

Digital transformation of tourism education: Technologies, opportunities, challenges, and future research agenda

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Abstract

This study explores the integration of these technologies into tourism curricula, highlighting both opportunities and challenges. While digital tools enhance experiential learning, accessibility, and industry relevance, their adoption is hindered by high costs, faculty training, and resistance to change. The study employs qualitative research through semi-structured interviews with tourism educators to examine the effectiveness of digital tools and their impact on student learning. Findings indicate immersive technologies improve engagement, while cloud computing and AI facilitate data-driven decision-making. However, further research is needed to address institutional barriers and ensure equitable access to digital education. The study concludes with a future research agenda to optimize digital transformation strategies in tourism education.

Keywords: Digital transformation, Tourism education, Artificial intelligence, Virtual reality, Experiential learning

1. Introduction

Digitalization has recently transformed various sectors, including education and tourism. Integrating digital technologies into tourism education has reshaped traditional teaching methods, providing new tools and opportunities for learning. With the growing reliance on digital tools such as virtual reality (VR), augmented reality (AR), artificial intelligence (AI), and online learning platforms, tourism education has entered a new era of interactive and immersive experiences (Demir et al., 2024). Global trends, including technological advancements, the digital transformation of the tourism industry, and the increasing demand for digital competencies among future professionals, have accelerated this change (Raj et al., 2024).

The importance of digitalization in tourism education cannot be overstated. The tourism industry is inherently dynamic, requiring a flexible workforce with technological skills to meet travelers' constantly changing needs (Han, 2024). Digital tools allow students to gain practical experience, simulate real-world scenarios, and access various learning resources beyond traditional classroom settings (Busulwa et al., 2024). This shift not only enhances student engagement and learning outcomes but also prepares graduates for a competitive job market where digital literacy is crucial. Moreover, the COVID-19 pandemic highlighted the

need for digital education as institutions worldwide moved to online learning to ensure continuity (Demir et al., 2021; Keçi & Qosja, 2021). Consequently, adopting digital tools in tourism education has accelerated, creating new opportunities and challenges.

Despite the increasing integration of digitalization in tourism education, there remains a significant gap in the literature addressing its full scope, effectiveness, and long-term implications (Wan et al., 2024). Existing studies focus on specific digital tools or pedagogical approaches, lacking a comprehensive analysis of their collective impact. Furthermore, there is a lack of empirical research assessing the effectiveness of digital learning environments in preparing students for real-world careers in tourism (Demir et al., 2024). While some studies highlight the benefits of digitalization, such as improved accessibility and flexibility, others underscore challenges, including digital divides, resistance to change, and the necessity for faculty training.

Many studies (e.g., Dalgiç et al., 2024; Gutierriz et al., 2023; Kallou & Kikilia, 2021) focus on general education or hospitality management rather than the unique intersection of digitalization and tourism education. The tourism industry requires specialized knowledge that blends business management, customer service, cultural awareness, and technological proficiency. However, the existing body of

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research does not sufficiently address how digitalization influences the holistic development of these competencies in tourism students. This gap underscores the need for further investigation into best practices, the effectiveness of various digital tools, and the potential drawbacks that must be mitigated to optimize learning outcomes.

Given these gaps in the literature, this article aims to examine the tools, opportunities, and challenges related to the digitalization of tourism education. This study seeks valuable insights for educators, policymakers, and industry stakeholders by analyzing the current environment and proposing a future research agenda. Understanding the role of digitalization in tourism education is essential for designing curricula that incorporate innovative technologies and equip students with the skills needed to excel in a digitalized tourism sector. Additionally, this research will identify areas that require further exploration, fostering a more comprehensive understanding of digitalization's influence on shaping tourism education.

2. Literature

The digital transformation of tourism education has accelerated due to rapid advancements in various technologies, including cloud computing, machine learning, artificial intelligence (AI), augmented reality (AR), virtual reality (VR), mixed reality (MR), extended reality (XR), blockchain, 3D printing, digital twins, and the Internet of Things (IoT). These technologies are reshaping traditional tourism education by enhancing learning experiences, enabling virtual simulations, and improving data-driven decision-making. This literature review examines these technological innovations and their implications for tourism education.

Cloud computing has revolutionized delivering tourism education, providing scalable, cost-effective, and flexible computing resources (Cuomo et al., 2021; Hassan, 2022). It allows educational institutions to offer cloud-based learning management systems where students can access course materials, simulations, and virtual training environments. Platforms like Google Cloud, Microsoft Azure, and AWS enable students to work on real-world tourism data, fostering experiential learning. Additionally, cloud-based collaboration tools facilitate remote teamwork, enhancing international tourism education programs. Machine learning (ML) is increasingly integrated into tourism education to improve data-driven decision-making skills (Deri et al., 2024). ML algorithms analyze large datasets, assisting students in understanding customer behavior, forecasting demand, and managing revenue in tourism. Personalized learning experiences powered by ML tailor coursework to meet individual student needs, boosting engagement and retention. Furthermore, predictive analytics in tourism education can support scenario planning, enabling students to develop strategies for crisis management and market fluctuations.

Reality technologies provide immersive learning experiences in tourism education. Virtual field trips enable

students to explore global tourist destinations without needing physical travel, reducing costs and enhancing accessibility. AR applications improve on-site learning by overlaying digital information onto real-world tourism attractions, offering context and historical insights. MR and XR further connect the digital and physical worlds, allowing for simulations in customer service training, cultural immersion, and destination marketing strategies (Jalilvand & Ghasemi, 2024; Jia et al., 2023). Blockchain technology is emerging as a transformative tool in tourism education, delivering transparency, security, and decentralization (Ioannidis, 2023). Educational institutions use blockchain for credential verification, ensuring the authenticity of certifications tourism professionals hold. Additionally, blockchain-based smart contracts can facilitate secure transactions in tourism case studies, helping students comprehend digital payment systems, fraud prevention, and decentralized travel platforms.

3D printing is gaining traction in tourism education. It enables students to create tangible models of heritage sites, landmarks, and infrastructure (Jia et al., 2023; Owoseni, 2023). This technology supports architectural conservation studies and destination planning. 3D-printed prototypes assist students in designing sustainable tourism projects, visualizing urban planning concepts, and developing interactive museum exhibits that enhance visitor experiences.

AI-driven tools such as chatbots, intelligent tutors, and automated grading systems are transforming tourism education. AI improves customer service training by simulating real-world interactions with virtual tourists, enabling students to develop problem-solving and communication skills (Demir & Demir, 2023). Sentiment analysis through AI allows students to evaluate traveler feedback and improve tourism marketing strategies. Furthermore, AI-powered recommendation systems familiarize students with personalized tourism experiences and digital marketing techniques.

The concept of the digital twin—virtual replicas of physical environments—has vast applications in tourism education. By simulating real-world destinations, digital twins enable students to analyze visitor behaviors, assess tourism sustainability, and experiment with urban planning models (Engelbrecht et al., 2024; Wu et al., 2024). Universities utilize digital twins to replicate campus environments, offering virtual tourism courses and training modules. This approach provides hands-on experience managing tourism assets, crisis management, and environmental impact assessments.

IoT technology enhances tourism education by connecting smart devices (Demir et al., 2023; Deri et al., 2024), which improves hospitality training and destination management studies. Smart hotels equipped with IoT sensors provide students with real-time data on occupancy, energy efficiency, and guest preferences. Wearable IoT devices offer insights into tourist behavior, enabling students to analyze movement patterns and optimize visitor experiences. Additionally, IoT-powered smart classrooms enhance

engagement through interactive learning environments, preparing students for the digital transformation in tourism.

3. Methodology

The study received approval from the Georgia State University Research Center's Ethics Committee under protocol number 2023/X-114-2. It adhered to the guidelines outlined in the Declaration of Helsinki for human subjects research.

This study utilized a qualitative research methodology to investigate the digital transformation of tourism education by analyzing the tools, opportunities, challenges, and potential future research directions. It employed semi-structured interviews to collect insights from tourism scholars directly involved in integrating digital technologies into tourism education.

3.1. Research design

A qualitative research design offers an in-depth understanding of the complexities surrounding digital transformation in tourism education. Given the rapidly evolving nature of digital technologies and their impact on teaching methods, semi-structured interviews are the primary data collection method. This approach allows for flexibility, enabling researchers to delve deeper into responses while maintaining consistency across interviews. The research examines key digital tools in tourism education, evaluates opportunities and challenges, and suggests future research directions. It is guided by a constructivist paradigm, which acknowledges that knowledge is co-constructed through participants' experiences and perspectives.

3.2. Sample and data collection

The study employs a purposive sampling technique, selecting 22 tourism academicians from various institutions. Participants are chosen based on their expertise in tourism education and experience with digital tools and technologies in their teaching practices. The sample ensures diversity in terms of geographical regions, institutional types (e.g., public vs. private universities), and academic positions (e.g., assistant professors, associate professors, Full Prof.s). The inclusion criteria for selecting participants are:

- A minimum of five years of experience in tourism education.
- Active use of digital tools in teaching, such as Learning Management Systems (LMS), Virtual Reality (VR), Artificial Intelligence (AI), or online simulations.
- Involvement in research or curriculum development related to digital transformation in tourism education.

Data collection is conducted through semi-structured interviews, ensuring a balance between structured inquiries and open-ended discussions. The interview protocol consists of key themes, including:

- Current digital tools used in tourism education.

- Opportunities and benefits of digital transformation.
- Challenges and barriers in implementing digital technologies.
- Future trends and research need in tourism education.

Interviews were conducted via online platforms (e.g., Zoom, Microsoft Teams) due to their accessibility and convenience. Each interview lasted approximately 45–60 minutes and was audio-recorded with participants' consent. The recordings were then transcribed verbatim to ensure accuracy in data representation. To enhance data validity, member checking was employed, where participants reviewed their interview transcripts to confirm accuracy and provide additional clarifications.

3.3. Data analysis

The collected data have undergone a thematic analysis using the framework proposed by Braun and Clarke (2006). This approach systematically identifies, analyzes, and reports patterns (themes) within the data. The analysis followed these key steps:

- Familiarization with Data: Researchers read and re-read the transcripts to understand the data overall.
- Initial Coding: Open coding is conducted, and meaningful units related to digital transformation in tourism education are identified.
- Theme Identification: Codes are grouped into broader themes that align with the research objectives (e.g., digital tools, challenges, opportunities, future research agenda).
- Review and Refinement: The themes are reviewed to ensure coherence and relevance. Representative quotes from participants are selected to illustrate key findings.
- Final Interpretation: The identified themes are contextualized within the existing literature to draw meaningful conclusions and implications for tourism education.

3.4. Research questions

The research questions focused on the role of digital transformation technologies in tourism education. Five key questions were asked:

- 1- How are digital transformation technologies (e.g., AI, VR, AR, XR, IoT) integrated into tourism education curricula?
- 2- What key opportunities do cloud computing, machine learning, and blockchain offer to enhance tourism education?
- 3- What challenges do tourism educators face in adopting digital twins and 3D printing in tourism training programs?
- 4- How can immersive technologies like VR, AR, MR, and XR enhance experiential learning in tourism education?

5- What future research directions should be prioritized to maximize the potential of digital transformation technologies in tourism education?

4. Results

The study includes 22 tourism academicians from diverse backgrounds, ensuring representation across different academic ranks, age groups, and gender characteristics. Below is an example of the demographic distribution of the participants. This demographic distribution has provided a well-rounded sample with a mix of early-career and senior scholars, ensuring a broad range of insights into the digital transformation of tourism education.

Table 1. Demographic profile of participants

P. Code	Title	Age	Gender	Institution
P1	Ast. Prof.	30	Female	Public Un.
P2	Asc. Prof.	42	Male	Private Un.
P3	Full Prof.	44	Male	Public Un.
P4	Lecturer	37	Female	Private Un.
P5	Ast. Prof.	26	Female	Public Un.
P6	Asc. Prof.	41	Male	Public Un.
P7	Full Prof.	55	Female	Private Un.
P8	Lecturer	34	Male	Public Un.
P9	Asc. Prof.	39	Female	Private Un.
P10	Lecturer	42	Male	Public Un.
P11	Lecturer	41	Male	Private Un.
P12	Full Prof.	45	Male	Public Un.
P13	Lecturer	36	Female	Private Un.
P14	Ast. Prof.	29	Female	Public Un.
P15	Asc. Prof.	43	Male	Public Un.
P16	Full Prof.	57	Female	Private Un.
P17	Lecturer	39	Male	Public Un.
P18	Asc. Prof.	36	Female	Private Un.
P19	Asc. Prof.	40	Male	Public Un.
P20	Asc. Prof.	48	Male	Public Un.
P21	Asc. Prof.	38	Female	Public Un.
P22	Ast. Prof.	25	Female	Public Un.

P: Participants, Ast. Prof: Assistant Professor, Asc. Prof: Associate Professor, Un: University

Participants' responses were collected and presented in a thematic structure within the framework of five research questions.

Theme-1: Integration of digital transformation technologies in tourism education curricula

Integrating digital transformation technologies like AI, VR, AR, XR, and IoT into the tourism education curriculum is essential for preparing students for the industry's evolving demands. Some participants clearly emphasized the significance of these technologies for tourism education. For instance, "VR and AR are primarily used in practical tourism training, allowing students to explore destinations and hotel

operations" (P-13) virtually, and "We incorporate IoT in smart hotel management courses, enabling students to experience connected systems. However, the adoption of XR is still in its early stages" (P-4). These technologies enhance experiential learning by offering immersive simulations, virtual field trips, and real-time data analysis, which enable students to develop practical skills in a controlled setting.

P1, P6, and P7 stated that AI-driven analytics help students understand customer behavior, while VR and AR provide realistic training for hospitality and destination management. As the tourism industry increasingly relies on digital solutions, equipping students with these technological skills ensures they stay competitive and adaptable in a rapidly changing global environment. Additionally, while P17 noted that some courses introduce AI-driven analytics for customer behavior insights and interactive tourism maps and guides, P20 pointed out that VR is utilized for virtual internships and remote learning experiences, enabling students to gain exposure to real-world scenarios without needing to travel physically. However, there isn't a standardized approach to integrating these technologies. Participants, such as P3, P8, and P22, emphasized the need for more collaboration with tech companies, increased investment in infrastructure, and the development of standardized digital tourism education models.

Theme-2: Key opportunities of cloud computing, machine learning, and blockchain in tourism education

Participants (e.g., P2, P5, P9, P10, P14, P18, P19, P21) emphasized that cloud computing, machine learning, and blockchain offer innovative ways to enhance tourism education. These technologies increase accessibility, promote data-driven learning, and ensure secure credential verification, equipping students with the necessary skills for a technology-driven tourism industry—however, practical implementation demands appropriate faculty training, institutional investment, and collaboration with technology providers.

Cloud computing provides substantial benefits in tourism education by improving accessibility and collaboration. According to P2, cloud-based platforms allow students and educators to access learning materials from anywhere, fostering flexibility, especially for remote learners. P5 pointed out that these platforms enable real-time collaboration, letting students work together on projects regardless of location. P9 mentioned that cloud storage helps maintain large datasets, allowing students to analyze real-world tourism trends efficiently. Furthermore, P10 highlighted that cloud-hosted simulations offer interactive learning experiences without expensive on-premise software, making tourism education more inclusive and technologically advanced.

Machine learning is vital in data-driven decision-making and personalized learning within tourism education. As P14 explains, machine learning improves curriculum personalization by analyzing student progress and recommending customized learning paths based on their strengths and

weaknesses. P18 highlights that AI-driven recommendation systems assist students in exploring emerging tourism trends and customer preferences, ensuring their relevance to the industry. P19 states that predictive analytics allow students to study tourism demand forecasting, customer segmentation, and pricing strategies, providing valuable strategic insights. Additionally, P21 emphasizes that sentiment analysis of customer reviews helps students evaluate tourist behavior and enhance their service management skills.

Blockchain technology significantly enhances the transparency, security, and credential verification of tourism education. According to P2, blockchain ensures secure and tamper-proof academic records, making it easier for students and professionals to verify their credentials worldwide. P5 implied that smart contracts facilitate automated certification issuance, reducing administrative burdens and enhancing the credibility of tourism education. P9 emphasized that blockchain improves transparency in the tourism industry, allowing students to explore decentralized booking systems and fraud prevention techniques. P10 noted that secure and verifiable blockchain transactions serve as valuable case studies for teaching ethical and sustainable business practices in tourism management.

Theme-3: Challenges in adopting digital twins and 3D printing in tourism training programs

Participants (e.g., P3, P8, P11, P12, P15, P16, P19, P22) emphasized that although digital twins and 3D printing present innovative opportunities for tourism education, their adoption is restricted by high costs, insufficient faculty training, and challenges in curriculum integration. To address these hurdles, institutions require greater investment, technical support, and professional development programs for effective implementation.

Adopting digital twins and 3D printing in tourism education faces significant challenges due to high costs and limited resources. As P3 points out, implementing these technologies demands a considerable financial investment in hardware, software, and infrastructure, which many institutions struggle to afford. P8 highlights that restricted funding and inadequate technological resources create substantial barriers, particularly for smaller institutions lacking the necessary expertise. P11 emphasizes that maintaining and updating digital twin systems requires ongoing financial and technical support, presenting additional challenges for tourism education programs operating on tight budgets. These economic constraints hinder large-scale adoption.

A lack of technical expertise and faculty training hinders the successful integration of digital twins and 3D printing into tourism education. As P12 points out, many educators are unfamiliar with these advanced technologies, necessitating extensive training before they can be effectively integrated into the curriculum. P15 has highlighted the shortage of skilled instructors who can design and apply digital twin models, resulting in inconsistent adoption across institutions. P16 has noted that faculty members often struggle to

incorporate these tools into traditional teaching methods due to the lack of standardized training programs and adequate support materials, which further complicates implementation.

Integrating digital twins and 3D printing into tourism education poses significant challenges for both the curriculum and teaching methods. As P19 points out, these technologies are still in their early stages, complicating the creation of structured curricula that effectively incorporate them into tourism training. P22 notes that educators find it difficult to align digital twin applications with learning objectives since practical use cases for tourism education have not yet been fully developed or standardized. This absence of established frameworks complicates the design of relevant coursework by instructors, underscoring the need for further research, industry collaboration, and curriculum development to ensure effective integration.

Theme-4: Enhancing experiential learning in tourism education through immersive technologies (VR, AR, MR, XR)

Participants stress that immersive technologies like VR, AR, MR, and XR greatly enhance experiential learning by offering interactive, real-world simulations, encouraging deeper engagement, and bridging the divide between theory and practice. These technologies not only enhance students' comprehension of tourism concepts but also cultivate essential practical skills for success in the industry. However, the widespread adoption of these technologies necessitates sufficient infrastructure, training, and curriculum development to optimize their effectiveness in tourism education.

Immersive and interactive learning environments greatly enhance tourism education by providing engaging and experiential learning opportunities. As P1 highlights, Virtual Reality (VR) and Augmented Reality (AR) create immersive settings where students can virtually engage with real-world tourism scenarios, leading to deeper involvement and better information retention. P5 adds that Mixed Reality (MR) allows students to interact with both virtual and physical elements, simulating complex tourism operations such as hotel management and destination planning. Moreover, P9 emphasizes that XR (Extended Reality) platforms, which combine VR, AR, and MR, deliver a comprehensive learning experience in which students can explore virtual destinations, simulate customer interactions, and practice problem-solving.

Immersive technologies like VR and AR provide valuable real-world applications and opportunities for skill development in tourism education. As P12 highlights, VR allows students to take virtual field trips, offering practical exposure to remote and global destinations, and assisting them in grasping tourism management challenges and decision-making processes more effectively. P17 notes that AR-based tools enable students to interact with virtual guides, allowing them to explore cities or historical sites. This method not only enhances their understanding of cultural and heritage tourism but also increases learning engagement by making

the experience interactive and hands-on, which is vital for cultivating essential skills in the industry.

Immersive technologies play a crucial role in enhancing engagement and motivation in tourism education. As P16 emphasizes, these technologies provide dynamic, gamified experiences, such as simulated tour guide roles or navigating a virtual hotel, making learning more enjoyable and motivating for students. P21 notes that the ability to interact with virtual environments or simulate real-life tourism operations encourages students to learn by doing. This hands-on approach not only deepens their understanding of the subject but also improves retention, making the learning process more engaging and effective in preparing students for the tourism industry. Furthermore, P22 states that "these technologies bridge the gap between theoretical knowledge and practical experience. Students can virtually practice customer service, crisis management, and tourism planning skills, equipping them for real-world situations."

Theme-5: Future research directions to maximize the potential of digital transformation technologies in tourism education

Participants (e.g., P2, P5, P9, P10, P12, P15, P16, P19) agree that to maximize the potential of digital transformation technologies in tourism education, future research should concentrate on curriculum development, improving accessibility, enhancing faculty training, evaluating student engagement, and addressing ethical issues. The tourism education sector can better equip students for the industry's evolving digital landscape by focusing on these areas.

Future research should focus on developing frameworks to integrate digital transformation technologies into tourism curricula, as highlighted by P2, to ensure students acquire relevant industry skills. As P5 suggests, practical strategies must be explored to incorporate these technologies into existing curricula without disrupting the current structure. P9 emphasizes the need to make these technologies more accessible and affordable for all institutions, especially smaller ones with limited budgets. P10 additionally supports this by stressing the importance of creating low-cost, scalable solutions that can be widely adopted, ensuring that all students can benefit from digital tools in their education.

Future research should prioritize faculty training and professional development to ensure educators are equipped with the skills needed to effectively incorporate digital technologies into their teaching, as emphasized by P12. Comprehensive training programs are essential to address faculty's challenges when adopting new technologies, as noted by P15. Moreover, P16 suggests that understanding the impact of digital transformation technologies on student engagement and motivation is crucial. Research should explore how VR, AR, and other tools can enhance student learning outcomes. At the same time, P19 highlights the importance of examining how immersive technologies contribute to experiential learning, fostering more profound engagement with tourism concepts. Additionally, P5 stresses the ethical

implications of using digital technologies in tourism education, urging researchers to investigate these tools' potential risks and benefits, especially regarding privacy, data security, and sustainability. Combining faculty development with a focus on student engagement and ethical considerations will be key to maximizing the potential of digital transformation technologies in tourism education.

5. Discussions and conclusions

The findings of this study underscore the transformative role of digitalization in tourism education, highlighting its potential to enhance learning experiences, bridge theoretical and practical gaps, and prepare students for a rapidly evolving industry. As digital transformation redefines educational methodologies, institutions proactively adapt to emerging technologies to ensure graduates possess the competencies required in the digital tourism environment.

One of the most significant findings of this research is the increasing integration of digital tools such as artificial intelligence (AI), virtual reality (VR), augmented reality (AR), mixed reality (MR), and extended reality (XR) in tourism education (Jalilvand & Ghasemi, 2024). These technologies provide students with immersive, interactive learning environments beyond traditional classroom settings. For example, VR and AR allow students to explore virtual tourism destinations, simulate real-world customer interactions, and enhance their problem-solving skills. AI-driven analytics further enhance this by offering personalized learning experiences, assisting students in analyzing customer behavior, and improving their decision-making abilities. Despite these advantages, the study emphasizes that there is no standardized approach to integrating these technologies across institutions, highlighting the need for industry-wide collaboration and best practice guidelines.

Cloud computing, machine learning, and blockchain have also emerged as key technologies that offer new opportunities for tourism education. Cloud-based learning management systems provide flexible, scalable platforms where students can access course materials and collaborate on projects in real-time (Deri et al., 2024; Gupta & Jaiswal, 2024). Machine learning enables data-driven decision-making and personalized learning experiences, ensuring students acquire relevant, industry-specific skills. Additionally, blockchain enhances the security and transparency of academic records and certification processes, addressing credential verification and fraud prevention concerns. However, while these technologies offer substantial benefits, their widespread adoption requires significant investment in infrastructure and faculty training (Lapuz, 2023). Institutions must allocate resources to equip educators with the technical expertise to integrate digital tools into their curricula effectively.

The study highlights several challenges of adopting digital twins and 3D printing in tourism education. While these technologies present innovative ways to model tourism destinations, simulate visitor experiences, and support urban planning projects, their implementation is hindered by high

costs and a lack of faculty training. Many institutions struggle to afford the necessary hardware and software, which limits students' access to these advanced tools. Educators may lack the technical skills to integrate digital twins and 3D printing into their teaching methodologies. To address these challenges, greater institutional investment, faculty development programs, and partnerships with technology providers will be needed to make these tools more accessible.

The role of immersive technologies in enhancing experiential learning is another critical area of discussion (Arcodia et al., 2021; Chen et al., 2022). VR, AR, MR, and XR have demonstrated their effectiveness in providing students with hands-on learning experiences that simulate real-world tourism scenarios. These technologies allow students to explore destinations virtually, engage with digital guides, and practice customer service skills in simulated environments. Moreover, gamification elements embedded in immersive technologies increase student engagement and motivation, making learning more interactive and enjoyable. However, for these technologies to be fully integrated into tourism education, institutions must invest in appropriate infrastructure, create standardized curriculum frameworks, and ensure that educators receive adequate training on their use and pedagogical applications.

The study also sheds light on the importance of future research directions to maximize the potential of digital transformation in tourism education. Research has focused on developing structured frameworks for integrating digital tools into curricula, ensuring students gain practical, industry-relevant skills. Studies have explored ways to make digital technologies more affordable and accessible, particularly for institutions with limited resources. Faculty training and professional development are equally critical, as many educators require specialized training to incorporate digital tools into their teaching strategies effectively. Furthermore, research has examined the impact of digitalization on student engagement, learning outcomes, and ethical considerations, including data security, privacy, and sustainability concerns.

This study confirms that digital transformation profoundly reshapes tourism education, providing opportunities for new learning and skill development while presenting significant challenges. To fully harness the benefits of digitalization, institutions must adopt a strategic approach, investing in technological infrastructure, faculty training, and curriculum development. Collaboration among academia, industry, and policymakers will be crucial in ensuring that tourism education keeps pace with technological advancements and prepares students for the dynamic, digital tourism industry of the future. By addressing the identified challenges and embracing innovation, tourism education can continue to evolve and meet the demands of a rapidly changing global environment.

5.1. Theoretical implications

This study contributes to the literature on digital transformation in tourism education by comprehensively analyzing

emerging technologies and their impact on pedagogical frameworks. By integrating concepts from educational technology, experiential learning, and tourism management, this research highlights the theoretical underpinnings that shape the effectiveness of digital tools in tourism education. One significant theoretical contribution is the identification of digital transformation technologies as enablers of constructivist learning approaches, where students actively engage with knowledge through immersive and interactive experiences rather than passive instruction.

This study extends the theoretical discourse on competency-based education by illustrating how digital tools such as AI-driven analytics, VR-based simulations, and machine learning algorithms can personalize learning experiences to align with students' needs and industry requirements. These findings reinforce the importance of technology-enhanced learning theories, particularly in tourism education, where hands-on experience is critical for skill development. Additionally, the study contributes to research on institutional change by examining the barriers and facilitators of digital technology adoption in higher education. By identifying challenges such as financial constraints, faculty training gaps, and resistance to change, this research informs theoretical models of digital adoption and organizational learning, emphasizing the role of institutional readiness in successful digital transformation efforts.

5.2. Practical implications

From a practical perspective, this study offers valuable insights for educators, policymakers, and industry stakeholders aiming to enhance tourism education through digital transformation. One key implication is that institutions need to invest in digital infrastructure, including cloud-based learning management systems, VR and AR labs, and AI-driven analytics platforms. These investments will ensure students have access to cutting-edge tools that replicate real-world industry applications, preparing them for the digitalized tourism sector. Another practical takeaway is the need for faculty development programs centered on digital competencies. Educators must receive training on incorporating emerging technologies into their teaching methods to maximize their effectiveness. Universities should build partnerships with technology providers and industry professionals to facilitate knowledge exchange and ensure curricula remain aligned with shifting industry standards.

Furthermore, the study underscores the importance of inclusive and equitable access to digital tools. Institutions must create strategies to bridge the digital divide by providing essential resources and support to students from diverse socioeconomic backgrounds. This will help guarantee that all students, regardless of financial circumstances, can benefit from technology-enhanced learning environments.

5.3. Limitations and future research

While this study offers valuable insights, several limitations must be acknowledged. The research relies on qualitative

interviews, which, while rich in depth, may not capture the full breadth of digital transformation impacts across different educational contexts. Future studies could incorporate quantitative analyses or mixed-methods approaches to provide a more comprehensive understanding. The study primarily focuses on higher education institutions, leaving room for future research on digital transformation in vocational training and continuous professional development programs. Further investigation is also needed into the long-term effectiveness of digital tools in tourism education, including their impact on graduate employability and industry performance. Future research should explore cross-cultural comparisons of digital adoption in tourism education, identifying regional differences in technological accessibility and institutional readiness. Such studies would provide valuable insights into global best practices and inform tailored digital strategies for diverse educational environments.

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Author contribution

The author conducted the research design and implementation, analysis, and article writing without using AI applications.

Disclosure statement

The author reported no potential competing interest.

Ethics committee approval

The study received approval from the Georgia State University Research Center's Ethics Committee under protocol number 2023/X-114-2. It adhered to the guidelines outlined in the Declaration of Helsinki for human subjects research.