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Tourism Industry in the Era of the Fourth Industrial Revolution: Personalized Marketing and the Role of Artificial Intelligence

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Abstract

This study aims to present a comprehensive conceptual framework for integrating artificial intelligence into personalized marketing within the tourism industry during the era of the Fourth Industrial Revolution. It examines the role of this technology in enhancing traveler experiences and improving marketing strategies. Using a qualitative research approach and semi-structured interviews with 11 experts in the fields of marketing, artificial intelligence, and technologies related to the Fourth Industrial Revolution, data were collected and analyzed through thematic analysis. Based on the analysis, a conceptual framework was developed from 219 concepts extracted from the data. The findings of the study indicate that artificial intelligence can play a pivotal role in data management, enabling the analysis of big data and identification of traveler behavior patterns, predicting preferences and needs through machine learning algorithms, and designing precise marketing strategies to deliver personalized travel services and experiences. These capabilities significantly enhance the effectiveness of marketing strategies in the tourism industry. The proposed conceptual framework not only contributes new insights to the scientific literature on marketing and artificial intelligence but also serves as a practical guide for tourism organizations and travel service providers to effectively leverage artificial intelligence in developing personalized marketing strategies and enhancing the traveler experience.

Keywords: Personalized marketing, Artificial intelligence, Fourth Industrial Revolution, Tourism industry

1. Introduction

The Fourth Industrial Revolution, introduced by Klaus Schwab in 2011, is described as a phase of industrial transformation characterized by the convergence of digital, physical, and biological technologies. This revolution leverages advanced technologies such as artificial intelligence (AI), the Internet of Things (IoT), robotics, and big data to steer production and marketing processes toward personalization and optimization. Key features of this revolution include the digital connectivity of processes, real-time data management, and the use of intelligent systems for performance forecasting and improvement (Ardito et al., 2019; Ryan et al., 2020). In the tourism industry, these developments enable organizations to analyze big data to identify customer needs and preferences and offer unique experiences (Fredström et al., 2022). According to Mishra et al.

(2024), AI functions as a key technology in personalizing tourism services, facilitating the provision of customized experiences for travelers (Mishra et al., 2024). Additionally, Pendy et al. (2025) emphasize that AI-based recommender systems can generate comprehensive and real-time travel itineraries tailored to the individual needs of tourists (Pandey et al., 2025). These approaches not only enhance customer satisfaction but also optimize operations and increase efficiency (Senthil Kumar et al., 2024). Moreover, Eswaran et al. (2024) underscore the role of AI technologies in fostering sustainable and personalized tourism, while Samuel et al. (2024) propose integrating AI with emotional intelligence to enhance transformative tourism experiences (Eswaran et al., 2024). Lastly, Qasemi (2024) and Vaidya et al. (2024) respectively introduce fuzzy clustering models and AI-based systems as effective tools for delivering personalized recommendations to travelers (Qasemi, 2024; Vaidya et al., 2024).

The Fourth Industrial Revolution, through the integration of digital technologies and AI, has brought profound transformations across various industries, including tourism. These transformations have empowered organizations to analyze customer data using advanced technologies and provide personalized services. Within the framework of the Fourth Industrial Revolution and the proliferation of digital technologies and AI, personalized marketing has emerged as an effective strategy for fostering customer-centric engagement (Parsakia & Jafari, 2023). This transformation allows organizations to identify customer needs and preferences through big data analysis and deliver unique experiences (Fredström et al., 2022). However, the dynamic and variable nature of data presents challenges in designing intelligent systems (Agarwal et al., 2020). Key advantages of AI-based marketing include improved productivity, cost reduction, and enhanced customer engagement, all of which contribute to a strengthened competitive position for firms (Kaplan, 2021). In the tourism sector, integrating AI with personalized marketing enables the fine-tuning of marketing strategies, enhancement of customer experience, and acceleration of business growth. Furthermore, predicting customer behavior through data analysis and advanced algorithms facilitates the execution of targeted campaigns and the creation of competitive advantage for organizations (Rizvi et al., 2021; Sestino & De Mauro, 2022).

AI-based marketing, through service personalization, significantly improves the customer experience and leads to increased satisfaction and loyalty (Nazari et al., 2024). The integration of this technology into marketing enhances positive brand experiences and influences customers' decisions regarding repeat purchases (Noranee & bin Othman, 2023; Nwachukwu & Affen, 2023). The use of AI in the tourism industry offers opportunities such as enhanced predictive analytics, cost reduction, and increased efficiency (Dumitriu & Popescu, 2020; Eswaran et al., 2024). Despite significant advances in the fields of AI and personalized marketing, considerable research gaps remain. First, previous studies have primarily focused on the technical aspects of AI such as machine learning algorithms and data analytics, while the integration of these technologies with personalized marketing strategies has not been comprehensively examined. Second, although some studies have addressed the role of AI in predicting customer behavior, the practical application of such predictions in designing targeted marketing campaigns remains underexplored. Third, existing research has paid limited attention to the impact of the Fourth Industrial Revolution on personalized marketing in the tourism sector, despite the fact that this industry particularly benefits from modern technologies to enhance customer experience and competitiveness. This study aims to bridge these research gaps by examining the role of AI in personalized marketing within the tourism industry. Specifically, the study investigates three key questions: (1) How can AI be utilized for data management and customer behavior prediction in the tourism industry? (2) How can AI be employed in designing personalized marketing strategies? and (3) What are the impacts of the Fourth Industrial Revolution on the integration of AI and personalized marketing in the tourism industry? By addressing these questions, this study contributes not only to a deeper understanding of AI applications in personalized marketing but also provides valuable insights for improving marketing strategies in the tourism sector.

Nevertheless, challenges such as privacy concerns, data security, algorithmic transparency, and ethical issues hinder the widespread adoption of AI in the tourism industry (George et al., 2024). According to Mishra et al. (2024), these challenges are particularly prominent in sensitive areas such as the management of travelers' personal data and the delivery of customized services (Mishra et al., 2024). Moreover, Pandey et al. (2025) note that the lack of transparency in AI algorithm performance

can erode customer trust (Pandey et al., 2025). The scientific literature in this field still exhibits significant gaps and demands comprehensive and structured frameworks for integrating AI with personalized marketing strategies (Ardito et al., 2019; Asoudi et al., 2021; Chandra et al., 2022; Dumitriu & Popescu, 2020; Eswaran et al., 2024). For example, Senthil Kumar et al. (2024) stress the need for developing transparent and ethical AI models in the tourism industry (Senthil Kumar et al., 2024), while Eswaran et al. (2024) recommend the establishment of robust regulatory frameworks to safeguard tourists' data privacy (Mandeep et al., 2024). The objective of this study is to propose a comprehensive conceptual framework for personalized marketing in the tourism industry using AI within the context of the Fourth Industrial Revolution.

2. Methods and Materials

From the perspective of research philosophy, this study adopts an interpretivist approach, as its goal is to gain a deep understanding of complex phenomena related to personalized marketing and artificial intelligence within the context of the Fourth Industrial Revolution. Interpretivism enables the researcher to focus on the subjective experiences and perspectives of participants, allowing for the analysis and interpretation of data. This approach aligns with the exploratory and applied nature of the study, which aims to offer practical solutions for enhancing marketing strategies in the tourism industry.

This study employs a qualitative research design, utilizing semi-structured interviews as the primary tool for data collection. The data obtained from the interviews were analyzed using MAXQDA software through thematic analysis. To ensure the reliability and validity of the study, common qualitative research methods such as participant validation and inter-coder agreement were employed. These measures contributed to the accuracy and credibility of the findings.

The study population consists of experts and specialists in the fields of marketing, artificial intelligence, and technologies associated with the Fourth Industrial Revolution. These individuals include senior marketing managers, academic researchers, business consultants, and AI specialists with both theoretical knowledge and practical experience. The educational level of the participants was predominantly at the master's and doctoral levels, indicating a high level of expertise in the relevant subject areas.

Given the lack of domestic studies in this area, this research takes on an exploratory-applied orientation, aiming to develop a practical conceptual framework for personalized marketing using artificial intelligence in the tourism industry. This framework not only enhances the understanding of related phenomena but also serves as a practical guide for tourism organizations and institutions.

The sampling method used in this study was purposive and snowball sampling. This approach allows the researcher to deliberately select initial participants and expand the network of relevant experts through referrals from interviewees. The primary data collection tool was semi-structured interviews, which provided the opportunity to collect in-depth and flexible information and enabled the researcher to explore emerging topics and dimensions throughout the interviews.

A total of 11 interviews were conducted—9 in-person and 2 by phone. The average duration of each interview was approximately 30 minutes. The data collection process occurred over a two-month period, and after the eleventh interview, no new information emerged, indicating that theoretical saturation had been reached. All interviewees held at least a master's degree in fields related to marketing management and artificial intelligence and had sufficient knowledge in personalization and related technologies.

The qualitative data gathered from the interviews were analyzed using thematic analysis, which consisted of three main stages:

- **Open coding**: At this stage, the data were broken down into initial concepts and categorized.
- **Theme identification**: The initial concepts were organized into themes and subthemes.
- **Analysis and interpretation**: Relationships among the themes were extracted and a conceptual framework was developed.

In total, 219 concepts were identified, which were eventually grouped into 4 main themes and 16 subthemes. The data analysis was conducted iteratively to ensure the comprehensiveness and precision of the findings. According to Mishra et al. (2024), the use of thematic analysis allows researchers to derive deep insights from qualitative data and identify complex relationships between concepts.

3. Findings and Results

In this section, which pertains to the categorization of codes and initial concepts, codes with similar meanings were grouped together and a meaningful concept was defined for each group. Simultaneously, categories or indicators, along with their statements and sub-indicators, were identified. At this stage, 219 concepts were obtained through open coding and were categorized into 4 main themes and 16 sub-themes. It should also be noted that the data analysis process was repeated multiple times with great precision to achieve theoretical saturation for both main and sub-themes.

Subsequently, the concepts and codes relevant to the research topic were identified and organized in separate columns under extracted codes or concepts. It is worth mentioning that the visual diagrams were developed using MAXQDA software. The research findings indicate that artificial intelligence plays a key role in three major areas of personalized marketing in the tourism industry. These findings are comprehensively presented in Table 1.

Table 1. Identification of Main, Sub, and Basic Themes (Extracted Concepts) of AI-Based Personalized Marketing

Organizing Themes (Level 1)	Organizing Themes (Level 2)	Basic Themes
Customer Interaction Management	Marketing Strategy and Design	Marketing strategies, strategy design, personalized marketing, targeted advertising, content optimization, brand awareness enhancement
	Customer Experience and Communication Management	Customer experience management, personalized interactions, real-time automated interactions, effective communication with tourists, tourist satisfaction enhancement, brand communication improvement, stronger brand–tourist relationships
	Data Management and Analysis	AI-driven data management, continuous monitoring and improvement of tourist interactions, process complexity
	Organizational Culture and Efficiency	Organizational culture, increased return on investment, stronger brand–tourist relationships, increased tourist satisfaction
Customer Behavior Analysis	Data Analysis and Prediction	Customer behavior prediction, tourist data analysis, big data analytics, predictive analytics, precise data analysis, data processing, advanced analytics, high-volume data analysis, user behavior simulation
	Algorithms and Analytical Techniques	Clustering algorithms, decision trees, neural networks, advanced data analytics, predictive analysis
	Customer Behavior and Patterns	Tourist behavior pattern identification, tourist behavior patterns, detailed behavior analysis, tourist journey analysis, review analysis
	Sentiments and Feedback	Sentiment analysis and tourist feedback, review analysis
Customer Experience	Experience Personalization	Tourist experience personalization, more accurate recommendations, personalized and relevant suggestions, tailored advertising content, personalized experiences, tourist experience optimization, personalized experiences on websites and apps, service personalization, product personalization, social personalization
	Experience Improvement and Enhancement	Tourist experience improvement, service level enhancement, creation of unique marketing experiences, customized experiences, positive interactions
	Interactions and Communication	Tourist experiences and interactions, smart interactions, positive interactions, creation of unique marketing experiences
	User and Technical Experience	User experience, personalized experiences on websites and apps, tourist experience optimization
Artificial Intelligence	Models and Algorithms	Advanced algorithms, predictive models, AI models, machine learning algorithms, reinforcement learning, continual learning, deep neural networks, advertising optimization algorithms, complex algorithms
	Data Processing and Analytical Technologies	Data mining, big data processing, fast and accurate data processing, advanced data analytics, natural language processing, machine vision
	AI and Digital Technologies	Digital technologies, AI technologies, intelligent chatbots, user behavior simulation, Internet of Things, personalized marketing technologies
	Advanced Insights and Analytics	Deeper insights into tourist needs and preferences, machine vision, advanced data analytics

4. Discussion and Conclusion

This study, aimed at presenting a comprehensive conceptual framework for integrating artificial intelligence into personalized marketing in the tourism industry, examined the role of the Fourth Industrial Revolution as a transformative foundation. The findings indicate that the Fourth Industrial Revolution, by introducing advanced technologies such as artificial intelligence, the Internet of Things, and big data analytics, has enabled digital connectivity and the intelligentization of processes. These advancements allow tourism organizations to analyze tourist data in real time and deliver fully personalized services. Specifically, the Fourth Industrial Revolution facilitates the design of targeted marketing campaigns through big data analysis and behavioral prediction of tourists. These findings align with previous studies by Ardito et al. (2019) and Ryan et al. (2020), which emphasized the role of digital technologies in transforming the tourism industry (Ardito et al., 2019; Ryan

et al., 2020). Furthermore, the revolution has laid the infrastructure for service personalization, enabling tourism organizations to significantly enhance customer experience by tailoring services to individual tourist preferences. This is consistent with Kaplan's (2021) findings, which highlight personalization as a key driver of satisfaction and loyalty in the digital age (Kaplan, 2021). The current study also reveals that integrating AI with personalized marketing allows tourism organizations to leverage competitive advantages and improve their marketing strategies more effectively.

In contrast to previous research, this study specifically explores the role of the Fourth Industrial Revolution in shaping and developing personalized marketing in tourism. The revolution has not only provided modern technologies to tourism organizations but also established a framework for the integration of AI and personalized marketing. The results show that AI can assist in accurately predicting tourist behavior, personalizing services, and improving efficiency in marketing interactions. The comprehensive framework developed for managing complex data and designing precise marketing strategies empowers tourism organizations to enhance the tourist experience and compete more successfully. The study's objectives included analyzing the role of AI in improving tourist interaction management, understanding tourist behavior, identifying behavioral patterns, and assessing the impact of personalized marketing on tourist experiences. The findings indicate that advanced machine learning algorithms and data analytics enable tourism organizations to identify tourist behavior patterns and offer personalized services. Moreover, investment in AI infrastructure and staff training plays a crucial role in the successful implementation of this technology in tourism.

This study, by offering an integrated approach to combining AI technologies with marketing strategies, emphasizes the demands of the Fourth Industrial Revolution and demonstrates how emerging technologies can improve customer-centric interactions and organizational performance in competitive markets. Unlike earlier studies such as Fredström et al. (2021) and Kaplan (2020), which were largely theoretical, this research presents an operational framework with defined indicators such as "tourist interaction management," "tourist behavior analysis," and "tourist experience enhancement." (Fredström et al., 2022; Kaplan, 2021). Using qualitative methods such as thematic coding and cluster analysis, this study gains deeper insights into tourist behavioral dynamics, unlike quantitative approaches in studies such as Agarwal et al. (2020), which focused on statistical analysis (Agarwal et al., 2020). Additionally, this research identifies the link between tourist behavioral patterns and AI-driven smart interactions, positioning personalized marketing as a dynamic and adaptive process. Innovations like "machine learning for predictive behavior analysis" and "AI-enhanced communication" are introduced, offering new composite and practical indicators compared to those in Ryan et al. (2020). By developing a practical and comprehensive framework, this research strengthens the role of AI in predicting and analyzing tourist behavior and creates a foundation for integrating human interaction with technology in managing tourist experiences (Ryan et al., 2020).

This study shows that personalized marketing improves experience and satisfaction among tourists—especially in tourism, where AI plays a vital role in enhancing the customer journey. These findings are consistent with Kaplan (2021) and Ryan et al. (2020), who identify customer experience as a key success factor in digital marketing (Kaplan, 2021; Ryan et al., 2020). According to George et al. (2024), personalized tools such as custom recommendations and intelligent interactions can significantly enhance tourist experiences (George et al., 2024). Nazari et al. (2024) also found that with adequate preparation, AI can improve customer experience and organizational efficiency. These results are also aligned with Deborah et al. (2024), who showed that smart technologies increase tourist satisfaction and loyalty, becoming effective tools for customer retention and acquisition (Nazari et al., 2024). According to Senthil Kumar et al. (2024), integrating AI with personalized marketing in tourism not only improves customer experience but also enables organizations to design more effective strategies by analyzing big data (Senthil Kumar et al., 2024).

The current study emphasizes the importance of machine learning algorithms and big data analytics technologies, including natural language processing, in personalized marketing in tourism. These findings are in line with Rizvi et al. (2021) and Sestio and Di Maro (2022), who focused on AI's capabilities in deep data analysis and enhancing customer interactions (Rizvi et al., 2021; Sestino & De Mauro, 2022). George et al. (2024) also highlight how these technologies enable tourism organizations to provide more tailored services and products. Similarly, Asoudi et al. (2021) showed that technologies such as chatbots, search engine optimization, and content personalization have a direct impact on attracting tourists (Asoudi et al., 2021).

This research underscores AI's impact on managing tourist interactions and improving key indicators such as "facilitating effective communication," "optimizing interaction timing," and "strengthening customer relationships." These findings correspond to Kaplan's (2021) theory, which stresses AI's role in creating personalized communication and optimizing customer interactions (Kaplan, 2021). Fredström et al. (2022) also emphasize the importance of tourist data analysis for targeted communication and future needs prediction (Fredström et al., 2022). According George et al. (2024), AI use in tourism improves the quality and timing of interactions with tourists, while sentiment analysis enables organizations to identify tourist reactions and predict future needs, ultimately enhancing communication quality (George et al., 2024).

By exploring the use of AI in analyzing tourist behavior in the tourism industry, this study addresses behavior pattern identification, predictive behavior modeling, and feedback analysis, underscoring AI's role in enhancing these analyses. Compared to previous studies like Agarwal et al. (2020), which employed statistical and demographic analyses, this study uses more advanced tools such as machine learning and deep analysis (Agarwal et al., 2020). Furthermore, by offering a practical and comprehensive framework extracted through semi-structured interviews, this research fills gaps left by earlier studies like Ryan et al. (2021), which emphasized the importance of predictive behavior analysis (Ryan et al., 2020).

Findings from this study demonstrate that the Fourth Industrial Revolution, as a transformative platform, plays a crucial role in personalized marketing in the tourism industry. The revolution has enabled the delivery of fully personalized tourism services by integrating advanced technologies such as AI, IoT, and big data analytics. These findings are aligned with previous studies such as Ardito et al. (2019) and Ryan et al. (2020), which highlight the digital technologies' impact on tourism transformation (Ardito et al., 2019; Ryan et al., 2020). The revolution facilitates big data analysis and behavior prediction, allowing for the design of targeted marketing campaigns, consistent with Sestino et al. (2022), who emphasize how AI and related technologies have improved organizations' ability to accurately predict tourist needs. Furthermore, personalization of services—a key indicator of the Fourth Industrial Revolution—allows tourism organizations to significantly enhance the customer experience by aligning offerings with individual tourist preferences. This aligns with Kaplan (2021), who stresses the importance of personalization in the digital age. Compared to previous studies, this research demonstrates that the Fourth Industrial Revolution not only provides advanced technologies to tourism organizations but also builds a framework for integrating AI with personalized marketing (Kaplan, 2021). This integration enables organizations to leverage the competitive benefits of these technologies and improve their marketing strategies more effectively. In short, the Fourth Industrial Revolution, through technological transformation, plays an unparalleled role in the development of personalized marketing in tourism.

In summary, this study, by emphasizing the use of AI in personalized marketing and presenting a new framework, aligns with previous research while offering innovations in analytical depth and a focus on qualitative dimensions that can serve as a foundation for future research. Beyond emphasizing the importance of AI in managing interactions and analyzing tourist behavior, the study introduces new operational frameworks and indicators, contributing to both theoretical and practical advancement and serving as a valuable resource for future research and application.

Findings from this study indicate that AI-based tools such as predictive analytics can significantly improve the timing and quality of interactions. In addition to emphasizing data analysis, the study designs operational indicators for interaction management—rarely seen in studies like those by Fredström and Kaplan. Unlike studies relying on AI tools such as clustering or machine learning for data analysis, this research focuses on qualitative data analysis and thematic coding, allowing a deeper understanding of the dynamics of tourist behavior and the impact of AI on personalized marketing.

One of the study's innovations is the development of a conceptual framework based on semi-structured interviews and qualitative analysis, which—unlike previous quantitative models such as Agarwal et al. (2020)—emphasizes complex interactions and dynamic relationships among factors (Agarwal et al., 2020). Unlike earlier research such as Fredström et al. (2021), which focused on statistical data analysis, this study uses qualitative methods to provide deeper insights into tourist behavior and AI's influence on decision-making (Fredström et al., 2022). Especially in the context of personalized marketing in the Fourth Industrial Revolution, this study explores the relationships among tourist behavior analysis, customer experience, and service personalization, contributing to the literature by introducing new indicators such as the "Tourist Behavior Analysis Index" and the "Customer Experience Index."

This research offers practical recommendations for the tourism industry in applying AI to personalized marketing. The first recommendation is to design intelligent marketing systems that, by analyzing tourist data, tailor services and suggestions to individual behavior patterns and preferences, thereby improving the tourist experience. Another recommendation is to invest in data infrastructure for precise data collection and analysis, and to use predictive algorithms to optimize services. Additionally, improving real-time interactions and personalized services using AI, training staff to utilize AI tools, and implementing smart technologies such as chatbots and predictive systems for better communication management with tourists can all enhance loyalty and satisfaction. These actions help tourism organizations provide optimized services and improve the tourist experience.

This study identifies customer-centric experience creation as a key aspect. Tourism organizations can enhance tourist interactions and build stronger relationships by using personalized tools. This approach enables organizations to anticipate future tourist needs and deliver appropriate services. Investment in advanced technologies such as natural language processing and data mining for analyzing data and identifying tourist issues through online feedback is also essential. Furthermore, focusing on transparency and ethics in AI system design is necessary to ensure operational efficiency while respecting tourist rights. These recommendations can help tourism organizations improve performance, deliver personalized services, and establish stronger relationships with tourists, while also incorporating ethical principles and transparency in decision-making processes.

Despite its significant contributions, the study has limitations. Focusing on a specific group of experts and consultants limits the generalizability of the findings, and some aspects of AI performance in marketing that may differ across industries have not been fully explored. Additionally, the data are primarily based on qualitative interviews within the tourism sector, which may hinder the applicability of results to other sectors. While qualitative research allows deeper analysis, the lack of quantitative data and statistical methods to validate the conceptual framework is a noted limitation. The study also focused on a limited dataset from the tourism industry and did not employ longitudinal studies to observe long-term behavioral changes in tourists. Future research should explore the long-term effects of AI on tourist behavior through longitudinal studies, expand the scope to other industries, conduct comparative analyses across countries to understand cultural and geographical impacts, and investigate ethical and privacy aspects of AI in tourism marketing.

For further development in this field, studies in diverse industries and markets—particularly in international contexts—are recommended to identify the applicability and regional variations of the proposed framework. Attention to ethical and legal challenges associated with AI use and the design of transparent, interpretable models is essential. Additionally, conducting quantitative and experimental research to test the framework in real business environments and analyze relationships among indicators such as “tourist interaction management,” “tourist behavior analysis,” and “tourist experience enhancement” can lead to greater generalizability and deeper understanding. Cross-national comparative studies and the use of advanced machine learning and data mining techniques to analyze tourist behavior are other suggestions that can enrich and operationalize the framework. This study also offers practical recommendations for tourism organizations, including investment in technology infrastructure, staff training, personalized service design, and the use of intelligent systems and chatbots to improve interactions and anticipate tourist needs.

In the era of the Fourth Industrial Revolution, employing artificial intelligence in personalized marketing—especially in tourism—emerges as a vital strategy for enhancing competitiveness and improving tourist interactions. This study, by presenting a conceptual framework for enhancing personalized marketing in tourism, demonstrates that tourism organizations can leverage these technologies to advance their marketing strategies and align their services more effectively with individual tourist needs. The study holds both scientific and practical significance, and with the expansion of quantitative research, longitudinal studies, and testing of the framework in various tourism environments, its generalizability across the industry can be enhanced. The practical recommendations provided can also serve as effective guidelines for improving tourist interactions and experiences in the tourism sector.

Ethical Considerations

All procedures performed in this study were under the ethical standards.

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Conflict of Interest

The authors report no conflict of interest.

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