DIGITAL TOURISM AND TOURISM 4.0 AS A CONCEPT OF THE FUTURE

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ABSTRACT

Tourism 4.0 encompasses the integration of the most advanced digital technologies, including artificial intelligence (AI), the Internet of Things (IoT), virtual reality (VR), augmented reality (AR), blockchain technology, and advanced data analytics. These innovations facilitate a comprehensive transformation within the tourism industry, aimed at improving the user experience, optimizing operational efficiency, and promoting sustainable practices. Through a systematic literature review, meta-analysis, and thematic analysis, this study identifies key themes concerning service personalization, economic contributions to local communities, and challenges associated with digitalization. The research questions deal with the main advantages and obstacles presented by digital technologies, their role in sustainable development, their impact on service quality, and their contributions to local communities. The results indicate the transformative potential of digital technologies for the future of tourism, while also highlighting the challenges related to data security and privacy. This document provides a framework and practical recommendations for the advancement of Tourism 4.0 as an emerging field of study.

Key words: tourism 4.0, AI, IoT, VR, AR, future tourist experience, impact on local communities

INTRODUCTION

Digitalization, which includes a wide range of technologies from artificial intelligence to blockchain, is the foundation of the fourth industrial revolution and has a deep impact on the tourism industry [1]. The process of digital transformation is fundamentally changing the way consumers plan, book, and engage in their trips. Innovations like artificial intelligence and the Internet of Things make it easier to personalize experiences and optimize operational processes, creating opportunities for economic and environmental sustainability. This paper examines the impact of Tourism 4.0 on the future landscape of the tourism industry and explores the role of

digital innovations in promoting economic sustainability and helping destinations adapt to emerging market trends. The research questions were designed to clarify the main benefits and challenges associated with this evolution, assess its impact on sustainability and service quality, and evaluate its contribution to the economic development of local communities.

Formulating research questions is key to clarifying the fundamental aspects of Tourism 4.0:

- What are the advantages and what are the obstacles associated with the implementation of digital technologies in the tourism sector?
- What is the impact of Tourism 4.0 on the sustainability of tourist destinations?
- How do digital technologies affect the customer experience?
- How does digitalization benefit local communities?

The introduction provides an overview of the concept of Tourism 4.0 and explains why it is important for the development of the sector in tourism, key research questions are outlined. The theoretical framework explains the main technologies of the Fourth Industrial Revolution that enable Tourism 4.0, including the application of smart technologies in tourist destinations and their impact on sustainability. The research methodology explains the process of data collection, literature analysis, and the use of meta-analysis and thematic analysis to identify key themes. The research results show the analysis results organized according to main themes, which are economic sustainability, personalization of the user experience, and sustainable development of tourist destinations. In the discussion, the challenges and opportunities related to the implementation of Tourism 4.0 are analyzed, as well as its impact on local communities. The conclusion presents the key results and highlights recommendations for future development and research, focusing on long-term sustainability and data security.

THEORETICAL FRAMEWORK OF THE RESEARCH

The theoretical framework of this paper focuses on analyzing the transformative role of digital technologies in tourism, specifically on the concept of Tourism 4.0, which arises from the Fourth Industrial Revolution. The mentioned revolution represents a new era of applying digital innovations in nearly all industries, including the tourism sector, transforming traditional business models and creating new opportunities for personalizing customer services, increasing sustainability, and managing resources more efficiently [2]. Tourism 4.0 relies on technologies like artificial intelligence, the Internet of Things, blockchain, virtual reality, and augmented reality, which together make it possible to tailor experiences to the needs of modern users, improve business, and support sustainable development of destinations. Technological infrastructure and its use in tourism have the potential to enhance user experiences, reduce costs, empower local communities, and provide security and transparency for transactions in the tourism sector [3].

The Fourth Industrial Revolution and Its Technologies

The Fourth Industrial Revolution marks an era of integrating advanced digital technologies into almost every aspect of modern life, from business processes and social interactions to individual user experiences. The revolution is transforming various sectors, including tourism, which is going through deep changes in how services are delivered, how customers are reached, and how resources are managed [2]. The main drivers of this revolution include a wide range of technologies that enable personalization, optimization, and security, as well as new opportunities for sustainable development. Tourism 4.0 uses these same technologies to improve services and enhance the user experience, making them personalized, dynamic, and secure. One of the key technologies enabling Tourism 4.0 is artificial intelligence (AI). This technology allows understanding and analyzing user preferences and adjusting services based on collected data, which increases user satisfaction and loyalty [3]. Artificial intelligence algorithms in tourism can predict user needs, offer personalized recommendations, and tailor travel experiences to their specific interests. For example, AI-based hotel systems can analyze previous user choices to customize the offering of accommodation, services, and entertainment activities. Another important technology is the Internet of Things (IoT), which connects physical devices like sensors,

smart devices, and other tech solutions, allowing for real-time data collection and analysis. Through IoT, tourist destinations can monitor resource consumption, like energy and water, which helps optimize resource use and reduce their impact on the environment [1]. IoT also allows for a better understanding of user behavior patterns, which makes it easier to customize offerings and improve operational efficiency. For example, hotels can use IoT to control room temperature based on the number of guests, thus reducing unnecessary energy consumption. Blockchain technology also plays an important role in Tourism 4.0, increasing the security and transparency of transactions. Blockchain creates a decentralized network where data is stored in secure blocks, allowing for a high level of security and reducing the need for intermediaries in financial transactions [4]. The use of blockchain technology in tourism allows guests and service providers to make safer bookings, conduct direct financial transactions, and even set up personalized loyalty programs without needing complex intermediary systems. Finally, virtual reality (VR) and augmented reality (AR) technologies let tourists 'experience' destinations before they actually arrive. VR offers a fully virtual experience of a tourist spot, while AR enhances the real world with digital information and enriched content. The use of these technologies in tourism allows visitors to virtually get to know places, reducing the chance of dissatisfaction while increasing their interest and engagement [5]. AR also helps in interpreting cultural sites by providing interactive information about historical events, cultural heritage, and local attractions, which helps preserve the destination's identity and promotes cultural tourism. All these technologies form the foundation of Tourism 4.0 and make it possible to build new service models that are tailored to the needs of today's users and focused on sustainable development. Integrating these advanced technologies into tourism not only improves the quality of customer service but also optimizes resource management, providing long-term benefits to local communities and the environment.

Smart Tourism and Smart Destinations

Smart tourism has emerged as a concept based on using advanced digital technologies to optimize resources and enhance tourist experiences. As an example of this concept, smart destinations use IoT sensors and data analytics to manage resources like energy, water, and space in an eco-friendly way [3]. By using these technologies, destinations can track visitors' movements and behavior and provide personalized recommendations, which enhances user satisfaction. Smart tourism is the foundation of a sustainable model that considers the needs of local communities and the environment. For example, cities that adopt smart technologies can monitor tourist flow to reduce congestion in the most visited areas, making for a better experience for tourists and a more comfortable life for local residents. Besides that, the collected data allows destinations to predict resource consumption needs and plan necessary interventions in advance, which reduces negative impacts on the environment and improves long-term sustainability.

Sustainable Development in Tourism

Sustainable development is becoming a key aspect of Tourism 4.0 as more and more destinations use digital technologies to support environmental, economic, and social sustainability goals. By using IoT technologies, destinations can reduce resource consumption like energy and water, helping to protect the environment and lower their ecological footprint [2]. Sustainable development also includes economic aspects, with blockchain technology allowing transparent tracking of financial transactions, which encourages local development by supporting small entrepreneurs and local producers [4]. Social sustainability, an important part of Tourism 4.0, refers to preserving cultural heritage and promoting local identity. Technologies like augmented reality allow visitors to interact with historical and cultural landmarks, which increases understanding and respect for local culture [5]. For example, augmented reality apps can allow tourists to learn about local history and customs through interactive guides, helping preserve cultural identity and promote local heritage. By putting sustainability at the center of their strategies, Tourism 4.0 aims to create a balance between economic benefits and ecological priorities, making destinations more resilient and appealing to visitors who increasingly value sustainability.

RESEARCH METHODOLOGY

To analyze the effects of digital transformation and Tourism 4.0, this paper uses a systematic methodological approach based on reviewing relevant literature and using qualitative research methods like meta-analysis and thematic analysis. The goal of this systematic approach is to provide a comprehensive overview of the existing literature to identify key themes, patterns, and trends related to the use of advanced technologies in tourism, with a special focus on personalization, sustainability, and economic benefits for local communities.

Data Collection and Literature Selection

Data collection was carried out using articles from relevant academic databases like Google Scholar, by selecting articles related to Tourism 4.0, digital technologies, sustainable development, and smart directions in tourism development. In the selection process, special attention is given to works that provide empirical and theoretical knowledge on the application of digital technologies, which allows for a comprehensive analysis of the impact of Tourism 4.0 on the tourism industry.

Meta-analysis

Meta-analysis is used to combine results from different studies on Tourism 4.0 to assess the overall impact of digital technologies on the tourism industry. This method helps organize data on the effects of digitalization on aspects like personalizing the customer experience, transaction security, resource sustainability, and economic benefits. A meta-analysis involves showing the results of research from multiple sources to get an idea of the overall direction of development and the impact of digitalization on the tourism industry.

Thematic Analysis

Thematic analysis was applied to identify the main themes and patterns in the existing literature on Tourism 4.0. This method allows for the identification of key aspects and trends in the use of digital technologies in tourism, such as increased personalization, sustainability, and economic benefits for local communities. The analysis involves picking out and interpreting patterns in the data, which gives a deeper understanding of how digital technologies are transforming the tourism sector and laying the groundwork for sustainable development.

RESEARCH RESULTS

This chapter presents the results derived from the meta-analysis and thematic analysis of the collected literature, with a particular focus on the impact of Tourism 4.0 on tourist destinations. The analysis focuses on three key areas: economic sustainability, personalization of user experiences, and sustainable development.

Economic Sustainability

An extensive meta-analysis covering various studies on the implementation of blockchain technology indicates that Tourism 4.0 plays a significant role in improving the economic sustainability of destinations. This improvement is primarily achieved through enhanced transparency of financial transactions, reduced operational costs, and greater direct market access for local entrepreneurs [4], [6].

Using blockchain technology allows for safer and more efficient transactions, which reduces the reliance on intermediaries, thereby lowering associated costs and increasing the security of financial data. The results support the idea that blockchain technology can promote economic stability and boost revenue in the tourism sector, bringing benefits to both destinations and local communities [7]. The thematic analysis revealed noticeable patterns that highlight the importance of Internet of Things (IoT) technology in improving resource optimization and helping reduce costs. For example, destinations that use IoT sensors to monitor energy and water consumption experience a decrease in operating costs and an improvement in efficiency [1]. The analysis shows that tourist destinations using IoT systems have better control over their resources and show increased operational efficiency, which leads to lower costs and greater economic sustainability

[1]. The results highlight the potential of IoT to reduce environmental impact while also boosting economic profitability.

Personalizing User Experiences

A meta-analysis of existing literature on implementing artificial intelligence (AI) technologies in the tourism sector shows that digital innovations make it easier to achieve a high level of personalization, which in turn boosts user satisfaction and encourages customer loyalty [8], [3], [9]. Empirical studies suggest that artificial intelligence algorithms, by analyzing large datasets related to user behavior, are able to customize offers to match the different interests of individual visitors. For example, it has been shown that providing personalized itineraries and tailored recommendations increases overall tourist satisfaction, which in turn boosts the likelihood of them returning to the destination. A meta-analysis confirms the claim that the principles of Tourism 4.0 give destinations a competitive edge through personalization, a phenomenon that also reflects on their economic success. The thematic analysis revealed noticeable patterns that show the capabilities of Internet of Things (IoT) sensors and data analytics tools in enabling a personalized user experience in real time. For example, IoT sensors placed in hotel environments can autonomously adjust temperature and lighting settings based on individual guest preferences, enhancing both the overall experience and comfort during their stay [3], [5]. The identified patterns show that IoT technology can be used to continuously adjust service offerings according to the development of tourist preferences. This adaptability not only boosts customer satisfaction but also contributes to the overall success of tourism businesses.

Sustainable Development

A meta-analysis of existing literature on sustainable development shows that Internet of Things (IoT) technology significantly contributes to reducing the ecological footprint of tourist destinations. By using IoT sensors to monitor resource consumption in real time, these destinations can improve energy and water management efficiency, thereby mitigating negative environmental impacts and promoting sustainability [3], [5]. Meta-analysis findings show that destinations implementing IoT technologies achieve significant reductions in greenhouse gas emissions, reinforcing the idea that Tourism 4.0 can be both sustainable and environmentally responsible. The results of the thematic analysis highlight the significant role of augmented reality (AR) technology in promoting sustainability by preserving and showcasing cultural heritage. A review of existing literature on the use of AR in the tourism sector shows that AR makes it easier for tourists to access information about local culture, which helps preserve cultural resources, while also encouraging responsible behavior among visitors [3], [1]. Furthermore, AR applications offer opportunities for virtual tours and deliver interactive content related to historical events, traditions, and cultural landmarks, which not only increase visitor engagement but also support the preservation of cultural identity. Tourism 4.0 represents a transformative paradigm that integrates key technologies linked to the Fourth Industrial Revolution, reshaping the tourism industry. The integration of technologies like blockchain, artificial intelligence (AI), the Internet of Things (IoT), and augmented reality (AR) is revolutionizing the processes through which tourist destinations are developed, resources are managed, and visitors are provided with personalized experiences [1]. The synthesis of results highlights the interconnected effects of Tourism 4.0 on economic sustainability, tailoring customer experiences, and the sustainable development of tourist destinations. A key part of Tourism 4.0 is its role in boosting the economic sustainability of tourist spots, especially through innovative technologies like blockchain and Internet of Things (IoT) systems. Findings from the meta-analysis show that blockchain technology is crucial for increasing transparency and security in financial transactions. By cutting out middlemen, blockchain helps reduce costs and allows direct transactions between tourists and service providers, which boosts market competitiveness and gives local businesses more direct access to potential customers. Additionally, IoT technologies contribute to this sustainability by allowing tourist facilities to optimize operational costs through monitoring and managing resources, including energy and water consumption. As a result, by minimizing resource use and streamlining expenses, tourist

destinations can establish a stable financial framework that supports their long-term economic sustainability. A critical aspect of Tourism 4.0 is about personalizing user experiences, which is made easier by sophisticated analytics tools and artificial intelligence (AI) technologies. Findings from the thematic analysis show that integrating AI and the Internet of Things (IoT) promotes a significant level of customization, boosting user satisfaction. By using data on past behaviors and preferences, AI systems can offer personalized suggestions for travel plans, activities, and accommodations that match the unique needs of each traveler. Additionally, IoT technology further enhances this personalization by using sensors that adjust environmental conditions in real time, ensuring optimal comfort for visitors and providing experiences that meet the high expectations of modern travelers. Such a high level of personalization not only boosts customer satisfaction and loyalty but also gives destinations a competitive edge in attracting and keeping visitors. The sustainable development of tourist destinations in the context of Tourism 4.0 is increasingly enabled by the use of advanced technologies, like the Internet of Things (IoT) and augmented reality (AR). These technologies help make resource use more efficient while promoting the preservation of cultural heritage. IoT sensors are key to improving environmental sustainability by allowing precise monitoring of resource consumption, which helps reduce the ecological footprint of tourist destinations. During the peak tourist season, IoT systems can effectively manage the flow of visitors, directing tourists and regulating their distribution across different locations, which helps protect the environment and reduces pressure on infrastructure. Additionally, augmented reality contributes to social sustainability by providing tourists with interactive and informative ways to engage with a destination's cultural resources. AR apps offer additional insights into the historical significance and relevance of various landmarks, fostering a sense of responsibility and encouraging contributions to the preservation of cultural heritage. Tourism 4.0 isn't just about technological progress; it's a fundamental shift in how destinations operate and interact with their resources, visitors, and local communities. Using advanced technologies makes it easier to develop the tourism sector sustainably and responsibly, giving destinations a framework that boosts economic resilience, increases visitor satisfaction, promotes environmental goals, and offers a holistic approach to tourism development that considers economic, social, and environmental factors, creating conditions for long-term sustainable tourism that benefits not only visitors but also local communities and the environment.

DISCUSSION

This part of the paper examines the research findings in relation to the research questions posed, followed by discussions on the study's recommendations and limitations. The analysis highlights the main challenges and opportunities that Tourism 4.0 presents for the tourism sector, with a particular focus on the involvement of local communities and the long-term implications for the development of this paradigm. Empirical evidence shows that Tourism 4.0 offers a host of benefits within the tourism industry, including improved economic sustainability, tailored customer experiences, and greater commitment to environmental care [4], [6]. Implementing technologies like blockchain boosts transaction security and transparency of financial info, which in turn helps lower operational costs and gives local entrepreneurs direct access to the market. Using Internet of Things (IoT) sensors guides resource usage, helping cut costs and improve environmental efficiency [1]. On the other hand, adopting digital technologies in the tourism sector comes with several challenges, with data security and user privacy being the most important issues. Extensive collection of user data requires the implementation of strong data protection measures to prevent privacy breaches [3]. The use of augmented reality (AR) gives tourists access to information about local culture and history, promoting responsible behavior and the preservation of cultural resources [5]. Tourism 4.0 serves as a foundational framework for encouraging long-term sustainability in the tourism industry. How do digital technologies impact the user experience? The findings show that digital technologies, including artificial intelligence (AI) and the Internet of Things (IoT), play a key role in improving customer experiences by making service personalization easier. Artificial intelligence algorithms are used to analyze user preferences, providing tailor-made recommendations that not only boost tourist satisfaction but also encourage

loyalty to the destination [8]. IoT sensors allow real-time modifications of environmental conditions, such as temperature and lighting in hotel accommodations, which contributes to a better overall experience and greater comfort for users [3]. While implementing personalized services increases the competitiveness of tourist destinations, it also presents significant challenges related to data privacy. Delivering tailored experiences involves collecting and processing users' personal data, which requires strict compliance with privacy regulations.

The digitization of tourism services offers significant benefits to local communities by increasing job opportunities, improving the transparency of financial transactions, and encouraging economic development. Implementing blockchain technology allows local entrepreneurs to directly participate in the global market, which helps boost economic growth and smooth out seasonal income fluctuations [4]. Furthermore, integrating Internet of Things (IoT) and augmented reality (AR) technologies provides innovative ways to promote local culture and heritage, which in turn supports the preservation of community identity and increases visitors' appreciation of the intrinsic value of local resources [3]. It's essential to involve local communities in shaping tourism initiatives and offer them education on using digital technologies. This approach allows them to actively participate and helps achieve the best benefits from Tourism 4.0. Based on the research conducted, recommendations are proposed for a more successful implementation of Tourism 4.0. It's crucial to establish data protection standards, which include well-defined protocols that regulate the collection and use of personal data to protect user privacy. There's also a need for support in developing Internet of Things (IoT) and augmented reality (AR) technologies that facilitate optimized resource use, minimize environmental impact, and help preserve cultural heritage. It is recommended to carry out further research on the impact of digital technologies on sustainability, environmental preservation, and the protection of cultural resources to ensure alignment with sustainable development goals. Promoting education in local communities is important so that they can fully take advantage of Tourism 4.0; it's key to implement educational initiatives focused on digital technologies and their associated benefits. The research was conducted by reviewing available literature, which may limit the breadth of information and the geographic context considered. Future studies should include empirical research carried out in specific tourist destinations to get more accurate data on the actual effects of Tourism 4.0. Further research should focus on longitudinal studies exploring the implications of digital technologies on social sustainability, especially regarding the preservation of cultural resources and their impact on local communities. The emergence of Tourism 4.0 marks a potential shift in the paradigm within the tourism industry; however, it also presents challenges that require further research to ensure alignment with sustainable development goals and to optimize benefits for all stakeholders involved.

CONCLUSION

The research results highlight the potential of Tourism 4.0 to significantly enhance the sustainable development of the tourism industry. This improvement is primarily made possible through personalized user experiences, resource optimization, and promoting economic benefits for local communities. The integration of advanced technologies, including artificial intelligence (AI), the Internet of Things (IoT), and blockchain, allows tourist destinations to strengthen operational efficiency, minimize costs, and increase market accessibility for local entrepreneurs. Technological progress contributes to the stability and sustainability of the local economy. At the same time, the opportunities offered by personalization help enrich the user experience, increasing visitor satisfaction and encouraging loyalty to the destination. Despite this, there are still significant challenges in protecting privacy and ensuring data security, especially regarding the extensive collection and analysis of user data. Effective implementation of Tourism 4.0 requires setting strict data protection standards and complying with relevant regulations.

A key component involves getting local communities involved in digital initiatives, which makes it easier to fairly share benefits and promote social sustainability in tourism development. Future research efforts should focus on exploring the long-term implications of digitalization,

especially when it comes to adapting technologies in different tourism settings. The goal of this approach is to make sure that the benefits linked to Tourism 4.0 are available and useful to all stakeholders and communities. It's recommended to carry out further research on the effects of Tourism 4.0 on preserving cultural heritage and natural resources. Such studies would help establish Tourism 4.0 not just as a basis for economic progress, but also for a holistic improvement of sustainability within the tourism sector.

DECLARATIONS OF INTEREST STATEMENT

The authors affirm that there are no conflicts of interest to declare in relation to the research presented in this paper.

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