi Septyandi, 2022) that developed a WebGIS application to visualize the distribution of tourists at sites and travel route patterns, thereby facilitating the monitoring of density and identifying potential alternative areas to spatially shift the burden of

tourism. (Xing, 2024) also emphasizes that applied studies in the field of modern tourism planning highlight the use of GIS in designing visitation routes, optimizing the tourism experience, and minimizing environmental impact, which is at the core of a comprehensive and sustainable tourism strategy.

Thus, the interpretation of these ANN results not only provides an overview of spatial patterns, but also offers a reasonable basis for sustainable tourism development strategies in Surakarta City.

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Average Nearest Neighbor Summary



Average Nearest Neighbor Summary

Observed Mean Distance:	512,7766 Meters
Expected Mean Distance:	832,4216 Meters
Nearest Neighbor Ratio:	0,616006
z-score:	-3,028865
p-value:	0,002455

Dataset Information

Input Feature Class:	Wisata
Distance Method:	EUCLIDEAN
Study Area:	47118947,202000
Selection Set:	False

Figure 5. Results of the Average Nearest Neighbor Analysis



Figure 6. Main Display of Story Maps Tangible Cultural Tourism in Surakarta City

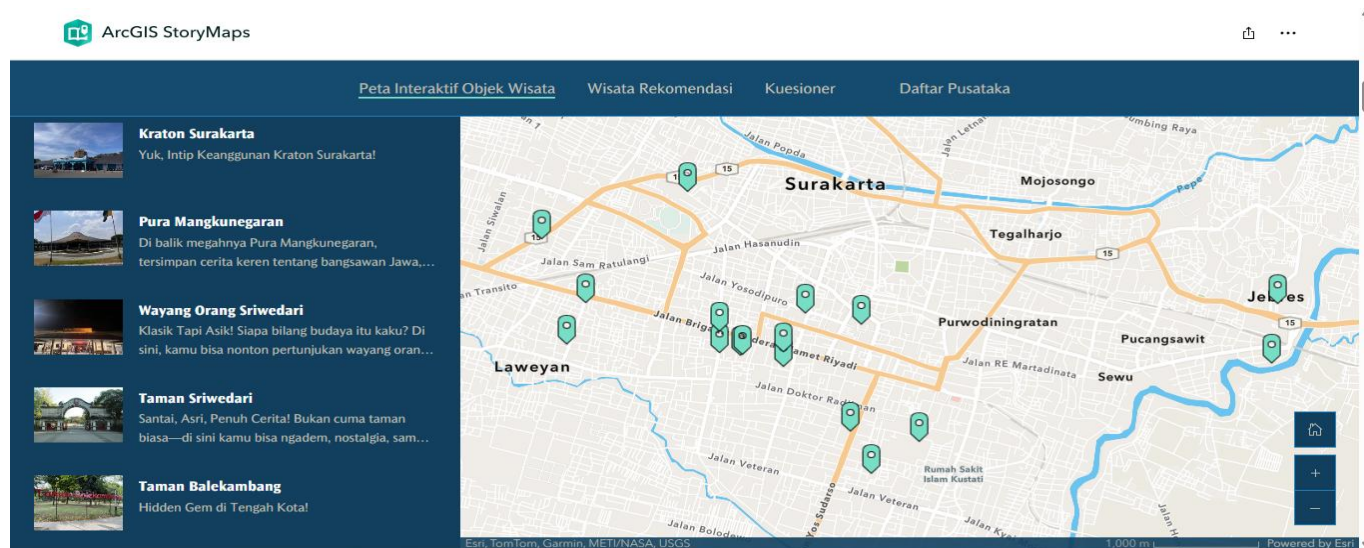


Figure 7. Map Display on Story Maps (Source: access): <https://arcg.is/1PqyOD0>).

The main display on the ESRI StoryMaps platform geographically combines the concepts of cultural geography and tourism by documenting tangible cultural spaces in Surakarta using visual media and interactive maps. This enhances users' spatial understanding of the

interactions between people, culture, and the environment in the region, while also supporting the development of appropriate cultural tourism strategies at the local level.

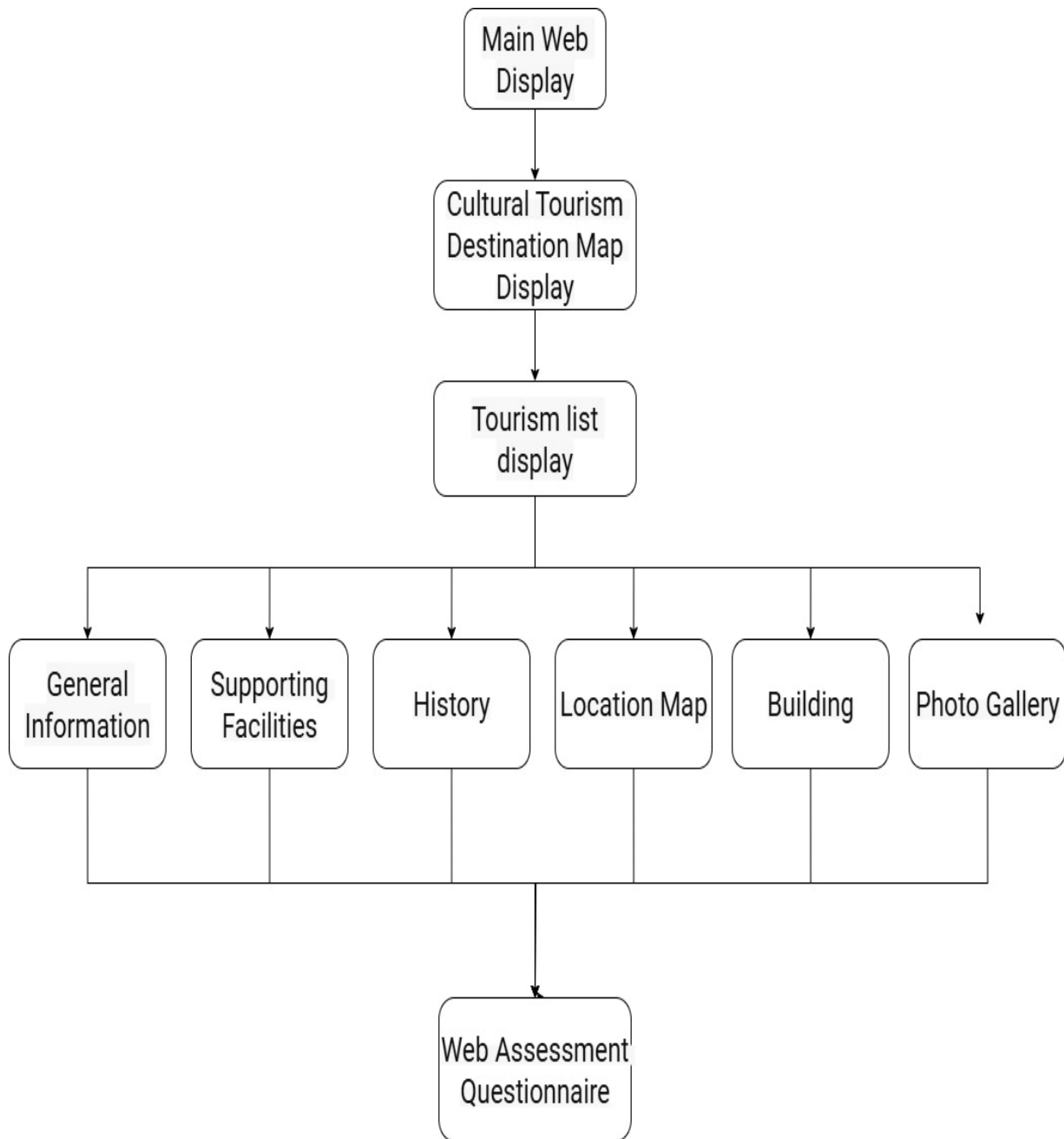


Figure 8. Flowchart of Map Display on Story Maps

The StoryMaps product on Tangible Cultural Tourism Objects in Surakarta City received very positive responses from survey respondents, indicating that the use of interactive WebGIS with ESRI StoryMaps can effectively increase the appeal and accessibility of information on cultural tourism destinations in Surakarta.

Story Maps Rating Score form 1 - 10

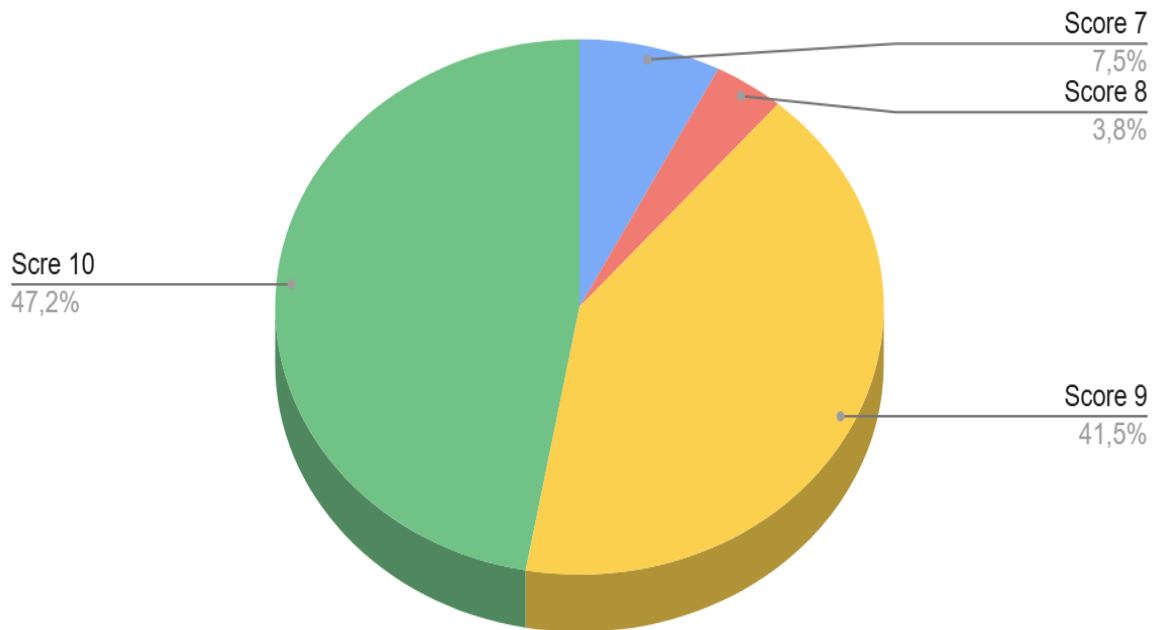


Figure 9. Story Maps Rating Diagram
Source: Results of Research Data Processing in 2025

Level of interest of tourists to travel directly

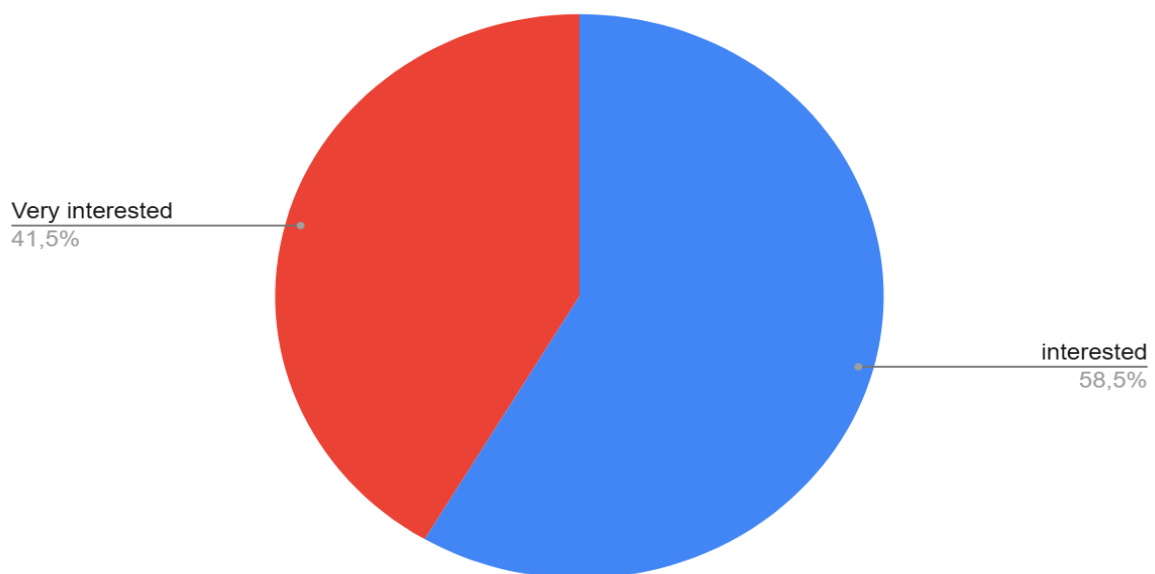


Figure 10. Story Maps Assessment Diagram
Source: Results of Research Data Processing in 2025

Based on the graph results, it can be seen that respondents' assessments of the story maps product for cultural tourism objects in Surakarta City are in the good category. Of the total 106 respondents, most gave scores of 9 and 10, respectively 41.5% (44 respondents) and 47.2% (50 respondents). This shows that more than 88% of respondents found the product very satisfactory. Meanwhile, only a few respondents gave scores of 7 (8 respondents or 7.5%) and 8 (4 respondents or 3.8%). No respondents gave scores below 7. These findings indicate that story maps are considered to be of high quality, relevant to user needs, and effective in presenting information about cultural attractions in Surakarta.

This assessment category uses a scale of 1–10, which is grouped into five levels: very poor, poor, fair, good, and Very good. Score 1–2 including A score of 1-2 falls into the very poor category, indicating that the product is not suitable for use, while a score of 3-4 falls into the poor category, meaning that the product is far from expectations and requires significant improvement. A score of 5-6 is categorized as fair, meaning that the product meets minimum standards and provides information but is still unattractive in its presentation. Scores of 7-8 fall into the good category, indicating that the product is adequate even though there are still minor aspects that can be improved. The highest score, 9-10, falls into the very good category, confirming that the product is highly suitable for its intended purpose, informative, and easy to use. Thus, the public's overall perception of this product is very positive and shows good potential for wider use.

Based on the pie chart above, from the question "After exploring the story maps presented, are you interested in visiting these cultural attractions in person?", it can be concluded that respondents' assessment of their interest after viewing the story map products of cultural attractions in Surakarta City was positive, with the majority giving a rating of 58.5% interested, while the other 41.5% rated the display as very interested. In this assessment, no respondents chose the categories of less interested or not interested, according to the answer categories from (Cahyani, 2022), so it can be interpreted that all respondents were satisfied with the visual display of this story map product. This shows that the design and presentation of information are considered appropriate, attractive, and able to attract the attention of users. Thus, these results reinforce previous findings that story maps are of high quality, not only in terms of content but also in terms of aesthetics and visual

appearance. This has the potential to increase public interest in using this product as a medium for cultural tourism information in the city of Surakarta.

Discussion

This study aims to develop interactive WebGIS dissemination using ESRI StoryMaps in mapping tangible cultural tourism destinations in Surakarta City. The main contribution of this research lies in the application of GIS-based digital technology that combines spatial data with multimedia visual narratives to enrich the user experience in accessing local cultural information. Thus, this research provides a relevant technological solution to overcome the challenges of limited access and dissemination of accurate information about cultural tourism destinations, which have been obstacles in tourism management in Surakarta.

As stated in "Integrating story maps into case-based geography teaching," it has been proven effective in enriching spatial understanding through a case-based approach (Tusam, Somantri, Setiawan, & Sugito, 2024). Furthermore, in the context of higher education, (Ribeiro, 2024) emphasizes that story maps, as accessible geotechnology tools, can help students' geographical abilities by incorporating multimedia stories into spatial data to help them explore the world. Things similar to confirmed by (Özkara, Altıntaş, & Bilişli, 2025), who found that the application of the story map method in learning yielded significantly better results than traditional methods, shows that the use of story maps does indeed increase student engagement and learning effectiveness.

From a technological perspective, Esri consistently develops new features for StoryMaps. For example, (Lei et al., 2024) mentions that our framework flags potential issues when analysts select model parameters, creates template-based text to summarize model outputs, and connects to external knowledge repositories to provide annotations that help explain model results. Meanwhile, (W. Li et al., 2023) adds that the use of text-based templates in the GeoExplainer framework enables the creation of consistent and replicable spatial analysis documentation; this is comparable to the template function in ArcGIS StoryMaps for composing structured and easily customizable spatial narratives. (Kim et al., 2024) highlight how immersive spatial narrative design, as used in ArcGIS StoryMaps, can increase reader engagement and persuasion. (Mai, Huang, Cai, Zhu, & Lao, 2022) explain the importance of integrating maps

and narratives in location-based storytelling, a concept adopted in the use of sidecars and media actions in StoryMaps. Thus, this study supports recent literature that affirms the role of StoryMaps as an innovative medium for the promotion, education, and sustainable management of cultural destinations.

Strategic locations such as train stations serve as major transit hubs that facilitate visitor access to geographically adjacent premier tourist destinations (Senes et al., 2025). A study (Laphet, Gooncockord, Sanvises, & Klinsreesuk, 2025) discusses solutions for transport integration for tourism and public safety, highlighting how the integration of transport options can improve travel efficiency and create an environmentally friendly and well-managed travel experience. The study also underscores the importance of strategic planning to support better overall travel and transportation experiences (Inturri, Giuffrida, Le Pira, Fazio, & Ignaccolo, 2021).

The grouping of tourist destinations in city centers and cultural areas not only encourages local economic activity but must also consider environmental sustainability by reducing dependence on private vehicles and optimizing environmentally friendly public transportation. However, sustainable tourism policies in Kadaka Hills can increase tourist visits and boost the local economy. The sustainability of tourist destinations is well supported by a management approach that emphasizes environmental preservation, optimization of public facilities, and local community participation. To overcome potential congestion and pressure on the environment without sacrificing visitor comfort and the quality of the living environment around tourist areas, visitor flow management and infrastructure development are very important. (Setiawati & Ramdani, 2025).

The strategic implications emerging from the ANN analysis open up opportunities to promote the equitable development of tourist destinations in underdeveloped peripheral regions. This approach is also consistent with the recommendations of (Arman, Rahmelina, Purwarsih, & Kurnia, 2025), who emphasize that Public Participation Geographic Information Systems (PPGIS) enhance public engagement and decision-making in tourism planning by conveying residents' perspectives on tourism-related issues. (Gheitasi, Salari, & Clark, 2024) and (Kajosaari, 2024).

The use of ESRI StoryMaps in this study adds a multimedia and interactive dimension, presenting not only static maps but also visual narratives that invite users to understand the cultural and historical context of

tourist attractions. These findings support the results of previous studies by (Yuxin, Jianpeng, Xiaoyu, Yunxia, & Weilong, 2024) and (N. Li, Li, Chen, & Wong, 2024), which confirm the effectiveness of StoryMaps in increasing user engagement and interest in visiting through interactive and educational digital media. However, the focus of this study, which specializes in tangible cultural tourist attractions in Surakarta, adds specific and thematic local value, unlike previous studies that were more general or focused on promotion.

The success of developing StoryMaps also opens up opportunities to explain unexpected phenomena, such as how easy access to digital information can shorten the duration of tourist visits without reducing the quality of the cultural experience. These findings form the basis for the idea that digitizing information and providing clear spatial access can support the efficiency of tourist travel, especially in cities with tourist attractions that are geographically close to each other.

However, this study has limitations that need to be considered. Data collection through questionnaires is still limited to respondents who access WebGIS through social media, so it does not cover all tourist segments. In addition, developments in infrastructure and spatial planning in Surakarta, which can change rapidly, require regular data updates to maintain the relevance of StoryMaps. Technical conditions such as internet coverage can also affect user accessibility to this WebGIS platform.

As a follow-up to this study, it is recommended that StoryMaps features be developed to be more adaptive and mobile-friendly, and that real-time data be integrated to monitor tourist movements dynamically. Further research could also explore the influence of this technology on tourist behavior and its socio-economic impact on local communities. A participatory approach that directly involves cultural communities and tourism managers can enrich the content and enhance the sustainability of this information system.

Overall, this study makes a significant contribution to the development of digital innovation for the promotion and management of tangible cultural tourism destinations using interactive, informative, and accessible WebGIS and StoryMaps technology, thereby supporting the development of sustainable cultural tourism in the city of Surakarta.

CONCLUSSION

StoryMaps for mapping tangible cultural tourism destinations in Surakarta City. The findings show that the integration of GIS and StoryMaps is an effective solution, which can be measured through several indicators, namely the level of user interaction such as likes and comments during visits to the platform, as well as user feedback through questionnaires that have been conducted, which received a rating of 10 by 47.2% of respondents, meaning that Storymap is quite effective to use and can assess their satisfaction and understanding of the information presented.

The presentation of cultural tourism information is easily accessible, informative, and attractive to various groups. The distribution pattern of tourist destinations in Surakarta tends to be clustered in historical areas in the city center, with Solo Balapan Station as a strategic transit point that facilitates access to a number of leading tourist attractions. The use of the StoryMaps platform enhances spatial understanding and user experience, while supporting the promotion and preservation of culture in a sustainable manner.

However, researchers also found issues related to tourist density and how to develop tourist destinations evenly. In addition, it should be noted that this study has several limitations. These include the short data collection period, limited data coverage of specific destinations, and a lack of quantitative measurements of how the use of StoryMaps affects visitor behavior. It is crucial to clarify these limitations so that future research can incorporate innovations such as real-time data integration, more comprehensive user behavior analysis, or the development of additional interactive features to enhance user experience and promote tourist

destinations evenly.

This research makes an important contribution to the development of digital innovations in the management and promotion of sustainable cultural tourism, while also opening up opportunities for further feature development and follow-up research to improve the effectiveness and socio-economic impact of this technology in the future.

Acknowledgments

The authors would like to express their sincere gratitude to the Department of Geography, Universitas Muhammadiyah Surakarta, for the institutional support and academic facilities provided throughout this research, as well as to the supervising lecturers for their valuable guidance, critical feedback, and scholarly direction. The authors also acknowledge the Surakarta City Tourism Office for providing official data on cultural tourism destinations and visitation statistics, which formed a crucial foundation for the development of the ESRI StoryMaps-based WebGIS system, and extend their appreciation to all respondents who participated in the questionnaire survey and contributed to the evaluation of this interactive platform. This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Conflict of interest The author has no competing interests to declare that are relevant to the content of this article.

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