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Innovative Technologies in Tourism and Hospitality Education: A Bibliometric Review with Future Research Directions

Md. Tariqul Islam
School of Hospitality, Tourism and Events, Taylor's University, Malaysia

Jeetesh Kumar
Faculty of Social Sciences and Leisure Management, Sustainable Tourism Impact Lab, Cluster for Research and Innovation in Tourism (CRiT), Taylor's University, Malaysia

Rupam Konar
School of Hospitality, Tourism and Events, Sustainable Tourism Impact Lab, Cluster for Research and Innovation in Tourism (CRiT), Taylor's University, Malaysia

Neethiahnanthan Ari Ragavan
Faculty of Social Sciences and Leisure Management, Taylor's University, Malaysia

Faizan Ali
School of Hospitality and Tourism Management, Muma College of Business, University of South Florida, USA

Laiba Ali
IRC for Finance and Digital Economy, KFUPM Business School, King Fahd University of Petroleum & Minerals, Dhahran, Saudi Arabia

Abstract: This study aims to present a comprehensive bibliometric analysis of 204 scholarly publications (1984–2025), examining the integration of innovative technologies in tourism and hospitality education. Bibliometrix and VOSviewer software were utilised to identify the publication frequency, as well as the most prominent authors, journals, affiliation, articles, and countries. Moreover, word cloud, trending topics, and the co-occurrence network of authors' keywords were also analysed. Results highlight a significant rise in research output post-2015, driven by emerging technologies such as artificial intelligence, virtual reality, online learning, and simulation-based learning. The findings of co-occurrence network analysis reveal five conceptual clusters reflecting pedagogical innovation, curriculum redesign, and technology-driven skill development. The study highlights the increasing relevance of digital fluency, equity, and sustainability in education. It contributes theoretically by mapping interdisciplinary research directions and practically by providing insights for curriculum developers, educators, and policymakers. The study concludes by indicating several future research directions.

Correspondence: Md. Tariqul Islam, School of Hospitality, Tourism and Events, Taylor's University, Malaysia. Email: *tariqul.tonmoy812@gmail.com*

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Introduction

The tourism and hospitality sector is expected to contribute USD15.5 trillion to the global GDP by 2033. It is increasingly leveraging technologies like virtual reality (VR), augmented reality (AR), and AI-driven analytics to enhance operational efficiency, improve customer experiences, and support sustainable practices (Islam et al., 2024a). Simultaneously, the COVID-19 pandemic has led to a significant transition towards hybrid and fully online learning models, revealing educational systems' strengths and weaknesses. Essential tools like Coursera for industry and VR-based simulations have emerged; however, their rapid adoption has uncovered systemic challenges, including fragmented teaching strategies, unequal access to digital resources, and a disconnect between academic programs and the fast- evolving demands of the industry (Carpenter et al., 2023).

The global tourism and hospitality industry, essential for economic growth and cross-cultural engagement, is undergoing substantial digital disruption. With technologies such as generative artificial intelligence (AI) and immersive metaverse ecosystems (Hussain et al., 2021; Tuo et al., 2025) altering industry standards, educational institutions face pressure to adapt their teaching frameworks. This necessity extends beyond simply integrating new technologies; it calls for a fundamental rethinking of how we equip future professionals to thrive in a landscape characterised by algorithmic decision-making, highly personalised service, and innovation focused on sustainability (Jorzik et al., 2024; Yang et al., 2024). Addressing these gaps requires a shift from viewing technology solely as a tool to recognising it as a vital pedagogy component, necessitating in-depth insights into how academic conversations have evolved to meet these challenges.

Although current bibliometric research (Asif & Fazel, 2024; Cardoso et al., 2024; Shin et al., 2023) has investigated technological advancements within tourism and hospitality operations, a notable gap remains. There is an insufficient comprehensive synthesis that delineates the development, intellectual landscape, and interdisciplinary boundaries of research concentrated on innovative technologies in tourism and hospitality education. Additionally, earlier bibliometric studies have extensively examined technological progress in tourism marketing (Arici et al., 2024; Bekele & Raj, 2025; Mei et al., 2024; Peng et al., 2025), the application of AI in

hospitality operations (Kim et al., 2025; Yan et al., 2024), and blockchain's influence on sustainable tourism (Asif et al., 2025). However, these assessments primarily focus on industry-level applications, neglecting the vital role of education in developing tech-savvy professionals.

Previous syntheses of AI in tourism literature (Hussain et al., 2014; Li et al., 2025) indicate that less than 5% of the research discusses educational frameworks, highlighting a systemic oversight of pedagogy in technological discussions. This gap is critical as, without a solid understanding of how educational research approaches technological integration, such as through gamified learning, AI-driven personalised curriculum, or ethics-centred digital literacy, stakeholders risk producing a workforce ill-equipped for the challenges of Industry 4.0. This study aims to fill these gaps through a thorough bibliometric analysis, reviewing four decades (1984–2025) of scholarly progress to shed light on pathways, challenges, and transformative possibilities within this essential field. This research utilised bibliometric techniques to analyse 204 publications indexed in Scopus, focusing on five research objectives:

RO1: To examine the annual scientific production trends in publications related to innovative technologies in tourism and hospitality education.
RO2: To identify the most influential authors, journals, affiliations, countries, and articles contributing to research on innovative technologies in tourism and hospitality education.
RO3: To analyse and visualise the most frequently occurring keywords through word cloud analysis.
RO4: To analyse the temporal evolution of trending research topics in the field of innovative technologies in tourism and hospitality education.
RO5: To map the intellectual structure of the field by analysing the co-occurrence patterns of authors' keywords.

Utilising Bibliometrix and VOSviewer, this analysis goes beyond a mere descriptive summarisation to provide three key contributions. Theoretically, it consolidates fragmented knowledge into a unified framework, pinpointing five thematic clusters that transform the nexus of technology and pedagogy. Practically, it equips educators and policymakers with evidence-based strategies to align curricula with AI ethics, immersive learning, and sustainable tourism priorities. Methodologically, it presents a replicable bibliometric protocol for specialised educational fields, incorporating normalised citation metrics to mitigate temporal biases. The paper's PRISMA-oriented methodology underscores the rigour of Scopus's metadata, showcasing results through quantitative (publication trends,

citation networks) and qualitative (thematic shifts, keyword dynamics) perspectives. The discussion addresses critical issues, such as the prevalence of "virtual reality" research contrasted with overlooked AI ethics and promotes decolonised and inclusive research agendas. By examining historical and current trajectories, this study positions tourism and hospitality education at the forefront of pedagogical innovation. It empowers stakeholders to actively shape technological change in the digital era, rather than merely react to it.

Methodology

Data Source and Search Strategy

The bibliometric analysis procedure was employed in the current study, and the Scopus database was used to retrieve the data. The Scopus database was selected as it provides a broad journal coverage and publications related to the education domain. Moreover, Scopus is widely acknowledged for providing more robust and representative results in that domain compared to the alternative databases. In addition, Scopus provides more comprehensive metadata for efficient software calculations, which is required for the bibliometric analysis (Martín-Martín et al., 2018). This study adapted the PRISMA 2020 (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) framework from Page et al. (2021) to guide the identification, screening, eligibility and inclusion of relevant literature (see Figure 1).

Document Identification Strategy

The primary search query was designed to identify the comprehensive and broad range of publications on innovative technologies in hospitality and tourism education. This study utilised a systematic and thorough procedure to collect, screen, and include data. This procedure will ensure that the dataset's quality is employed for the bibliometric analysis. The search and screen procedure was conducted in March 2025. The details of the search query are as follows:

("tourism education" OR "hospitality education" OR "tourism training" OR "hospitality training") AND ("innovation" OR "technology" OR "e-learning" OR "digital learning" OR "online learning" OR "virtual reality" OR "VR" OR "augmented reality" OR "AR" OR "artificial intelligence" OR "AI" OR "simulation" OR "gamification" OR "mobile learning" OR "metaverse" OR "LMS" OR "MOOC" OR "immersive learning" OR "digital pedagogy")

A total of 458 publications were identified after the initial search.

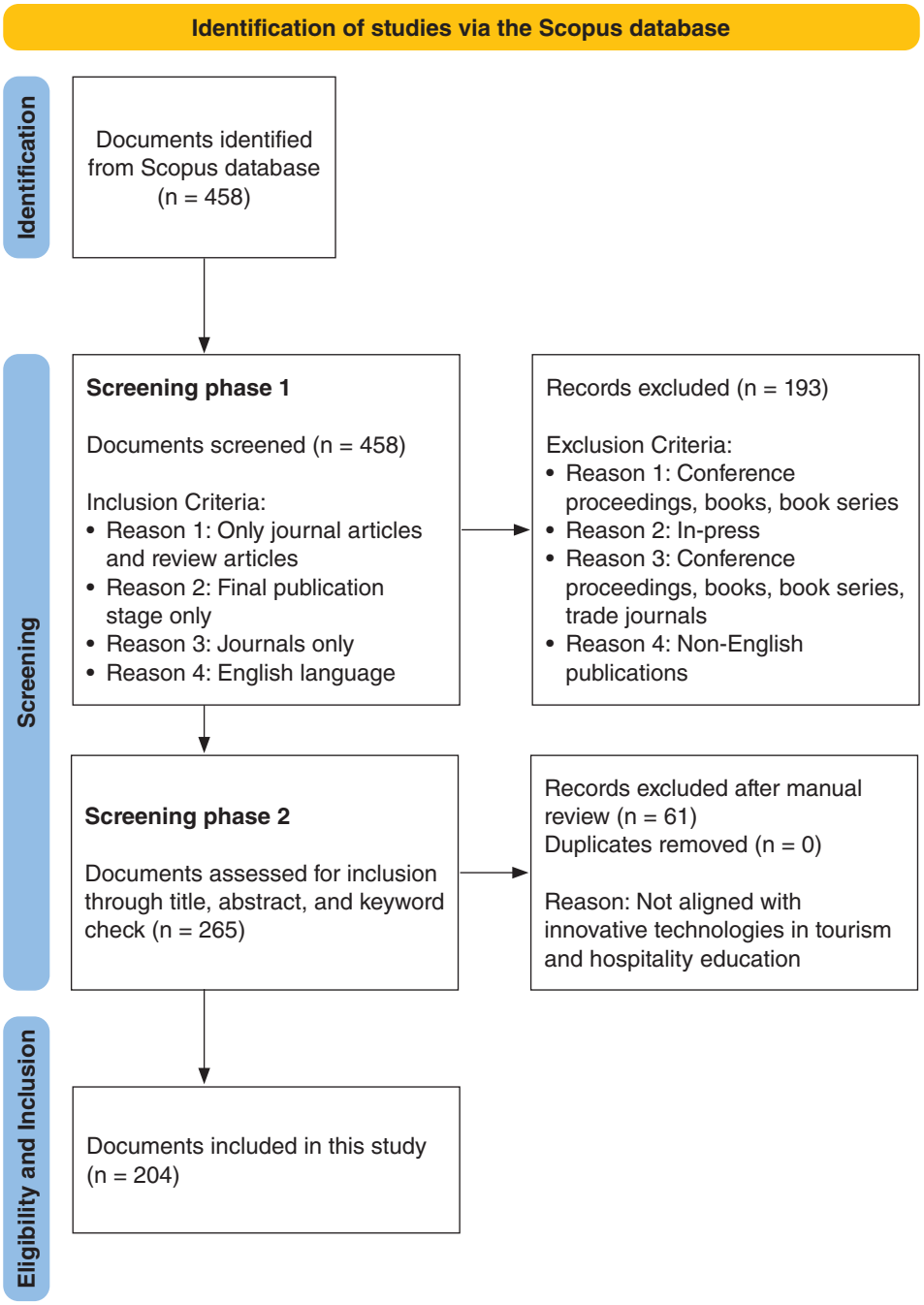

Figure 1. The PRISMA 2020 flow diagram of the document selection process

First Phase Screening

The first phase of screening employed certain criteria focused on the document type, publication stage, source type, and language.

In this study, only research articles and review articles published in journals and in the final stage of publication were included to focus on the more reliable and robust foundation for evidence-based conclusions. This type of documents has undergone a robust and strict peer review process, which eventually ensures the validity and credibility of the documents. It will decrease bias and ensure domain experts recognise the documents.

Moreover, documents published only in English were included to ensure the prevalence of English as the language of communication among scholars and to maintain consistency in language analysis. After the first round of screening, 265 articles were taken for the next phase of screening.

Second Phase Screening

The second phase of screening included the manual review of each document's title, keywords, and abstract. This process ensured alignment with the current study's particular focus and ensured that all selected documents are highly relevant to the study. Moreover, it is essential to maintain the quality of the documents. A total of 61 documents were excluded from the dataset.

Eligibility Assessment, Final Inclusion and Data Extraction

After conducting a rigorous two-phase screening process, 204 documents were included in this study for the bibliometric analysis. These documents' data (e.g., citation information, bibliographical information, abstract, and keywords) were extracted in CSV format. That CSV file served as the input for the bibliometric analysis. Table 1 provides the statistical overview of all 204 documents adopted in the current study.

Table 1. Overview of documents

Description	Results
Main Information about Data	
Timespan	1984:2025
Sources (Journals)	90
Documents	204
Annual growth rate (%)	5.51
Document average age	8.33
Average citations per doc	21.73
References	9444

Table 1. (con't)

Description	Results
Document Contents	
Keywords Plus (ID)	216
Author's kywords (DE)	626
Authors	
Authors	475
Authors of single-authored docs	50
Authors Collaboration	
Single-authored docs	58
Co-authors per doc	2.53
International co-authorships (%)	21.57
Document Types	
Article	198
Review	6

Table 1 highlights that all the documents were published between 1984 and 2025 and sourced from 90 journals. The outcome illustrates that the annual growth rate in this research domain is 5.51%, whereas the documents' average age is 8.33, and on average, each document received 21.73 citations. A total of 9,444 references were cited within these documents. In addition, the content of these documents is indexed by 216 keywords plus, and 626 keywords provided by the authors. 475 authors contributed to these publications, and 50 contributed to the single-authored publications. Whereas there were 58 single-authored publications, the average co-authors per publication was 2.53, and 21.57% of the publications involved international collaborations. The leading source of the publications was research articles (198) and a small number of review articles (6).

Data Analysis Tools and Techniques

The Bibliometrix R package within the RStudio and VOSviewer software was employed to conduct the bibliometric analysis in this study. Bibliometrix was employed to identify the statistical overview of the publications, annual scientific production, most impactful authors, journals, institutions, countries, and articles. Moreover, it also facilitated the word cloud and trend topic analysis within that research domain. The VOSviewer software was used to conduct the co-occurrence network of authors' keywords.

Results and Findings

Annual Publications Frequency

Figure 2 illustrates the number of publications in the domain of technological innovation in hospitality and tourism research. The first article was published in 1984, and it remains ongoing in 2025. Based on the number of publications, the entire period has been segmented into three phases: emergence (1984–2009), development (2010–2019), and expansion (2020–2025).

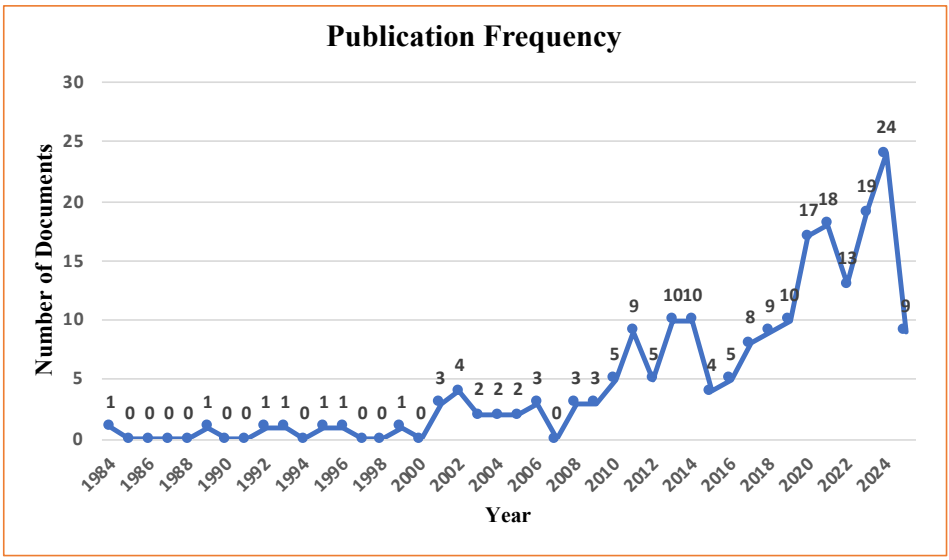

Figure 2. Annual publications frequency

Emergence Phase (1984–2009)

29 documents were published in this stage. This phase highlights a low number of publications on technological innovations in tourism and hospitality education, whereas several years were recorded with zero publications. The publications record in this phase indicates an early stage where the topic was less studied or less focused in research, or relevant technologies remained in the early stages of being adopted in hospitality and tourism education.

Development Phase (2010–2019)

75 articles were published in this phase, which indicates a noticeable growth in the number of publications compared to the earlier phase. However, the publication record indicates that the publications' growth fluctuated, but overall, there was a growing interest in research activity in this domain.

Expansion Phase (2020 to Present)

100 articles have been published in this phase, indicating a significant growth in the number of publications. This phase demonstrates a consistency in terms of the number of publications, including 2025 (which is partial). This phase suggests a period of expansion, significantly driven by the advancement of this research domain.

Most Impactful Authors, Journals, Countries, and Affiliations

Table 2. List of most impactful authors, journals, countries, and affiliations

Most Impactful Authors		Most Impactful Journals		Most Impactful Countries		Most Impactful Affiliations	
Authors	**Number of Articles**	**Journal**	**Number of Articles**	**Country**	**Frequency**	**Affiliation**	**Number of Articles**
Hsu, Liwei	6	*Journal of Hospitality, Leisure, Sport and Tourism Education*	41	China	87	The Hong Kong Polytechnic University	11
Cantoni, Lorenzo	4	*Journal of Teaching in Travel and Tourism*	25	USA	77	Griffith University	8
Chou, Sheng-Fang	3	*Journal of Hospitality and Tourism Education*	14	Australia	33	National Kaohsiung University of Science and Technology	8
Deale, Cynthia S.	3	*Worldwide Hospitality and Tourism Themes*	11	India	33	Purdue University	8
Horng, Jeou-Shyan	3	*Journal of Hospitality and Tourism Technology*	4	Turkey	20	Helwan University	7
Liburd, Janne	3	*Tourism*	4	Uk	19	Macau University of Science and Technology	6

Table 2. (con't)

Most Impactful Authors		Most Impactful Journals		Most Impactful Countries		Most Impactful Affiliations	
Authors	**Number of Articles**	**Journal**	**Number of Articles**	**Country**	**Frequency**	**Affiliation**	**Number of Articles**
Liu, Chih-Hsing	3	*International Journal of Hospitality and Tourism Systems*	3	Switzerland	15	Ming Chuan University	6
Sigala, Marianna	3	*Journal of Environmental Management and Tourism*	3	Malaysia	12	The Chinese University of Hong Kong	6
Adukaite, Asta	2	*Journal of Hospitality & Tourism Research*	3	Thailand	11	University of Calabria	6
Agyeiwaah, Elizabeth	2	*Journal of Hospitality and Tourism Research*	3	Egypt	10	University of Florida	**6**

Table 2 illustrates the list of the top 10 most impactful authors, journals, countries, and affiliations contributing to the literature on technological innovation in tourism and hospitality education. Regarding impactful authors, Hsu Liwei and Cantoni Lorenzo published 6 and 4 articles, respectively. Whereas, among the top 10 contributors, except Hsu Liwei and Cantoni Lorenzo, the rest of the authors published 3 to 2 articles in that domain. In addition, Table 2 indicates that, among the top 10 impactful journals, *Journal of Hospitality, Leisure*, *Sport and Tourism Education* (41), *Journal of Teaching in Travel and Tourism* (25), *Journal of Hospitality and Tourism Education* (14), and *Worldwide Hospitality and Tourism Themes* (11) published the maximum number of articles while the remaining 6 journals published 3 to 4 articles each. In terms of the most impactful countries, China is the leading country in this research domain with a publication frequency of 87, followed by the USA (77), Australia (33) and India (33). Regarding the most impactful affiliation, The Hong Kong Polytechnic University holds the leading position with 11 articles, followed by Griffith University, National Kaohsiung University of Science and Technology, and Purdue University with 8 documents each.

Most Impactful Articles

Table 3. List of most impactful articles

Title	Journal	Source	Total Citations (TC)	TC per Year	Normalised TC
New realities: A systematic literature review on virtual reality and augmented reality in tourism research	*Current Issues in Tourism*	Yung & Khoo-Lattimore (2017)	650	92.86	7.98
Examining the usability of an online virtual tour-guiding platform for cultural tourism education	*Journal of Hospitality, Leisure, Sport and Tourism Education*	Chiao et al. (2018)	132	16.50	3.38
Game of algorithms: ChatGPT implications for the future of tourism education and research	*Journal of Tourism Futures*	Ivanov & Soliman (2023)	128	42.67	9.35
Exploring the factors influencing the adoption and usage of Augmented Reality and Virtual Reality applications in tourism education within the context of COVID-19 pandemic	*Journal of Hospitality, Leisure, Sport and Tourism Education*	Shen et al. (2022a)	128	32.00	4.40
Tourism education on and beyond the horizon	*Tourism Management Perspectives*	Hsu (2017)	94	11.75	2.40
Online teaching and learning experiences during the COVID-19 pandemic— A comparison of teacher and student perceptions	*Journal of Hospitality and Tourism Education*	Lei & So (2021)	92	18.40	3.39
Entrepreneurship education in tourism: An investigation among European universities	*Journal of Hospitality, Leisure, Sport and Tourism Education*	Ndou et al. (2018)	92	13.14	1.13

Table 3. (con't)

Title	Journal	Source	Total Citations (TC)	TC per Year	Normalised TC
Teacher perceptions on the use of digital gamified learning in tourism education: The case of South African secondary schools	*Computers and Education*	Adukaite et al. (2017)	91	10.11	3.15
Integrating Information & Communication Technologies (ICT) into classroom instruction: Teaching tips for hospitality educators from a diffusion of innovation approach	*Journal of Teaching in Travel and Tourism*	Goh & Sigala (2020)	87	14.50	3.67
Networking for sustainable tourism —Towards a research agenda	*Journal of Sustainable Tourism*	Albrecht (2012)	81	6.23	2.54

Table 3 presents the list of impactful articles on technological innovation in tourism and hospitality education, which was ranked by citation metrics. The article with the highest total citations (650) and a strong normalised citation score (7.98), systematically reviewed virtual reality and augmented reality in tourism research (Yung & Khoo-Lattimore, 2017). Another highly cited study (132 total citations, normalised score of 3.38) examined the usability of an online virtual tour-guiding platform for cultural tourism education (Chiao et al., 2018). Research on Game of algorithms and ChatGPT implications for the future of tourism education and research also garnered significant attention (128 total citations, normalised score of 9.35) (Ivanov & Soliman, 2023).

Other influential articles, with citation counts ranging from 81 to 128, cover topics such as the adoption and usage of augmented reality and virtual reality applications in tourism education (Shen et al., 2022a), online teaching and learning experiences within the context of COVID-19 pandemic (Lei & So, 2021), and use of digital gamified learning and ICT in tourism education (Adukaite et al., 2017; Kumar et al., 2024). These highly cited works highlight the scholarly focus on several

technological innovations in the tourism and hospitality education domain. The normalised citation count further emphasises the sustained impact of the top-cited studies over time.

Word Cloud Analysis

Figure 3. Word cloud analysis

Figure 3 highlights the word cloud analysis, which indicates the dominant and frequently occurring words in the literature on innovative technologies in hospitality and tourism education. The central prominence of words like "tourism", "teaching", "students", "higher education", and "students" demonstrates a foundational focus on the pedagogical approach and students' engagement. It indicates the continuous academic interest in enhancing instructional methods and highlights the curricular structure to meet growing industry demands. Moreover, several terms (e.g., "innovation", "gamification", "digitalisation", "e-learning", "augmented and virtual reality") indicate a growing implication of innovative technologies in the educational context. These words highlight the adoption of immersive and interactive tools for increasing experimental learning and simulation in real-world tourism environments. The appearance of a few other terms like "computer simulation", "spatial analysis", and "artificial intelligence" demonstrates the integration of digital and cutting-edge technologies to improve critical, analytical, and decision-making skills among the tourism and hospitality students.

In addition, the continuous scholarly effort to develop curriculum and training methodologies due to technological advancements is reflected through the frequent presence of several terms like "research", "training", "curriculum", and "knowledge". The appearance of "tourism development", "ecotourism", and "tourism economics" in the word cloud indicates that technological integration is not just restricted to the educational context, but also intersects with the economic understanding and sustainable development of tourism. Furthermore, this word cloud highlights an interdisciplinary approach to integrating tourism education with "information technology", "cybersecurity", and "machine learning" due to the appearance of words like "contrastive learning", "computer security", and "education computing". This indicates that the tourism and hospitality sector is growing, and students need to be prepared to face real-world challenges.

Trend Topic Analysis

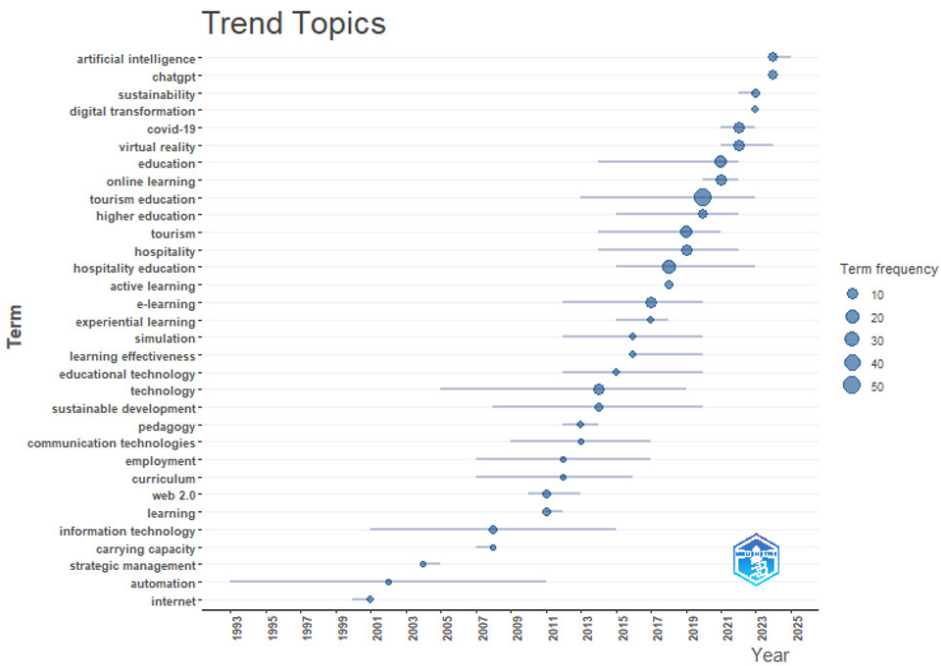

Figure 4. Trend topic analysis

Figure 4 demonstrates the trending topics on the research on innovative technologies in tourism and hospitality education from 1984 to 2025. The entire period has been categorised into three phases. Each phase highlights the transformation of the research area within this domain.

Emergence Phase (1984–2009): Laying the Conceptual Foundations

The research activity during the early period was very foundational and limited. A few terms emerged during that phase, like "internet", "automation", "strategic management", "information technology", and "carrying capacity". It indicates an initial curiosity about the digital transformation and its implications for the tourism and hospitality sector. The term "Web 2.0", appearing in the late 2000s, marks a turning point in user engagement and interactivity. It shows a promising interest in participatory and networked learning environments. However, the frequency and depth of these topics remained low, indicating a conceptual rather than empirical engagement with technology.

Development Phase (2010–2019): Integration and Diversification

The second phase indicates a significant growth in scholarly output and demonstrates an expanding array of educational and technological terms. Several keywords (e.g., "educational technology", "simulation", "experiential learning", "learning effectiveness", "e-learning", and "curriculum") reveal the increasing assimilation of digital tools into pedagogical frameworks. Additionally, the recurrence of keywords such as "tourism education", "hospitality education", and "higher education" demonstrates a transformation towards discipline-specific instructional innovation. A broader systemic concern, such as "employment", "sustainable development", and "pedagogy", was also introduced in this phase. This indicates a convergence of educational reform with the global sustainability trend and the labour market. The moderate bubble sizes for this phase reflect a maturing but not yet saturated research field. These developments likely laid the groundwork for the large-scale digital adoption in the following phase.

Expansion Phase (2020–2025): Acceleration and Technological Convergence

The final phase, which coincides with the COVID-19 pandemic and the rise of disruptive technologies, marks a rapid expansion of interest and diversification in research themes. Terms such as "digital transformation", "online learning", "virtual reality", "artificial intelligence", "ChatGPT", and "COVID-19" dominate this period. This highlights the sector's urgent pivot to remote, immersive, and AI-enhanced learning environments.

The appearance of "sustainability", "education", "technology", and "tourism" in larger nodes suggests these themes are trending and central to contemporary discourse. These terms reflect a response to crisis-induced disruption (e.g., pandemic-driven digitalisation) and a proactive transformation toward future-ready education models. "Active learning" and "hospitality education" highlight a strong focus on learner engagement, practical skill acquisition, and industry relevance (Arora et al.,

2023; Lee et al., 2018). This phase is characterised by the convergence of rapid technological advancement and educational adaptation, positioning tourism and hospitality education at the frontier of pedagogical innovation.

Co-occurrence Network of Keywords

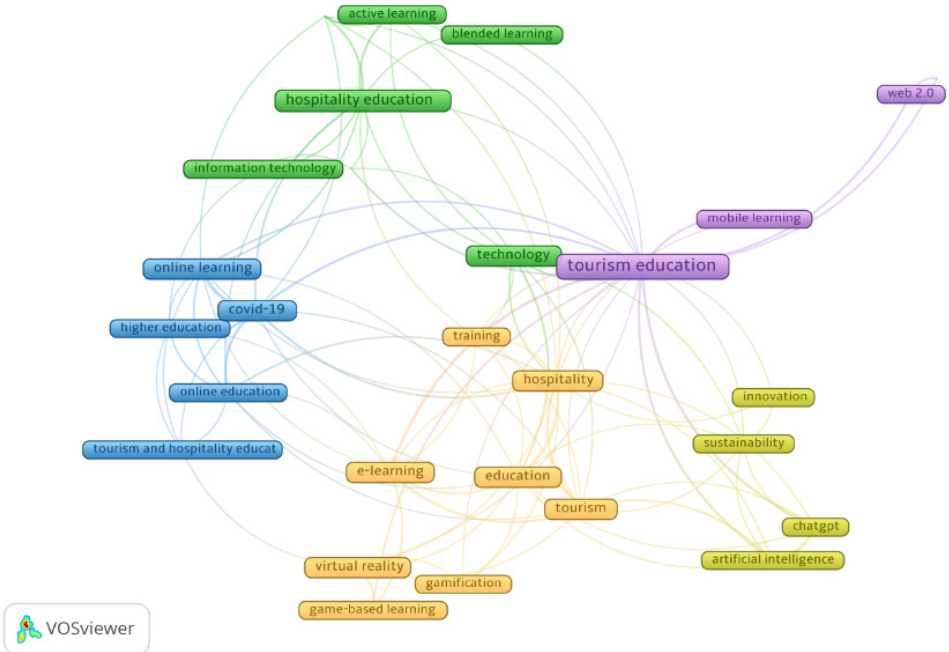

Figure 5. Co-occurrence network of authors' keywords

Figure 5 highlights the co-occurrence network analysis of authors' keywords. This figure shows five significant thematic clusters that indicate the growing and interconnected landscape of tourism and hospitality education research. These five clusters represent a conceptual focus and their interconnected relationships among key terms.

Blue Cluster: The Nexus Between Online and Higher Education

This cluster highlights the growth in literature focused on "online learning", "higher education", and "COVID-19", with a strong connection to "online education" and "tourism and hospitality education". This grouping highlights the pedagogical transformation triggered by the pandemic, which has led to a substantial amount of research focused on integrating digital methods in tourism and hospitality education.

Green Cluster: Nexus Between Pedagogical Approaches and Curriculum Innovation

This cluster combines terms like "hospitality education", "active learning", "blended learning", and "information technology". It highlights the evolving scholarly focus on learner-centred pedagogies. The frequent co-occurrence of technology within this network not only indicates a robust technological underpinning for redesigning the curriculum, but also demonstrates the implementation of innovative instructional strategies in tourism and hospitality education.

Orange Cluster: Nexus Between Technological Integration and Educational Transformation

This cluster groups terms like "e-learning", "virtual reality", "gamification", and '-"game-based learning", with a connection to broader terms like "education", "training", "hospitality", and "tourism". It emphasises an intense research focus on innovative, interactive, and immersive learning tools. This cluster also indicates the domain's transition towards an experimental digital format for developing learners' engagement and skill acquisition.

Purple Cluster: Mobile and Flexible Learning Environments

This cluster combines key terms like "tourism education", "mobile learning", and "Web 2.0". It highlights a research thread on flexible learning supported by mobile technology. Tourism education's central role in this domain emphasises how digital learning tools and resources can be adapted and made easily accessible for tourism students.

Yellow Cluster: Future-Oriented Innovations and Emerging Technologies

This cluster combines emerging terms like "artificial intelligence", "ChatGPT", "innovation", and "sustainability". The grouping of these terms indicates the interconnection and emerging importance of these innovative technologies to structure the future of tourism and hospitality education. Thematic direction derived from this cluster highlights the domain's sensitivity to technological interruption and societal demands for sustainable practices and AI-enhanced learning tools.

Discussion

The study highlights a global focus on integrating innovative technologies in tourism and hospitality education since 2015, aligning with increasing digitalisation and a shift towards technology-enhanced learning in higher education (Kallou & Kikilia, 2021; Saleh et al., 2022). The COVID-19 pandemic accelerated this change, prompting

institutions to adopt online platforms and evolve into a hybrid model (Adedoyin & Soykan, 2020). The word cloud, trending topics, and co-occurrence network show the evolution towards a technology-enabled, interdisciplinary framework. Researchers are examining how technological tools enhance learning and prepare students for a digital industry (Adukaite et al., 2017). This transformation aligns with higher education's focus on flexibility, accessibility, and innovation (Tierney & Lanford, 2016). Keywords like "virtual reality", "augmented reality", "e-learning", and "simulation" reflect the synergy in experiential learning technologies across industry and academia, essential for preparing students for real-world challenges. For example, virtual reality immerses students in simulated hotel operations or tourist destinations, linking theory with practice (Islam et al., 2024b; Tussyadiah et al., 2017). Simulation software replicates front-desk tasks and crisis situations, allowing students to hone decision-making without risks (Boppana, 2022).

The trend analyses reveal an evolving field; educational technology is now a transformative force in teaching and curriculum development. The use of artificial intelligence and machine learning illustrates a strategy that aligns educational outcomes with industry advancements (Neophytou et al., 2025; Prome et al., 2024). Keyword co-occurrence points to an integrated research landscape, connecting "cybersecurity" and "digital computing" with tourism education, equipping students with essential domain knowledge and technological skills (Morellato, 2014). The emphasis on student engagement signals a shift towards a learner-centred approach, promoting active and applied learning in vocational training. Additionally, countries like China, the USA, Australia, and India lead scholarly output due to better funding, advanced technology, and global academic networks (Shen et al., 2022b). Conversely, developing regions are underrepresented, highlighting concerns about global inclusivity and the contextual relevance of research outcomes, reflecting educational disparities in technology adoption and emphasising the need for global partnerships to bridge the digital gap.

Theoretical Implications

This study advances theory by mapping and synthesising the literature on technology-enhanced learning in tourism and hospitality education. It identifies key themes like immersive technologies, AI integration, mobile learning, and simulation-based education, creating a framework that enhances our understanding of teaching innovation in this field. This categorisation consolidates knowledge and uncovers conceptual links and underexplored areas, particularly regarding AI-driven personalisation and gamification in experiential learning. By moving beyond traditional narratives, this study contributes to theoretical discussions, emphasising digital transformation's role in improving learner engagement, curriculum delivery, and competency development.

Analysing co-occurrence and trend analysis offers evidence of shifting academic priorities in response to technological advancements and industry needs. This study enhances theory by demonstrating technology's dual role as a teaching tool and transformative force, prompting a revaluation of educational frameworks and learner-institution dynamics. Furthermore, it encourages exploration of the socio-technical dimensions of educational technology, addressing gaps in literature related to ethical design, inclusivity, and cultural adaptability. It advocates for future inquiries into how digital tools influence knowledge transfer, equity, and power dynamics in hospitality education. This study lays a foundation for future theoretical development, especially regarding technology adoption through constructivist learning theory, human-computer interaction, and transformative pedagogy. In summary, the study contributes to the theoretical framework at the intersection of tourism education and digital progress.

Practical Implications

This study provides educators and institutions with insights to effectively integrate technology into tourism and hospitality curricula. It advocates for interactive, student-centred teaching methods, emphasising the importance of immersive technologies, simulation-based learning, and AI-driven personalisation. Universities can use these insights to update their teaching strategies, employ evidence-based digital tools, and improve student engagement, especially in hybrid and remote settings. Organising training programmes for faculty in adaptive learning technologies and aligning curricula with digital competencies is crucial for preparing future learners in the evolving educational landscape. Additionally, this study offers policymakers and education leaders a framework for strengthening higher education systems in tourism and hospitality. It identifies investment areas that can enhance learning outcomes and graduate employability, such as digital infrastructure, faculty development, and instructional design. The findings also stress the need for national education frameworks to acknowledge and accredit technology-enhanced learning methods, promoting their adoption and standardisation across institutions.

Furthermore, forming partnerships with edtech providers and industry stakeholders can better align academic programs with real-world needs, offering insights for informed decision-making. This study underscores the importance of industry collaboration with academia to create curricula that reflect technological advancements and practical applications. By engaging in the development of simulation tools, virtual internships, and AI-enhanced learning environments, hospitality businesses can help build a workforce equipped for the job market. Organisations also gain from supporting educational initiatives that enhance employee skills in customer relations, sustainability practices, and digital competencies. Such collaborations strengthen workforce capabilities and enable the industry to adapt

more successfully to a technology-driven service environment, ensuring that partners feel valued and integral to the educational process.

Conclusion and Limitations

The emergence of advanced technologies in tourism education marks a significant shift in teaching frameworks for the digital demands of Industry 4.0. This research examines historical and contemporary trends, positioning the industry at the forefront of educational change. Findings indicate that technological advancements have evolved from enhancements to essential drivers of curriculum design, student engagement, and teacher preparedness. Innovations like AI-powered platforms and immersive simulations create digitally proficient graduates ready for the evolving tourism sector. Since 2015, especially during COVID-19, research shows a clear transition toward hybrid learning and experiential technologies. Increased phrases such as "virtual reality" and "artificial intelligence" highlight a shift from passive teaching to interactive learning. This educational transformation mirrors changes in global industries, where customer service and digital flexibility are vital for competitiveness. Integrating these technologies enhances pedagogy and equips future professionals with resilience, adaptability, and innovation for success.

This research advances theoretical understanding by integrating diverse perspectives into a thematic framework, showcasing five clusters that reflect the evolving conversation in the field: curriculum innovation, mobile learning, pedagogical transformation, and sustainability-focused education. These clusters emphasise the interdisciplinary nature of modern tourism education research. Academics are connecting computer science, cybersecurity, and pedagogy to foster a comprehensive understanding of technological proficiency's intersection with tourism education. Discussions on ethics, including algorithmic bias systematic errors leading to unfair outcomes and data privacy highlight the need to align technological advancements with responsible educational practices. This study offers guidance for educators and institutional leaders looking to enhance academic program resilience. Institutions are encouraged to create flexible learning environments with mobile and blended technologies to meet diverse student needs and broaden learning experiences. These insights can aid the redesign of tourism curricula to align with academic standards and industry expectations.

This study notes significant research contributions from countries like China, the USA, and Australia while highlighting uneven access to technological resources in developing regions. To address this inequality, fostering international research collaborations and funding is crucial. Bibliometric metrics suggest that collaboration increasingly drives impactful research, serving as a guideline for emerging scholars aiming for credibility and relevance. As educational technologies evolve, particularly with AI and the metaverse, the frameworks developed can guide strategic decisions

on technology adoption and stakeholder engagement. The study advocates for integrating innovative educational technologies in tourism and hospitality, emphasising a collaborative, inclusive approach to educational reform. Embracing these innovations can foster sustainable and future-ready human capital development. While this study provides a comprehensive overview of research on technologies in tourism education, it also acknowledges limitations. It includes articles indexed in the Scopus database until March 2025, potentially missing works published in 2025. Future bibliometric studies can utilise databases like Web of Science (WoS) and should consider publications in multiple languages.

Future Research Directions

Future research should expand on this study using longitudinal methods to explore the long-term impacts of technology-integrated teaching on students' skills and career preparedness in tourism and hospitality education. Longitudinal research would provide essential insights into how ongoing digital engagement affects the development and application of industry-relevant skills. Additionally, studies could assess the effectiveness of digital tools in enhancing knowledge retention, skill transfer, and job readiness over time. Comparative research across various geographical and institutional contexts is also needed. Given the global nature of tourism and hospitality, future studies should investigate differences in digital integration in education across regions, especially between emerging and developed markets. Cross-cultural studies can reveal socio-economic, infrastructural, and educational factors affecting the adoption and effectiveness of technology in hospitality and tourism education programs. These insights are crucial for creating educational frameworks tailored to regional contexts.

Emerging technologies offer opportunities for exploration. Studying the impact of artificial intelligence, extended reality (XR), and blockchain in tourism education contributes to discussions on digital innovation. Research can examine the effects on learning experiences, engagement, and ethical issues. Additionally, experimental and mixed-method strategies could evaluate the links between digital tools and learning outcomes, providing empirical support for theoretical models. Researchers should collect insights from diverse stakeholders, including employers, industry specialists, and academic policymakers. This approach will enhance the dialogue and help develop effective digital strategies that align educational objectives with industry needs.

Conflict of Interest: The authors declare no conflict of interest.

Data Availability: The dataset used in this study is available at [https://drive.google.com/drive/folders/10OBJWSUavIw8uCHniRLmEr71AGoyzo1c?usp=sharing].

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