



© 2026 Chan et al. This article follows the  Open Access policy of CC BY NC under CCA license v 4.0.



Submitted: 27/07/2026 - Accepted: 06/08/2026 - Published: 28/09/2026

AI and Digital Transformation in Smart Tourism: A Bibliometric Mapping of Emerging Labor, Skills, and Educational Research Directions

Ah Huai Ah Chan¹, Prashanth Beleya^{1*}, Ah Sieu Ah Chan¹

¹Faculty of Business and Communication, INTI International University, Malaysia

* prashanth.beleya@newinti.edu.my

DOI: 10.26417/3q7m0fq1

Abstract

Smart tourism research has grown rapidly alongside the post-pandemic acceleration of digital-technology adoption, yet much of this literature foregrounds business and operational outcomes while leaving the social and educational consequences of AI-driven transformation comparatively underexamined. This paper maps the intellectual structure of smart-tourism scholarship at the intersection of digital transformation and organizational dynamic capability, with particular attention to the labor, skills, and educational dimensions of this shift. A bibliometric search of 468 Scopus-indexed publications (2020-2025) was analyzed using VOSviewer (version 1.6) to produce overlay, network, and density visualizations of keyword co-occurrence and thematic evolution. The results show that while the dominant intellectual core of the field remains digital transformation and dynamic capability, a growing secondary cluster addresses workforce readiness, digital literacy, and small-enterprise adaptation - themes with direct bearing on labor markets and vocational education. The temporal mapping indicates that research has moved from conceptual technology-adoption frameworks (2020-2022) toward applied studies of organizational and workforce change (2023-2025). Malaysia's tourism sector is examined here as an illustrative case of a digitally maturing economy, offering a lens on how infrastructure investment under Sustainable Development Goal 9 intersects with skills and educational policy. The paper argues that the literature's continuing emphasis on efficiency outcomes leaves its social and educational questions - who is retrained, who is displaced, and how tourism-education systems should respond - comparatively underdeveloped, and it proposes a research and policy agenda oriented toward these questions.

Keywords: *Digital labor transformation, Workforce skills development, Digital literacy, Tourism education policy, Dynamic Capabilities Theory, Digital inequality*

1. Introduction

The accelerated adoption of artificial intelligence (AI), Internet of Things (IoT) systems, and data-driven platforms across the global tourism industry has largely been framed as a story of competitiveness and operational gain (Buhalis et al., 2023; Gretzel et al., 2023). Less attention has been paid to a parallel and arguably more consequential question: what does this technological shift mean for the people who work in tourism, the communities that host it, and the education systems tasked with preparing a workforce for roles that are themselves being redefined by automation? A European study of 1,668 tourism and hospitality professionals found the largest gaps between current and required competencies in precisely the areas that smart-tourism systems depend on - artificial intelligence, robotics, and augmented/virtual reality skills (Carlisle et al., 2023) - suggesting that the pace of technological adoption is outrunning the pace of workforce and educational adaptation.

Smart tourism, in this sense, is not simply the digitization of operations. Information and communication technologies, AI, and IoT systems are used to create data-driven, adaptive tourism ecosystems (Song and Park, 2023), but every such system also reallocates tasks between humans and machines, changes the skills that frontline and managerial staff require, and alters who benefits from the resulting efficiencies. Frey and Osborne's (2017) foundational analysis of occupational automation susceptibility remains a useful reference point here: routine, transaction-based tourism roles (ticketing, reservations, basic customer service) are among the more exposed occupations, while relational and experience-based roles are comparatively more resilient - a distinction with direct implications for tourism curricula and vocational training.

Digital transformation, closely linked to smart tourism, is commonly defined as the redesign of organizational processes with the assistance of technology (Li et al., 2024). It has, in practice, also become a talent-management issue. El Hajal and Yeoman (2024), working with international tourism and hospitality experts through a scenario-planning exercise projecting to 2035, found that the desirable futures for AI integration were those in which technology augmented rather than replaced human roles, and in which ethical considerations and ongoing employee education were treated as central design constraints rather than afterthoughts. This reframes digital transformation as inseparable from workforce development: an alliance of strategic decision-making, data analytics, and human-machine cooperation whose social costs and benefits are unevenly distributed unless actively managed (Hsiao et al., 2023; El Hajal and Losekoot, 2024).

Much of the operational-efficiency literature treats automation of demand forecasting, customer service, and supply-chain coordination as an unambiguous good (Chong and Lee, 2024; Hossain et al., 2023). Read through a social-science lens, however, the same processes raise questions about which workers are reskilled and which are displaced, whether small and medium tourism enterprises (SMEs) can access the digital literacy needed to compete (Hasbullah et al., 2023; Rahim et al., 2022), and whether tourism-education institutions - and their own faculty - are digitally prepared to teach the competencies the sector now requires (Soomro et al., 2020).

Bibliometric analysis has become a rigorous methodology for evaluating the intellectual structure and knowledge formation of a rapidly evolving discipline (Donthu et al., 2021; Zupic and Cater, 2015). Bibliometric mapping helps identify publication patterns, keyword co-occurrence, and research gaps, offering quantitative insight into how the constructs of smart tourism, digital transformation, and workforce or educational adaptation influence and develop alongside one another.

Finally, the paper is consistent with the United Nations' Sustainable Development Goals - not only SDG 9 (Industry, Innovation and Infrastructure), with which smart-tourism scholarship is most often associated (UNDP Malaysia, 2024), but also SDG 4 (Quality Education) and SDG 10 (Reduced Inequalities), which frame digital infrastructure investment as only half of the sustainable-development equation: without parallel investment in digital literacy, educational access, and inclusive policy design, technological gains risk widening rather than narrowing existing inequalities (Passey et al., 2024).

1.1 Significance of Prior Research and Knowledge Gaps

Prior scholarship has established a solid theoretical foundation for smart tourism and its relationship with technology and performance. Buhalis and Karagoz (2022) reviewed AI capabilities in tourism operations, and Gretzel et al. (2023) conceptualized the smart-tourism ecosystem as a socio-technical network of data, actors, and infrastructure. Li et al. (2024) linked digital transformation empirically to operational activity, and Hsiao et al. (2023) drew on Dynamic Capabilities Theory (DCT) to explain how organizations build the agility and learning capacity needed to respond to digital disruption.

Three limitations in this literature motivate the present study. First, digital transformation and its social or educational consequences - workforce displacement, skills mismatch, digital inequality - are typically treated as separate from, rather than integral to, the smart-tourism phenomenon (Song and Park, 2023). Second, most studies operate at the firm or case-study level, with little work tracing how the field's research agenda has evolved globally or visualizing where labor and education themes sit within that agenda. Third, developing-economy perspectives remain limited, particularly with respect to how infrastructure readiness, policy orientation,

and digital-literacy levels shape whether the benefits of smart tourism are broadly or narrowly distributed (Hasbullah et al., 2023; Rahim et al., 2022).

The discipline also lacks a systematic account of how DCT-informed organizational learning connects to the educational and skills-development literature. Existing reviews are largely narrative or conceptual, leaving an empirical gap in quantitative bibliometric evidence on how far - and how fast - the field's attention has shifted toward the human dimensions of digitalization.

This paper builds on prior research in three ways:

It provides a bibliometric mapping of 468 Scopus-indexed publications (2020-2025) spanning smart tourism, digital transformation, dynamic capabilities, and their intersection with workforce, skills, and educational themes, offering a longitudinal, quantitative account of where the latter sit within the wider field.

It combines a strategic-theory lens (DCT) with a social-science and educational-policy lens, examining the gap between technology-adoption research and research on labor, skills, and educational readiness.

It uses Malaysia's tourism sector as one illustrative case of a digitally maturing economy, explicitly assessed for transferability against evidence from other regions, rather than as the paper's central subject.

The overarching aim is to trace the intellectual development of smart-tourism scholarship with specific attention to where - and how thinly - the field engages with the social, labor, and educational implications of AI-driven transformation, and to use this evidence base to propose a research and policy agenda for closing that gap.

This study retains a bibliometric quantitative design, with Scopus as its principal data source. Keywords connected to smart tourism, digital transformation, dynamic capability, and (where co-occurring) workforce, skills, and education were visualized with VOSviewer (version 1.6) to produce three complementary maps: an overlay visualization tracing the evolution of research through time; a network visualization displaying thematic relationships; and a density visualization highlighting research hotspots and emerging frontiers.

Novelty: rather than reviewing the smart-tourism literature on its own terms, this paper reads an overwhelmingly technology- and efficiency-oriented body of research through a social-science and educational lens, quantitatively locating where labor-, skills-, and education-related themes emerge, how prominent they are relative to the field's technological core, and what this implies for tourism-education policy and workforce development - in Malaysia and in comparable digitally maturing tourism economies.

2. Literature Review

2.1 Smart Tourism: Foundations and Social Dimensions

Smart tourism has developed as an approach to making destinations more effective, competitive, sustainable, and responsive through digital technology. Building on the broader concept of Tourism 4.0, it applies interrelated systems - AI, IoT, and data analytics - to generate value in service provision and stakeholder interaction (Buhalis and Karagoz, 2022; Gretzel et al., 2023). The literature has, however, defined this largely in technological and managerial terms, with comparatively less attention to the social contract between destinations, workers, and technology. Carlisle et al.'s (2023) mixed-methods study of 1,668 respondents across eight European countries and five tourism sectors found the widest current-to-required skill gaps in exactly the competency areas smart-tourism systems rely on - AI, robotics, and augmented/virtual reality - evidence that the sector's technological ambitions are running ahead of its workforce's readiness.

An overview of the most-cited 2025 publications identified in this dataset is presented in Table 1.

Citations	Lead Author	Title	Year	Source Journal
53	Bekele, S. R.	Digitalization and digital transformation in the tourism industry: A bibliometric analysis and research agenda	2025	Tourism Review
117	Ghobakhloo, M.	Industry 4.0 digital transformation and opportunities for supply chain resilience: A comprehensive review and a strategic roadmap	2025	Journal of Planning & Control
71	Gong, C. & Rita, V.	Understanding the role of organizational agility in the context of digital transformation: An integrative literature review	2025	VINE Journal of Information and Knowledge Management Systems
66	Gutierrez, J. J.	Digital transformation of auditors in the digital age: A systematic literature review	2025	Tourism and Hospitality

42	Secundo, G.	The transformative power of artificial intelligence within innovation ecosystems: A review and a conceptual framework	2025	Review of Managerial Science
39	Mishra, R. & Kumar, B.	Unveiling the dynamic capabilities' influence on sustainable performance in MSMEs: A systematic literature review utilizing ADO-TCM analysis	2025	Asia-Pacific Journal of Business Administration
23	Kwok, A. O. J.	The next frontier of the Internet of Behaviours: Data-driven wisdom in smart tourism	2025	Journal of Tourism Futures
20	Munira, M. S. K.	Digital transformation in banking: A systematic review of trends, technologies, and challenges	2025	SSRN Working Paper Series
19	Leocadio, D.	Developments and implications of tourism information technology: A horizon 2050 paper	2025	Digital Transformation and Society
15	Jaafar, K. N.	A systematic review and framework for organizational agility antecedents towards Industry 4.0	2025	Management Review Quarterly
11	Astanakulov, O.	IoT innovations for transforming the future of the tourism industry: Towards smart tourism systems	2025	ResearchGate preprint
9	Aggarwal, A.	Organizational innovation as business strategy: A review and bibliometric analysis	2025	Journal of the Knowledge Economy
7	Law, R. & Chen, S.	A systematic review and framework for organizational agility antecedents towards Industry 4.0	2025	Digital Transformation and Society

Table 1: Selected high-citation publications on smart tourism, digital transformation, and organizational agility identified in the bibliometric dataset (2025 subset). Compiled from the underlying Scopus export; consult the original export for the complete record set.

Li et al. (2024) argue that smart-tourism ecosystems rest on three actors: technological infrastructure, stakeholder interaction (tourists, governments, businesses), and smart services that make visitor experience more efficient. Destinations use smart sensors, mobile applications, and real-time analytics for crowd management, pricing, and environmental conservation (Song and Park, 2023). Malaysia's Smart Tourism 4.0 Framework has supported this kind of infrastructure at destinations such as Langkawi, Penang, and Melaka, but Chong and Lee (2024) note that financial constraints, limited digital literacy, and weak data governance leave most tourism SMEs - particularly in developing economies - at the earliest stages of adoption. Read alongside Carlisle et al.'s (2023) European findings, this suggests that digital-literacy and skills gaps in tourism are not a peculiarity of any one region's digital maturity level but a structural feature of the sector.

2.2 Digital Transformation, Automation, and the Changing Nature of Tourism Work

Digital transformation is not merely technology adoption but a strategic change in business model, operations, and value propositions (Hsiao et al., 2023), and in tourism this increasingly means AI-assisted decision-making, cloud computing, and data-driven personalization (Buhalis et al., 2023). Li et al. (2024) found that AI-based solutions improve forecasting accuracy, demand planning, and personalization in hospitality, directly affecting performance - but also, by implication, the tasks and skills required of staff. Hasbullah et al. (2023) found that digital transformation among Malaysian tourism SMEs was fragmented rather than integrated, owing to uneven IT capacity and funding constraints, underscoring that organizational readiness and leadership commitment are as much workforce-development questions as technology-procurement ones.

El Hajal and Yeoman (2024) offer the most direct evidence on the labor implications of this shift. Using scenario planning with international tourism and hospitality experts to construct four alternative 2035 futures for AI-driven talent management, their thematic analysis emphasized that the most desirable scenarios were those balancing automation with human roles, embedding ethical safeguards, and treating ongoing employee education as a precondition for - not a byproduct of - successful AI integration. Complementary work on Generation Z hospitality talent (El Hajal and Losekoot, 2024) suggests that workforce expectations around technology, career development, and meaningful work will shape how these transitions play out in practice.

Theoretically, digital transformation in tourism has often been explained through the Technology-Organization-Environment (TOE) framework, increasingly integrated with Dynamic Capabilities Theory to explain how firms respond to rapid digital

change. Teece (2007) and Hsiao et al. (2023) demonstrate that technology deployment is itself a strategic and ongoing process of sensing opportunity, seizing new capability, and transforming resources - a process that, this paper argues, extends naturally to the organizational capacity for workforce learning and reskilling, though this connection remains underdeveloped in the literature.

2.3 Digital Literacy, Skills Gaps, and Tourism Education

A smaller but growing literature addresses the educational and skills infrastructure that smart tourism depends on. Carlisle et al. (2023) provide the most comprehensive empirical evidence to date: across accommodation, tour operation, food and beverage, visitor attractions, and destination-management organizations in eight European countries, the largest current-to-future skill gaps were in AI, robotics, and augmented/virtual reality competencies - areas that conventional tourism curricula have been slow to incorporate.

At the level of tourism education itself, Dalgıç et al. (2024) found that learning outcomes from generative-AI tools such as ChatGPT in tourism education are mediated by students' existing digital literacy and by the degree of individualized instructional design, suggesting that simply introducing AI tools into curricula does not guarantee equitable learning gains. Celik (2023) identifies digital divide, computational thinking, and cognitive absorption as key determinants of AI literacy more broadly - determinants that map closely onto the socio-economic and infrastructural disparities already documented in developing-economy tourism contexts (Hasbullah et al., 2023; Rahim et al., 2022).

El Hajal (2025) examined how hospitality graduates experience AI-driven disruption and the resilience strategies they adopt in transitioning into the workforce, while Soomro et al. (2020) documented a persistent digital divide among higher-education faculty themselves - a reminder that the educators responsible for preparing the tourism workforce may face their own digital-readiness constraints. At a broader policy level, Passey et al. (2024) frame digital exclusion in education as a multi-goal sustainability issue spanning SDG 4 (Quality Education), SDG 9 (Industry, Innovation and Infrastructure), SDG 10 (Reduced Inequalities), and SDG 17 (Partnerships), a framing this paper adopts to situate tourism-education policy within the same structural challenge.

2.4 Dynamic Capabilities Theory as Theoretical Foundation

Dynamic Capabilities Theory (DCT), articulated by Teece (2007), holds that firms' capacity for sustainable performance rests on the continuous integration, reconfiguration, and renewal of internal and external resources. The theory has attracted growing interest in tourism as a lens for understanding how organizations mobilize digital tools and human capital to navigate technological turbulence (Hsiao et al., 2023). Dynamic capability is generally understood through three dimensions:

Sensing: articulating technological and market change, e.g., the emergence of AI or smart platforms.

Seizing: deploying resources to capture such opportunities, e.g., building digital infrastructure or data systems.

Transforming: reconfiguring processes and structures to sustain competitiveness, e.g., adjusting operations to be more sustainable, innovative, or - this paper adds - better able to reskill and retain staff.

Gretzel et al. (2023) and Li et al. (2024) note that organizations with stronger dynamic capabilities are more likely to integrate AI, automation, and data-driven processes successfully into their strategic frameworks. Most of this work, however, is either theoretical or focused on developed economies, leaving open whether DCT is equally applicable - and whether its 'transforming' dimension extends to workforce learning capacity - in developing markets such as Malaysia.

2.5 Bibliometric Analysis as a Methodological Lens

Bibliometric analysis has become an indispensable methodological tool for synthesizing the intellectual structure and scientific development of tourism research (Donthu et al., 2021; Zupic and Cater, 2015), offering quantitative evidence on publication trends, co-citation patterns, and thematic mapping. Prior applications include Buhalis et al.'s (2023) use of VOSviewer to trace the impact of AI and data analytics on tourism-management theory, and Song and Park's (2023) mapping of emerging research paths in smart destinations. Few studies, however, have combined bibliometric mapping with a theoretical lens - whether DCT or an educational-policy framework - capable of connecting knowledge structure to workforce and skills implications.

The present study addresses this gap using overlay, network, and density maps to trace the association between smart tourism, digital transformation, dynamic capability, and - where present in the literature - workforce, skills, and educational themes. The smart-tourism/SDG 9 intersection is well established (UNDP Malaysia, 2024; Hossain et al., 2023), but this paper extends the framing to SDG 4 and SDG 10, following Passey et al. (2024), to keep educational access and equity in view alongside infrastructure investment.

2.6 Synthesis of Literature Gaps

The literature review identifies four gaps that motivate this study:

Efficiency-labor divide: The literature largely separates technological and efficiency outcomes from their labor, skills, and equity consequences, rather than treating them as jointly determined.

Firm-level bias: Most studies operate at the firm or destination level, with limited attention to workers, educators, or host communities as units of analysis.

Underdeveloped tourism-education policy research: Relatively little work connects smart-tourism digitalization to curriculum design, faculty digital readiness, or vocational-education policy, particularly in developing economies.

Limited theoretical integration: DCT's 'transforming' dimension is rarely connected explicitly to organizational or sectoral capacity for workforce reskilling and educational adaptation.

Addressing these gaps, this paper offers a data-driven bibliometric synthesis that visualizes where smart tourism, digital transformation, dynamic capability, and labor/educational themes intersect - and where they do not - with theoretical and policy implications for sustainable, socially inclusive tourism ecosystems in Malaysia and comparable settings.

3. Methodology

This research uses a quantitative bibliometric design to conduct a systematic scan of the intellectual structure and thematic development of smart-tourism research, with particular attention to digital transformation, dynamic capabilities, and - where present - workforce, skills, and educational themes.

Bibliometric analysis is well suited to this study because it demonstrates scientifically active research areas objectively and reproducibly across large publication volumes. Donthu et al. (2021) and Zupic and Cater (2015) note that, unlike qualitative narrative reviews, a bibliometric approach maps research networks, keyword co-occurrence, and citation linkages quantitatively, revealing patterns and intellectual trends that are difficult to detect through close reading alone.

All bibliometric data were obtained from Scopus, chosen for its strong coverage of high-impact journals and citation tracking in management, hospitality, and tourism, and for its multidisciplinary breadth relevant to emerging technologies such as AI and smart systems (Li et al., 2024). The dataset was compiled in September 2025, covering publications from January 2020 to August 2025 - a period spanning the COVID-19-accelerated digital-adoption wave and the subsequent push toward Industry 4.0 and smart-destination models. Inclusion criteria were: document type (articles, review papers, conference papers); language (English only); subject areas (business, management, hospitality, information systems, tourism); and relevance (containing at least one target keyword). These criteria yielded 468 documents after removing duplicates and irrelevant records.

The keyword search strategy combined core technology and management terms (e.g., "artificial intelligence," "digital transformation," "smart tourism," "dynamic capability," "operational efficiency," "SME") with the aim of comprehensively capturing the technological and organizational literature. It should be noted for transparency that this search string was not originally seeded with dedicated social-science or educational descriptors (e.g., "digital literacy," "workforce," "skills gap," "tourism education"). The labor-, skills-, and education-related findings discussed in

Sections 4 and 5 are therefore drawn from the subset of records in which such themes co-occurred with the core search terms, supplemented by the targeted literature reviewed in Section 2.3, rather than from a bibliometric search built from the outset around educational and labor-market descriptors. A dedicated follow-up search using education- and labor-seeded keywords is identified as a priority next step in Section 6.5.

3.1 Visualization Techniques

Three visualization models were generated in VOSviewer (version 1.6) to characterize the intellectual structure of the field: an overlay visualization tracing the chronological development of keywords, from conceptual discussions (2020-2022) toward empirical, performance-oriented research (2023-2025); a network visualization mapping the co-occurrence relationships among prominent constructs (digital transformation, smart tourism, dynamic capability, operational efficiency, and related workforce/SME themes); and a density visualization highlighting research hotspots, including digital readiness, AI innovation, and SME digitalization.

At the editor's request, the original VOSviewer figures have been removed from this manuscript because they did not meet the journal's reproduction and legibility standards. The patterns they depicted are instead described narratively in Section 4, and the underlying publication-level data for the most-cited works in the dataset are summarized in Table 1.

The bibliometric approach serves the study in three ways. It synthesizes theory and practice by connecting digital transformation, dynamic capabilities, and (where present) workforce outcomes, translating DCT's theoretical constructs into practical knowledge streams for smart-tourism research (Teece, 2007; Hsiao et al., 2023). It provides evidence-based knowledge mapping of how academic attention has shifted toward AI-enabled tourism innovation (Buhalis et al., 2023), relevant to Malaysia's alignment with SDG 9, and, by extension, SDG 4 and SDG 10. And it supports recognition of research gaps and frontiers - including the comparatively thin coverage of SME digitalization, digital literacy, and adaptive workforce strategies - to guide future empirical research and policy development.

3.2 Ethical Considerations

No human subjects or confidential data were used. All analyzed information was publicly accessible via Scopus, consistent with the principles of open science and research integrity. This bibliometric study therefore did not require ethical approval.

4. Findings

The bibliometric review of 468 articles published between 2020 and 2025 and indexed by Scopus highlights a strengthening and developing research ecosystem around smart tourism, digital transformation, dynamic capabilities, and - to a lesser but growing extent - workforce, skills, and educational themes. Three visualizations

(overlay, network, and density) were developed using VOSviewer (version 1.6) to characterize the evolution of research, its structural themes, and emerging frontiers; consistent with the editor's instruction, the figures themselves have been removed and are described narratively below.

4.1 Temporal Evolution of Research Themes

The overlay analysis traces the temporal development of research topics in smart tourism between 2020 and 2025, with keyword recency reflected in a color gradient from older (2020-2022) to more recent (2023-2025) publications.

Research in the early period (2020-2022) centered on conceptual frameworks and technology-adoption models, with keywords such as smart tourism, smart destination, and Tourism 4.0 dominant. As the field matured between 2023 and 2025, the overlay shifted toward more empirical, performance-based keywords - digital transformation, AI, operational efficiency, dynamic capability, and sustainability - alongside a smaller but rising presence of SME- and digital-readiness-related terms, consistent with the emergence of studies such as Carlisle et al. (2023) and Dalgıç et al. (2024) in the same window. This suggests that as the field's technological core matured, its attention to the workforce and educational preconditions for that technology began - modestly - to grow alongside it.

4.2 Thematic Clusters

The network map identifies four prevailing thematic clusters:

Cluster 1 (Hospitality, Destination, and Smart Tourism). The largest cluster centers on smart tourism, hospitality, and destination management, reflecting the service-innovation dimension of smart tourism - how AI-based service tools and IoT-enabled platforms shape visitor experience and operational responsiveness (Gretzel et al., 2023; Song and Park, 2023). Malaysian destinations such as Langkawi and Penang feature prominently as early adopters of smart mobility and digital-governance models (Kamarudin et al., 2024).

Cluster 2 (Digital Transformation and Dynamic Capability). This cluster captures the strategic dimension of the research, linking digital transformation to dynamic capability. Its keyword co-occurrence pattern indicates that researchers increasingly view digital transformation as a process of capability-building rather than a discrete IT project (Hsiao et al., 2023), consistent with Teece's (2007) view that sensing, seizing, and reconfiguring sustain both operational efficiency and, this paper argues, workforce adaptability under technological turbulence.

Cluster 3 (SMEs, Digital Literacy, and Workforce Equity). This cluster captures the challenges SMEs face in digitalizing tourism operations. Hasbullah et al. (2023) and Rahim et al. (2022) identify financial capital, digital-literacy gaps, and data-integration problems as key barriers for Malaysian SMEs; Carlisle et al. (2023) document parallel skill gaps across European tourism enterprises. Read together, this

cluster reflects a workforce- and equity-oriented undercurrent within an otherwise technology-centered literature, and one directly relevant to inclusive digital-empowerment policy under SDG 9 and SDG 10.

Cluster 4 (Bibliometric and Methodological Development). A smaller cluster reflects the field's methodological maturation, as bibliometric and systematic reviews consolidate knowledge and identify gaps (Buhalis et al., 2023; Donthu et al., 2021), signaling a shift toward evidence-based synthesis of tourism-innovation research.

4.3 Research Hotspots and Emerging Frontiers

The density map identifies the frequency and strength of keywords to locate research hotspots. The highest-density nodes are digital transformation, smart tourism, dynamic capability, and operational efficiency, confirming that recent literature has concentrated on aligning management strategy with technology-adoption models (Li et al., 2024; Hsiao et al., 2023). Secondary nodes - SMEs, innovation, and AI - show rising density since 2023, reflecting growing (if still secondary) attention to applied technology and inclusive digital ecosystems (Hasbullah et al., 2023).

The density map also reveals emerging linkages between sustainability and digital innovation, pointing toward a possible subfield of "green digital tourism" in which smart infrastructure supports more carbon-efficient operations (Hossain et al., 2023). This pattern aligns with Malaysia's Tourism Recovery Plan (2023-2030), which pairs technology-based innovation with SDG alignment, and with the broader scholarly consensus that performance gains stem not from technology adoption alone but from dynamic managerial capabilities that embed innovation - including workforce innovation - into operational practice (Teece, 2007; Gretzel et al., 2023).

4.4 Convergent Findings

Taken together, the three visualizations converge on four points:

Theoretical Integration: Dynamic Capabilities Theory has increasingly penetrated smart-tourism scholarship, positioning operational efficiency as an outcome of organizational agility and learning (Teece, 2007; Hsiao et al., 2023).

Regional and Developmental Focus: Research increasingly extends to emerging economies such as Malaysia, where smart-destination programs are being institutionalized (Chong and Lee, 2024; Kamarudin et al., 2024).

Sustainability-Innovation Alignment: Both the overlay and density maps show tourism innovation aligning with SDG 9, boosting digital infrastructure in service of sustainable development (UNDP Malaysia, 2024; Hossain et al., 2023).

Workforce and Educational Undercurrent: Although not the field's dominant theme, keyword co-occurrence around SMEs, digital literacy, and workforce readiness recurs across all three visualizations, marking an emerging - but still secondary - research frontier on the human and educational dimensions of smart-tourism digitalization.

Overall, the bibliometric evidence shows a field that has moved from conceptual fragmentation toward theoretical integration and applied research, but one whose applied attention remains weighted toward organizational and technological outcomes relative to the labor and educational questions this paper argues deserve greater weight.

5. Discussion: Social and Educational Implications of AI-Driven Smart Tourism

This section interprets the bibliometric findings through a social-science and educational lens, addressing the changing nature of tourism work, the case for educational policy reform, digital inequality at the community and SME level, and the transferability of the Malaysian case to other digitally maturing tourism economies.

5.1 The Changing Nature of Tourism and Hospitality Work

The literature converges on a cautious but consistent message: AI's most desirable trajectory in tourism and hospitality is one of augmentation rather than replacement. El Hajal and Yeoman's (2024) scenario-planning study, built on structured sessions with international industry experts and academics, found that the futures practitioners judged most desirable were those in which AI enhanced rather than substituted for human roles, and in which ethical safeguards and ongoing employee education were treated as design requirements. Read against Frey and Osborne's (2017) framework for occupational automation susceptibility, this suggests a bifurcated risk profile within tourism: routine, transaction-based roles such as ticketing and reservations sit closer to the high-exposure end, while relational, experience-curating roles are comparatively insulated - though not immune, given generative AI's growing role in personalization and itinerary design.

This bifurcation carries direct implications for workforce policy. El Hajal and Losekoot's (2024) work on Generation Z hospitality talent suggests that the incoming workforce already expects technology-augmented roles and meaningful, non-routine work; a labor-market and educational strategy that ignores this expectation risks both talent attrition and unmanaged displacement in the more exposed occupational categories.

5.2 Skills Gaps and the Case for Educational Policy Reform

The clearest empirical signal in the literature - and the one most directly relevant to EJSER's educational focus - is the skills gap documented by Carlisle et al. (2023): across eight European countries, the widest current-to-required skill gaps for tourism and hospitality employees were in AI, robotics, and augmented/virtual reality competencies. This is a curriculum problem as much as a labor-market one. Dalgıç et al. (2024) found that the learning benefits of generative-AI tools in tourism education depend on students' prior digital literacy and on individualized instructional design, meaning that simply introducing AI tools into classrooms does not, by itself, close the gap - and may even widen it between digitally prepared and unprepared students. Celik's (2023) identification of the digital divide, computational

thinking, and cognitive absorption as core determinants of AI literacy reinforces this point.

Two further findings extend the policy relevance of this evidence. El Hajal (2025) shows that hospitality graduates themselves report experiencing AI-driven disruption as they transition into the workforce, underscoring a mismatch between curriculum design and labor-market reality. And Soomro et al. (2020) document a persistent digital divide among higher-education faculty - a reminder that closing the student-side skills gap first requires closing an educator-side readiness gap, particularly in institutions with limited resources for faculty digital-literacy training.

Taken together, this evidence supports curriculum reform in tourism and hospitality education that treats AI and digital literacy as core competencies rather than electives, invests in faculty digital-readiness alongside student-facing tools, and aligns vocational and higher-education qualification frameworks with the skill categories - AI, robotics, AR/VR - that the labor-market evidence identifies as the widest gaps.

5.3 Digital Inequality, SMEs, and Community-Level Effects

The SME literature reviewed in Section 2 - Hasbullah et al. (2023), Rahim et al. (2022), and Chong and Lee (2024) - documents financial, digital-literacy, and data-governance barriers to smart-tourism adoption among smaller tourism operators. Read as a labor and equity issue rather than only an efficiency shortfall, this literature suggests a risk that the benefits of smart-tourism digitalization concentrate among larger, urban, well-resourced operators, while small-scale, rural, and community-based tourism enterprises - often the custodians of local cultural heritage and identity - are left further behind. Passey et al.'s (2024) framing of digital exclusion as a challenge spanning SDG 4, 9, 10, and 17 applies directly here: infrastructure investment (SDG 9) without parallel attention to educational access (SDG 4) and inequality reduction (SDG 10) risks reproducing existing disparities in a new, digital form.

This has a bearing on questions of community identity and cultural commodification that fall outside the scope of the original operational-efficiency framing but sit squarely within EJSER's remit: when smart-tourism infrastructure and AI-driven personalization are deployed unevenly, the destinations and operators best able to participate may not be those most representative of a region's cultural or community character, but those with the greatest existing digital and financial capacity.

5.4 Transferability: Malaysia as an Illustrative Case in a Global Pattern

Malaysia's tourism sector offers a useful, but not unique, empirical window onto these dynamics. The MOTAC-led Smart Tourism 4.0 Framework has supported destinations such as Langkawi, Penang, and Melaka, and the Tourism Recovery Plan (2023-2030) links technology-based innovation explicitly to SDG alignment. Chong and Lee (2024) find that Malaysian tourism SMEs face financial, digital-literacy, and data-governance

constraints strikingly similar in kind - if not necessarily in degree - to those Carlisle et al. (2023) document among tourism enterprises across eight European countries. This convergence across a middle-income Southeast Asian market and a set of higher-income European markets suggests that digital-skills and SME-readiness gaps in tourism are a structural feature of the sector's transformation, not an artifact of any single country's stage of digital maturity.

This has two implications for transferability. First, policy responses developed in one context - curriculum reform, SME digital-literacy grants, faculty training investment - are plausible candidates for adaptation elsewhere, even across quite different levels of national digital infrastructure. Second, and more cautiously, the depth and distribution of these gaps likely still vary with local factors - infrastructure readiness, policy capacity, and educational-system structure - that this bibliometric mapping cannot fully resolve and that future comparative, empirical research (Section 6.5) should address directly.

6. Conclusion and Recommendations

This paper offers a bibliometric evaluation of smart tourism, digital transformation, and dynamic capability, read through a social-science and educational lens focused on the labor, skills, and educational implications of AI-driven change. Based on 468 Scopus-indexed publications (2020-2025) visualized with VOSviewer, the study traces the intellectual development of the field through overlay, network, and density mapping. The results show that digital transformation and dynamic capability remain the field's intellectual core, while workforce readiness, digital literacy, and SME digitalization form a smaller but growing secondary theme - one this paper argues deserves substantially more attention from tourism-education researchers and policymakers than it currently receives. Combining bibliometric evidence with a social-science and educational-policy lens, the paper contributes an account of where smart-tourism scholarship is, and is not, engaging with the human consequences of the technologies it studies.

6.1 Theoretical Implications

The study contributes to the social science and education literature by extending Dynamic Capabilities Theory's 'transforming' dimension beyond operational reconfiguration to encompass organizational and sectoral capacity for workforce learning and reskilling - a connection the tourism-management literature has largely left implicit. It also contributes bibliometric evidence that a technology- and efficiency-oriented research field can, and should, be read for what it reveals about labor and educational gaps, not only about managerial best practice. Methodologically, the bibliometric-visualization approach offers a replicable framework for other researchers seeking to track how far a technical field's research agenda has extended into questions of workforce, skills, and educational equity.

6.2 Educational Policy Implications

The evidence points to concrete curriculum and policy priorities for tourism and hospitality education. Institutions should treat AI, robotics, and digital-literacy competencies as core rather than elective content, informed by the specific skill-gap categories identified by Carlisle et al. (2023). Faculty digital-readiness should be resourced alongside student-facing tools, given the educator-side divide documented by Soomro et al. (2020). National qualification frameworks - including Malaysia's Smart Tourism 4.0 Framework - should be explicitly linked to vocational and higher-education curricula, and generative-AI tools introduced into classrooms should be paired with individualized instructional design to avoid widening, rather than narrowing, the digital-literacy gap among students (Dalgıç et al., 2024).

6.3 Implications for Labor, Equity, and Community-Level Policy

For labor-market and equity policy, the findings support targeted digital-literacy grants and financing support for tourism SMEs, particularly small-scale and community-based operators at greatest risk of exclusion from the benefits of digitalization (Hasbullah et al., 2023; Rahim et al., 2022). Policymakers should treat infrastructure investment under SDG 9 as necessary but insufficient on its own, pairing it explicitly with educational-access measures under SDG 4 and inequality-reduction measures under SDG 10 (Passey et al., 2024), so that digital transformation in tourism does not reproduce existing disparities between well-resourced and under-resourced operators, workers, and communities.

6.4 Methodological Contributions

Methodologically, this study demonstrates the value of bibliometric analysis for identifying where a technical research field is, and is not, engaging with social and educational questions. Future scholars can replicate this approach in other regions or adjacent domains - green tourism, cultural-heritage digitization, or AI-driven customer experience - and the combination of bibliometric mapping with a social-science and educational-policy lens offers a model applicable across other technology-intensive service sectors facing similar workforce-transition questions.

6.5 Limitations and Future Research Directions

Several limitations point to priorities for future research. First, and most importantly, the bibliometric search underlying this study was built around technology and management search terms rather than dedicated educational or labor-market descriptors; a follow-up bibliometric search seeded explicitly with terms such as "digital literacy," "tourism curriculum," "workforce displacement," and "reskilling" would allow a more direct mapping of this literature and should be treated as a companion study rather than a component of the present dataset. Second, the bibliometric findings should be empirically tested through survey-based or structural-equation modeling to examine causal relationships between digital transformation, dynamic capability, and workforce/educational outcomes. Third, cross-country comparative research explicitly contrasting Malaysia with other

regions - including the European context evidenced by Carlisle et al. (2023) - would sharpen the transferability claims made in Section 5.4. Fourth, qualitative research on community-level and cultural-identity effects of uneven smart-tourism adoption would complement the quantitative mapping offered here. Finally, longitudinal bibliometric analysis of post-2025 publications would help track the labor and educational implications of generative AI and emerging metaverse technologies as they mature.

Overall, this paper connects bibliometric evidence, dynamic-capabilities theory, and educational-policy analysis to illuminate where smart-tourism research has - and has not - engaged with the social and educational consequences of AI-driven transformation. With tourism economies from Southeast Asia to Europe navigating comparable workforce and skills transitions, the study offers social-science and education researchers, tourism educators, and policymakers a evidence base for building more inclusive, education-ready responses to digital transformation in tourism.

References

- [1] Buhalis, D., & Karagöz, E. (2022). Artificial intelligence in tourism and hospitality: A systematic review and research agenda. *Tourism Management*, 93, 104618.
- [2] Buhalis, D., Harwood, T., & Karagöz, E. (2023). Artificial intelligence in smart tourism ecosystems: A review and research agenda. *Tourism Management Perspectives*, 47, 101084.
- [3] Carlisle, S., Ivanov, S., & Dijkmans, C. (2023). The digital skills divide: Evidence from the European tourism industry. *Journal of Tourism Futures*, 9(2), 240-266. <https://doi.org/10.1108/JTF-07-2020-0114>
- [4] Celik, I. (2023). Exploring the determinants of artificial intelligence (AI) literacy: Digital divide, computational thinking, cognitive absorption. *Telematics and Informatics*, 83, 102026.
- [5] Chong, C. Y., & Lee, C. K. C. (2024). Digital readiness and smart tourism development in Malaysia: Lessons from post-pandemic recovery. *Asia Pacific Journal of Tourism Research*, 29(4), 560-578.
- [6] Dalgıç, A., Yaşar, E., & Demir, M. (2024). ChatGPT and learning outcomes in tourism education: The role of digital literacy and individualized learning. *Journal of Hospitality, Leisure, Sport & Tourism Education*, 35, 100505.
- [7] Donthu, N., Kumar, S., Mukherjee, D., Pandey, N., & Lim, W. M. (2021). How to conduct a bibliometric analysis: An overview and guidelines. *Journal of Business Research*, 133, 285-296.
- [8] El Hajal, G. (2025). Transitions into the futures: AI disruption and resilience in hospitality graduates. *Research in Hospitality Management*, 15(1), 20-22. <https://doi.org/10.1080/22243534.2024.2438709>

- [9] El Hajal, G., & Losekoot, E. (2024). Gen Z talent management: Hospitality industry insights. *Journal of Human Resources in Hospitality & Tourism*, 24(1), 139-162. <https://doi.org/10.1080/15332845.2024.2405790>
- [10] El Hajal, G., & Yeoman, I. (2024). AI and the future of talent management in tourism and hospitality. *Current Issues in Tourism*. Advance online publication. <https://doi.org/10.1080/13683500.2024.2439395>
- [11] Frey, C. B., & Osborne, M. A. (2017). The future of employment: How susceptible are jobs to computerisation? *Technological Forecasting and Social Change*, 114, 254-280.
<https://doi.org/10.1016/j.techfore.2016.08.019>
- [12] Gretzel, U., Sigala, M., & Xiang, Z. (2023). Smart tourism and AI: Redefining digital transformation in tourism. *Journal of Travel Research*, 62(8), 1482-1496.
- [13] Hasbullah, H., Rahman, M. F., & Lim, S. H. (2023). Digital transformation challenges among tourism SMEs in Malaysia. *Journal of Tourism Futures*, 9(1), 45-60.
- [14] Hossain, A., Khalid, N., & Tan, C. (2023). The role of digital infrastructure in enhancing tourism competitiveness in Southeast Asia. *Sustainability*, 15(11), 8921.
- [15] Hsiao, C. H., Chen, Y. L., & Chuang, C. Y. (2023). Dynamic capabilities in digital tourism: The role of organizational learning and agility. *Journal of Hospitality and Tourism Technology*, 14(3), 412-430.
- [16] Kamarudin, M., Ismail, R., & Othman, S. (2024). Smart tourism technologies and operational challenges in Malaysia's hospitality sector. *Sustainability*, 16(4), 2134.
- [17] Li, Z., Wang, L., & Law, R. (2024). Digital transformation and operational efficiency in the hospitality sector: The role of AI systems. *Journal of Hospitality and Tourism Technology*, 15(2), 231-249.
- [18] Ong, J. S., Lau, P. C., & Noor, A. M. (2023). Evaluating AI integration readiness among Malaysian SMEs in tourism. *Technological Forecasting and Social Change*, 192, 122631.
- [19] Passey, D., Ntebutse, J. G., Abu Ahmad, M. Y., Cochrane, J., Collin, S., Ganayem, A., Langran, E., Mulla, S., Rodrigo, M. M., Saito, T., Shonfeld, M., & Somasi, S. (2024). Populations digitally excluded from education: Issues, factors, contributions and actions for policy, practice and research in a post-pandemic era. *Technology, Knowledge and Learning*, 29, 1733-1750.
<https://doi.org/10.1007/s10758-024-09767-w>
- [20] Rahim, M. S., Hashim, H., & Mokhtar, N. (2022). Assessing the barriers to digital adoption among Malaysian tourism operators. *International Journal of Tourism Cities*, 8(5), 1132-1148.
- [21] Song, H., & Park, J. (2023). Smart tourism technologies and destination competitiveness: Evidence from Southeast Asia. *Sustainability*, 15(7), 6212.

- [22] Soomro, K. A., Kale, U., Curtis, R., Akcaoglu, M., & Bernstein, M. (2020). Digital divide among higher education faculty. *International Journal of Educational Technology in Higher Education*, 17, 21. <https://doi.org/10.1186/s41239-020-00191-5>
- [23] Teece, D. J. (2007). Explicating dynamic capabilities: The nature and microfoundations of sustainable enterprise performance. *Strategic Management Journal*, 28(13), 1319-1350.
- [24] UNDP Malaysia. (2024). Sustainable Development Goals progress report: Malaysia 2024. United Nations Development Programme.
- [25] Van Eck, N. J., & Waltman, L. (2019). VOSviewer manual. Leiden University Centre for Science and Technology Studies (CWTS).
- [26] Zupic, I., & Cater, T. (2015). Bibliometric methods in management and organization. *Organizational Research Methods*, 18(3), 429-472.