Implementation of Mobile Applications in Improving Tourist Experience at the Mount Papandayan Tourist Destination, Garut Regency

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Abstract. This research explores the impact of mobile applications on enhancing tourist experiences at Gunung Papandayan, a natural destination in Garut Regency, Indonesia. The study investigates how digital tools improve navigation, provide educational content, enhance safety, and support sustainable tourism practices. A mixed-methods approach was used, combining surveys and in-depth interviews with 100 tourists who used a mobile application designed to aid exploration and learning at the site. Results indicate that mobile applications significantly increase tourist satisfaction by facilitating independent navigation, offering insights into environmental conservation, and providing real-time safety alerts. Tourists reported a deeper connection with the site, a heightened sense of environmental responsibility, and increased confidence in navigating natural landscapes. The application's role in minimizing the need for printed materials also aligns with eco-friendly practices, supporting sustainable tourism goals. This study underscores the potential of mobile applications to enrich tourist experiences and promote environmental stewardship in natural tourism settings, with implications for broader adoption in other destinations.

Keywords: Mobile Application; Tourist Experience; Natural Tourism; Sustainability; Enviromental Awareness

Introduction

The tourism industry has experienced significant growth in recent years, largely fueled by advancements in technology and an increasing desire among individuals to explore diverse cultures, landscapes, and historical sites. This expansion has transformed how tourism is experienced and managed, particularly through the integration of digital technology, which presents substantial opportunities for enhancing tourist satisfaction and promoting sustainable development. This study investigates the role of mobile applications in improving tourist experiences at Gunung Papandayan, a prominent natural destination in Garut Regency, Indonesia. The research aligns with several Sustainable Development Goals (SDGs), notably SDG 8 (Decent Work and Economic Growth), SDG 9 (Industry, Innovation, and Infrastructure), and SDG 11 (Sustainable Cities and Communities), by examining how digital tools can facilitate sustainable tourism development while simultaneously enhancing visitor experiences (Villacorta & Aguero, 2022; Liébana-Cabanillas et al., 2020).

In relation to SDG 8, sustainable tourism is recognized as a vital mechanism for fostering economic growth, creating employment opportunities, and preserving cultural heritage. By incorporating mobile applications that enhance visitor experiences, this study addresses the necessity for decent work and economic growth through tourism, thereby benefiting local communities by increasing tourist numbers, extending their stays, and generating additional opportunities for local service providers (Trišić et al., 2018). Furthermore, this research is pertinent to SDG 9, as it emphasizes innovation and infrastructure. Mobile applications serve as innovative solutions that improve access to information, provide real-time navigation, and offer visitor guidance, thereby contributing to the necessary infrastructure to accommodate a growing influx of tourists

(Villacorta & Aguero, 2022; Liébana-Cabanillas et al., 2020). Lastly, SDG 11 advocates for the sustainability of cities and communities by enhancing the management of natural sites, ensuring that tourism activities do not adversely affect local ecosystems, and involving local communities in managing the impacts of tourism (Trišić et al., 2018).

Mobile applications have emerged as essential tools within the tourism sector, providing a range of features that enhance user convenience, accessibility, and interaction (Chen et al., 2022; Dorčić et al., 2019). These applications enable tourists to access vital information, including real-time updates, navigation guides, local attractions, weather forecasts, and health and safety advisories ("Developing a “Smart Village” through the Implementation of Mobile Applications", 2022). Moreover, mobile applications facilitate personalized experiences by offering recommendations tailored to tourists' interests, locations, and past behaviors. By empowering tourists with greater control and customized information, mobile applications significantly enhance overall satisfaction and encourage repeat visits ("MEDIATING SOCIAL TOURISM EXPERIENCES THROUGH A MOBILE APPLICATION", 2021; Khoshaim, 2023). Several studies underscore the importance of mobile applications in tourism, particularly in enhancing visitor experiences through increased interactivity and convenience. These applications act as a bridge between visitors and local service providers, featuring digital maps, augmented reality tours, and virtual booking systems that reduce reliance on physical infrastructure and improve site accessibility (Chen et al., 2022; Dorčić et al., 2019; "Developing a “Smart Village” through the Implementation of Mobile Applications", 2022).

In natural tourism destinations like Gunung Papandayan, where physical accessibility and infrastructure may be limited, mobile applications provide viable solutions to overcome logistical challenges. By integrating essential information and interactive features into mobile platforms, these applications enable tourists to navigate challenging terrains, discover hidden attractions, and engage more meaningfully with local culture. In addition to navigational support, mobile applications can deliver educational content, such as information on local flora and fauna, conservation efforts, and cultural heritage, fostering a deeper appreciation for the site (Camilleri et al., 2023; Gupta et al., 2018). Thus, mobile applications not only enhance convenience but also contribute to sustainable tourism by educating tourists on the importance of environmental preservation and respect for local traditions (Kazmina et al., 2021).

Despite the potential advantages, several challenges impede the effective implementation of mobile applications in natural tourist destinations. A primary concern is the lack of adequate digital infrastructure at many natural sites, such as reliable internet connectivity, which can limit the functionality of mobile applications in remote areas. For instance, at Gunung Papandayan, weak mobile signals can hinder access to critical information for tourists, thereby diminishing the effectiveness of the application (Adityaji et al., 2023). Additionally, ensuring that mobile applications are user-friendly and accessible to diverse demographics, including elderly tourists who may be less comfortable with technology, presents another challenge (Simanjuntak, 2020). Furthermore, there is a risk that an over-reliance on mobile applications may detract from the authentic experience of exploring natural sites, which are often valued for their tranquility and sense of escapism. Therefore, it is essential to strike a balance between providing useful digital features and preserving the inherent charm of the site (Hashim & Isse, 2019). Environmental concerns also arise when considering the energy and resource demands associated with mobile technology, necessitating the promotion of sustainable use and digital minimalism among users to prevent exacerbating the very issues of environmental degradation that mobile applications aim to address (Nathan et al., 2020).

Although mobile applications have been extensively studied in urban and developed tourism contexts, their application in natural tourism destinations, particularly in Indonesia, remains underexplored. Most existing research has concentrated on enhancing visitor experiences through technological interventions in well-connected urban environments. However, the unique challenges and potential solutions for mobile application use in remote and natural destinations have not been thoroughly examined. This study contributes to the existing literature by focusing on Gunung Papandayan and investigating how mobile applications can be tailored to meet specific needs within this context (Iaquinto, 2020; Triantafillidou & Lappas, 2022). The novelty of this research lies in its emphasis on the implementation of mobile applications as tools for sustainable tourism at a natural site. Unlike previous studies that primarily explore the impact of mobile applications on urban tourism, this research investigates how these applications can support sustainable tourism practices by enhancing tourist experiences in a natural setting (Dennouni et al., 2018; Štetić et al., 2020). The study also aims to provide insights into the broader implications of mobile applications for rural

and natural tourism destinations, particularly those with limited infrastructure. By analyzing visitor feedback and identifying features that enhance user satisfaction, this research offers valuable recommendations for designing mobile applications that are user-friendly, resource-efficient, and aligned with sustainable tourism goals (Lu, 2019; Xu et al., 2019).

The primary objective of this research is to investigate how mobile applications can improve the tourist experience at Gunung Papandayan by providing easy access to relevant information, enhancing navigation, and supporting educational engagement with the site. Specific objectives include: 1. Assessing the impact of mobile applications on visitor satisfaction, navigation efficiency, and safety awareness at Gunung Papandayan.

2. Identifying the most effective features of mobile applications that contribute to positive visitor experiences in natural settings.

3. Providing recommendations for sustainable mobile application design, emphasizing usability, minimal environmental impact, and support for local tourism infrastructure.

4. Contributing to the body of knowledge on mobile applications in natural tourism, particularly within the Indonesian context.

By addressing these objectives, this research seeks to highlight the role of mobile applications in promoting sustainable tourism practices at natural destinations. It also aims to demonstrate how digital innovations can support local economies, protect natural resources, and enhance visitor experiences in alignment with the SDGs. Ultimately, the findings from this study will contribute to the growing literature on sustainable tourism and offer practical insights for the development of mobile applications that cater to the needs of natural tourism destinations.

Methods

General Background

This study investigates the impact of mobile applications on enhancing tourist experiences at Gunung Papandayan, a natural tourism destination in Garut Regency, Indonesia. Recognizing the unique challenges and opportunities presented by natural sites, the research focuses on how mobile applications can improve visitor satisfaction, provide navigation support, and increase engagement through educational features. The study employs a mixed-methods approach, combining quantitative surveys with qualitative interviews, to gather insights on the specific ways in which mobile technology can address visitor needs in a natural tourism setting Liberato et al. (2018)Liébana-Cabanillas et al., 2020).

Research Design

A mixed-methods design was chosen to provide a comprehensive understanding of the application's impact. Quantitative data were collected through structured surveys to measure general satisfaction and usability, while qualitative data from semi-structured interviews captured in-depth insights about visitor experiences and preferences. This design allowed for both the quantification of user experiences and exploration of nuanced aspects of mobile application use in natural settings (Gameiro et al., 2019; Fannisa et al., 2021).

Sample/Participants

The study sample consists of 100 tourists visiting Gunung Papandayan, selected using a convenience sampling method. Participants were chosen from those who had used the mobile application provided at the site or had prior experience using digital tools during their visit. The sample included a diverse group of visitors, ranging from domestic tourists of varying age groups to international tourists interested in eco tourism. Efforts were made to ensure demographic diversity in age, gender, and nationality to gather a comprehensive understanding of user experiences and needs (Lombardo et al., 2021; Muhammad et al., 2021).

Instruments

Two primary instruments were employed in this study:

1. Survey Questionnaire : A structured survey was developed to measure various aspects of user satisfaction,

navigation ease, educational engagement, and overall experience with the mobile application. The questionnaire utilized a 5-point Likert scale, ranging from "strongly disagree" to "strongly agree," to evaluate factors such as ease of use, information accessibility, and content relevance. Additionally, open-ended questions were included to allow respondents to elaborate on specific aspects they found beneficial or challenging (Reverté et al., 2018; Hashim & Isse, 2019).

2. Interview Guide : A semi-structured interview guide was used to conduct in-depth interviews with selected participants who expressed an interest in discussing their experiences in detail. Interview questions focused on the features of the mobile application that were most useful, challenges faced during usage, and suggestions for improvement. The interviews provided qualitative insights that complemented the quantitative data gathered from surveys (Tyag et al., 2021; Yin et al., 2022).

Procedure

The research was conducted in four main stages:

1. Preparation: Initial preparations included the development and pilot testing of the survey and interview instruments. The survey was pilot-tested with 10 visitors to ensure clarity, relevance, and reliability. Feedback was used to refine the wording of questions and improve the overall structure of the instruments (Pierdicca et al., 2019).

2. Data Collection: Data collection was conducted over a four-week period. Survey questionnaires were distributed to tourists at various entry and exit points of Gunung Papandayan. The research team briefed participants about the purpose of the study, ensuring informed consent and voluntary participation. For the interviews, participants who indicated an interest in sharing detailed feedback were contacted individually to schedule in-person interviews at a convenient location within the site (Wu et al., 2018).

3. Data Handling and Storage: All survey responses and interview recordings were securely stored to maintain confidentiality. Survey data were recorded in a secure database, while interview recordings were transcribed for analysis. Participant anonymity was maintained throughout the process, and all data were stored in compliance with data protection standards (Hu et al., 2020).

4. Data Analysis: Once data collection was complete, quantitative survey responses were analyzed using statistical software, while interview transcripts were coded thematically to identify recurring patterns and unique insights. The integration of quantitative and qualitative data allowed for a robust analysis of how mobile applications impact tourist experience at Gunung Papandayan (Gračan et al., 2021; Chang, 2023).

Data Analysis

The analysis combined descriptive and thematic analysis techniques:

1. Quantitative Analysis: Survey data were analyzed using descriptive statistics to calculate means, standard deviations, and frequency distributions for each survey item. This analysis provided a broad understanding of tourist satisfaction, ease of navigation, and educational engagement facilitated by the mobile application. Additionally, correlation analysis was performed to explore relationships between demographic variables and overall satisfaction scores (Štetić et al., 2020; Ballina, 2020).

2. Qualitative Analysis: Interview transcripts were subjected to thematic analysis. Initial codes were assigned to segments of text, and these codes were organized into broader themes, such as "navigation support," "information relevance," and "environmental awareness." This approach allowed the researchers to identify key themes and insights about the mobile application's role in enhancing visitor experiences. Data triangulation was employed to compare findings from surveys and interviews, ensuring a comprehensive understanding of the impact of mobile applications in this context (Buhalis et al., 2022; Lucia et al., 2021).

Ethical Considerations

All participants were briefed on the purpose and procedures of the study and provided informed consent before participating. Confidentiality and anonymity were ensured throughout, with participant data securely stored and only accessible to the research team. Ethical approval was obtained from the relevant institutional review board, ensuring compliance with ethical standards in social research (Lee et al., 2022; Al Hazmi, 2021).

Result and Discussion

The study results reveal significant insights into the ways mobile applications impact tourist experiences at natural destinations like Gunung Papandayan. Analysis of survey responses and in-depth interviews shows that tourists highly value features such as navigation support, real-time safety information, educational content, and eco-friendly digital materials. This section details the main findings of the study and discusses their broader implications for enhancing natural tourism through mobile applications.

1. Navigation and Accessibility

A significant majority of survey respondents (82%) rated the navigation feature in the mobile application as highly effective. Tourists commented that GPS-enabled maps and route guides were instrumental in making their visit smoother and more organized, especially for first-time visitors who were unfamiliar with Gunung Papandayan's trails and terrain. Many visitors reported feeling more confident navigating the site independently due to the application's guidance, as it allowed them to explore at their own pace without relying on physical maps or signs (Villacorta & Aguero, 2022; Liébana-Cabanillas et al., 2020).

The convenience of the app's navigation tools was also highlighted in interviews. Several respondents explained that the app's ability to provide real-time location tracking and suggest points of interest enhanced their freedom to explore independently. This independence was particularly valued among solo travelers and families who wanted flexibility in their itineraries. Furthermore, the app's feature of marking key attractions along the trail was described as a way to enrich the experience by enabling tourists to appreciate distinct natural spots that might otherwise go unnoticed (Trišić et al., 2018; Chen et al., 2022).

2. Educational Engagement

Educational content within the application received high ratings from survey participants, with 70% of respondents stating that it significantly enriched their understanding of Gunung Papandayan's ecosystem. The app provided information on local plant species, wildlife, and geological formations, which many tourists found engaging and informative. Through interviews, visitors noted that learning about the environmental and cultural significance of the site contributed to a deeper appreciation of the area and an increased sense of responsibility toward preserving it (Dorčić et al., 2019; "Developing a "Smart Village" through the Implementation of Mobile Applications", 2022).

Interviewees frequently mentioned that the educational information available in the app, especially details about the volcanic landscape and conservation efforts, helped them connect more personally with the destination. This connection fostered a sense of environmental stewardship, with some tourists indicating that the app's focus on conservation prompted them to be more mindful of their behavior during the visit. In particular, the ability to access information on flora and fauna while exploring the trails provided an immersive educational experience that traditional signage could not replicate ("MEDIATING SOCIAL TOURISM EXPERIENCES THROUGH A MOBILE APPLICATION", 2021; Khoshaim, 2023).

3. Tourist Satisfaction and Safety

The app's effect on tourist satisfaction was substantial, with 80% of respondents indicating that it positively impacted their overall experience. Visitors felt that the combination of navigation support, educational content, and real-time safety updates increased their enjoyment and comfort at Gunung Papandayan. The app's safety features, which included alerts about weather conditions and trail hazards, were especially valued by tourists who had concerns about navigating potentially challenging terrain. Many tourists stated that they felt reassured by the app's ability to provide immediate information on safety issues, allowing them to make informed decisions and avoid risky areas (Camilleri et al., 2023; Gupta et al., 2018).

The safety alerts were particularly impactful during unexpected weather changes, as Gunung Papandayan's mountainous environment is prone to sudden shifts in conditions. For example, some interviewees shared experiences of receiving weather warnings through the app that enabled them to seek shelter or adjust their plans promptly. This feature was cited as a major contributor to visitor satisfaction, as it minimized disruptions and ensured a safer experience in a natural setting that can be unpredictable (Kazmina et al., 2021; Adityaji et al., 2023).

4. Reduced Environmental Impact

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One of the notable benefits of the mobile application, as indicated by 68% of respondents, was its role in reducing reliance on physical materials like printed maps and guides. Tourists appreciated that the app's digital format minimized waste, aligning with eco-friendly practices that are increasingly valued in natural tourism. Interviewees expressed that having all necessary information in a digital format not only reduced environmental impact but also provided a more convenient and modern experience. By replacing traditional printed materials, the app supported the principles of sustainability that are essential to preserving natural destinations like Gunung Papandayan (Simanjuntak, 2020; Hashim & Isse, 2019).

Discussion

The findings of this study highlight the pivotal role mobile applications can play in enhancing tourist experiences at natural sites. The discussion explores how each result reflects broader trends in digital tourism, contributes to sustainable practices, and provides a framework for future developments in mobile applications for natural destinations.

Significance of Navigation Features

The high level of satisfaction with the app's navigation tools underscores the importance of accessibility in natural tourism. Natural destinations like Gunung Papandayan are often characterized by expansive landscapes and complex trails, which can be daunting for tourists unfamiliar with the environment. Mobile applications address this challenge by offering an accessible, GPS-enabled solution that simplifies navigation and enhances the visitor experience. The ability for tourists to explore independently without needing to follow strict guided tours represents a significant shift in how natural sites can cater to modern tourists who prioritize flexibility and autonomy in their travel experiences (Nathan et al., 2020; Iaquinto, 2020).

Moreover, by marking points of interest and suggesting routes, the application ensures that visitors can experience Gunung Papandayan's unique features in a structured yet personalized way. This approach aligns with the increasing demand for customized tourism, where visitors seek experiences that cater to their interests and schedules. The success of navigation features in enhancing visitor satisfaction suggests that similar applications could be adopted at other natural sites to offer flexible, autonomous exploration while reducing reliance on physical infrastructure like signs and tour guides (Triantafillidou & Lappas, 2022; Dennouni et al., 2018).

Educational Impact and Environmental Stewardship

The educational value provided by the mobile application reflects a growing trend in eco-tourism, where tourists are not only interested in exploring new places but also in understanding and preserving them. By providing information on conservation efforts, local wildlife, and geological features, the app engages tourists in a way that traditional methods often fail to achieve. This educational engagement contributes to a more meaningful connection with the destination, encouraging tourists to adopt environmentally responsible behaviors that can benefit the site (Štetić et al., 2020; Lu, 2019).

The significance of this finding lies in its potential to promote environmental stewardship among tourists. When tourists are informed about the ecological importance of a site, they are more likely to respect and protect it. For Gunung Papandayan, which features delicate ecosystems and volcanic landscapes, fostering this awareness is crucial for sustainable tourism. The success of the app's educational features suggests that digital tools could be integral to encouraging responsible tourism, ultimately supporting conservation efforts and enhancing the long-term viability of natural sites (Xu et al., 2019; Liberato et al., 2018).

Safety Features and Visitor Confidence

The app's safety alerts and real-time updates were essential in building visitor confidence, especially given the unpredictable nature of the environment at Gunung Papandayan. For tourists, particularly those unfamiliar with natural sites, the presence of immediate safety information is reassuring and enables them to explore with greater peace of mind. This feature not only enhances the visitor experience but also reduces the risk of accidents or adverse incidents, which can detract from the reputation of a tourist destination (Liébana-

Cabanillas et al., 2020; Gameiro et al., 2019).

The emphasis on safety through mobile applications represents a valuable addition to tourism at natural sites, where risks such as rough terrain and changing weather are common. By implementing real time safety alerts, tourism managers can enhance the appeal of these destinations for a broader range of visitors, including families and older tourists who may be cautious about visiting remote areas. The success

of the safety features in this study highlights the potential for mobile applications to provide a safer and more enjoyable experience, contributing to the reputation and sustainability of natural tourist destinations (Fannisa et al., 2021; Lombardo et al., 2021).

Environmental Sustainability through Digital Solutions

The app's ability to reduce environmental impact by replacing physical guides with digital materials is particularly significant in the context of sustainable tourism. Natural sites often face the challenge of balancing tourist influx with conservation goals. By shifting to digital solutions, tourist destinations can minimize waste and reduce the ecological footprint of visitor activities. The positive reception of the app's eco-friendly approach suggests that tourists are increasingly receptive to sustainable practices, especially those that do not compromise convenience (Muhammad et al., 2021; Reverté et al., 2018).

This finding has broader implications for the tourism industry, indicating a shift toward sustainable digital solutions that cater to eco-conscious tourists. As more travelers prioritize low-impact tourism, the adoption of mobile applications can help destinations align with environmental goals while providing a seamless visitor experience. For Gunung Papandayan, the success of this approach underscores the potential for integrating similar digital solutions across Indonesia's natural tourism sites, supporting nationwide efforts toward sustainable tourism development (Hashim & Isse, 2019; Tyag et al., 2021).

Conclusion

This study demonstrates the positive impact of mobile applications on enhancing the tourist experience at natural destinations, using Gunung Papandayan as a case study. The findings indicate that mobile applications significantly improve navigation, provide valuable educational content, enhance visitor safety through real-time alerts, and support eco-friendly practices by reducing reliance on printed materials. Tourists reported increased satisfaction and a deeper connection with the environment due to features that encouraged independent exploration, environmental awareness, and a safer experience.

The app's success at Gunung Papandayan highlights the potential for similar digital tools to be applied across other natural tourism sites, promoting sustainable tourism while enriching visitor experiences. The results suggest that integrating mobile applications into natural tourism can help destinations balance the goals of accessibility, safety, and environmental conservation. Further research could explore long-term effects on tourist behavior and scalability at other destinations, offering insights to advance sustainable, tech-driven tourism solutions.

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