

THE FUTURE OF TOURISM AND HOSPITALITY HIGHER EDUCATION IN THE CONTEXT OF INDUSTRY 5.0: OPPORTUNITIES, CHALLENGES, AND STRATEGIC CONSIDERATIONS

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Kratak sadržaj: Pojava industrije 5.0, zasnovane na čovekocentričnom, održivom i otpornom razvoju, radikalno menja očekivanja od visokog obrazovanja u turizmu i hotelijerstvu. U radu se analizira kako univerziteti primenjenih studija i visoke škole strukovnih studija mogu strateški da odgovore na ovu tranziciju. Na osnovu pregleda savremene literature o industriji 5.0, digitalnoj transformaciji i obrazovanju za turizam, najpre se razjašnjavaju ključne karakteristike i stubovi industrije 5.0 i njihove implikacije za saradnju čoveka i veštačke inteligencije, kiber-fizičko-društvene sisteme i dobrobit zaposlenih. Zatim se razmatraju očekivane promene obrazovnih paradigmi, uz naglasak na integraciji veštačke inteligencije, analitike podataka, proširene i virtuelne stvarnosti i pametnih tehnologija u nastavne planove, uz istovremeno jačanje viših kognitivnih veština, etičkog rasuđivanja i svesti o održivosti. SWOT analiza univerziteta primenjenih studija u oblasti turizma i hotelijstva ističe snažnu praktičnu orijentaciju i bliske veze sa privredom kao ključne snage, ali i ograničene istraživačke resurse, sporost u prilagođavanju kurikuluma i ubranu zastarelost veština kao važne slabosti i pretnje. Na kraju se predlažu strateški pravci delovanja: uvođenje čovekocentričnog obrazovanja, razvoj celoživotnog učenja i mikro-kvalifikacija, odgovorna upotreba novih tehnologija i razvoj agilnih, modularnih i u saradnji sa industrijom kreiranih programa. Zaključuje se da će institucije koje uspešno povežu ljudske vrednosti sa naprednim tehnologijama biti najbolje pozicionirane da obrazuju prilagodljive, etički utemeljene stručnjake i postanu nosioci inovacija i održivog razvoja u eri industrije 5.0 u turizmu i hotelijerstvu.

Ključne reči: industrija 5.0, visoko obrazovanje u turizmu i hotelijerstvu, univerziteti primenjenih studija, digitalna transformacija, veštačka inteligencija, redizajn kurikuluma, čovekocentrično učenje, celoživotno učenje, mala i srednja preduzeća u turizmu.

Abstract: The emergence of Industry 5.0, with its human-centric, sustainable and resilient orientation, is reshaping expectations towards tourism and hospitality higher education. This paper examines how universities of applied sciences in tourism and hospitality can respond strategically to this transition. Building on a synthesis of recent literature on Industry 5.0, digital transformation and tourism education, the paper first clarifies the defining characteristics and pillars of Industry 5.0 and their implications for human-AI collaboration, cyber-physical-social systems and worker well-being. It then analyses anticipated shifts in educational paradigms, highlighting the need to integrate artificial intelligence, data analytics, extended reality (VR/AR) and smart technologies into curricula, while simultaneously strengthening higher-order soft skills, ethical reasoning and sustainability awareness. A SWOT analysis of universities of applied sciences in tourism and hospitality identifies strong vocational orientation and close industry links as key strengths, but also limited research capacity, curriculum inertia and exposure to rapid skills obsolescence as critical weaknesses and threats. The paper proposes a set of strategic responses: embedding human-centric education, promoting lifelong learning and micro-credentials, leveraging emerging technologies responsibly, and developing agile, modular and industry-co-created curricula. It concludes that institutions which successfully align human-centric values with advanced technological capabilities will be best positioned to educate adaptable, ethically grounded graduates and to act as key drivers of innovation and sustainable development in the Industry 5.0 era of tourism and hospitality.

Key Words: Industry 5.0, tourism and hospitality higher education, universities of applied sciences, digital transformation, artificial intelligence, curriculum redesign, human-centric learning, lifelong learning, tourism SMEs.

1. INTRODUCTION

The advent of Industry 5.0, characterized by a human-centric approach that synergizes technological advancements with human creativity and well-being, presents both unprecedented opportunities and significant challenges for higher education institutions specializing in tourism and hospitality (George, 2024). This paradigm shift necessitates a re-evaluation of current educational frameworks to ensure graduates are equipped with the requisite skills and ethical considerations for a technologically advanced yet human-focused industry (George, 2024). This paper aims to explore the transformative potential of Industry 5.0 on tourism and hospitality higher education, identifying emerging dangers and conducting a comprehensive SWOT analysis to inform future strategic planning.

The ongoing digital transformation, accelerated by events such as the COVID-19 pandemic, underscores the urgency for academic institutions to adapt rapidly to new operational and marketing paradigms within the tourism sector (Velentza & Metaxas, 2023). This includes leveraging digital and physical convergence, as well as biological advancements, to enhance visitor experiences and operational efficiencies (George, 2024). Furthermore, the integration of cutting-edge technologies like artificial intelligence, big data analytics, and mobile applications is profoundly reshaping customer engagement and operational models within tourism, demanding a proactive curriculum overhaul (Bolesnikov, 1 C.E.).

2. THE FIFTH INDUSTRIAL REVOLUTION (INDUSTRY 5.0)

This revolution emphasizes a harmonious collaboration between humans and advanced technology, including AI as a "smart agent" to augment or even replace human functions, while also prioritizing sustainability through reduced energy consumption and waste (Hamdan et al., 2023). This necessitates a pedagogical shift towards fostering skills that enable students to effectively navigate and innovate within such integrated environments, preparing them for roles that demand both technological proficiency and a deep understanding of human interaction and ethical implications. Consequently, higher education institutions must address concerns about potential job displacement due to automation by implementing effective reskilling and upskilling programs to prepare the workforce for new roles emerging from this technological integration (George, 2024). This re-evaluation extends to understanding how technologies like AI can recognize user needs, thereby enabling tourism institutions to develop more personalized offerings and improve customer service (Skubis et al., 2024). The rapid evolution of artificial intelligence within the tourism and hospitality sector also necessitates frequent curriculum updates and robust faculty development to ensure educators are proficient in these emerging technologies (Aydın & Sirkeci, 2024). Therefore, educational programs must emphasize digital literacy, data analytics, and problem-solving skills to prepare students for a digitally-driven industry (George, 2024). Furthermore, a holistic approach is required to integrate ethical considerations and address challenges such as equitable digital access, alongside leveraging digital innovations for pedagogical strategies (Mandalia, 2023). This entails a critical examination of how educational institutions can leverage digital tools not only for remote learning but also for simulating real-world industry scenarios, fostering practical skills, and cultivating an adaptive mindset among future professionals (George, 2024). This includes developing curricula that emphasize higher-level soft skills, such as critical thinking, complex problem-solving, and continuous learning, which are essential for navigating constantly evolving socioeconomic and technological landscapes (Hsu, 2017). Moreover, the proliferation of digital technologies, such as artificial intelligence and big data analytics, in tourism operations demands a strategic focus on integrating these tools into academic programs to enhance both customer experience and operational efficiency within small and medium-sized enterprises (Bolesnikov & Gajić, 2025). This integration requires a comprehensive understanding of how these technologies can be applied to create hyper-personalized marketing strategies and data-driven customer segmentation, thereby reshaping how tourism SMEs attract and retain their clientele (Driving Digital Transformation: Challenges, Opportunities, and Marketing Impact for Serbian Tourism SMEs, n.d.).

3. DEFINING INDUSTRY 5.0

Industry 5.0, building upon the technological advancements of Industry 4.0, shifts the focus from mere automation and data exchange to a human-centric approach, emphasizing the collaborative interaction between humans and intelligent machines (Borchardt et al., 2022). This evolution integrates cognitive computing, artificial intelligence, and advanced robotics to augment human capabilities, fostering personalized and sustainable outcomes rather than solely optimizing production (Matušíková & ŠAFFOVÁ, 2024). This paradigm prioritizes the re-humanization of education and industry, moving beyond the automation focus of Industry 4.0 to achieve a symbiotic coexistence of humans and technology with shared purposes (Moola et al., 2024). This new industrial revolution also stresses the importance of sustainability, resilience, and human-centricity in technological development, urging a recalibration of educational objectives (Matušíková & ŠAFFOVÁ, 2024). Consequently, educational institutions must develop curricula that blend technological proficiency with humanistic principles, preparing graduates for roles that demand both advanced digital skills and a profound understanding of ethical and societal implications ("Fostering Digital Skills and Competencies in Higher Education," 2023). This involves fostering a mastery of both technical and soft skills, such as adaptability, data analytics, and effective communication, essential for navigating an increasingly complex technological landscape (George, 2024). Furthermore, Industry 5.0 emphasizes worker welfare, inclusivity, and empowerment, compelling educational programs to integrate these pillars into their pedagogical approaches (Dehbozorgi et al., 2024). This holistic perspective underscores the need for higher education to cultivate not just technical competence but also emotional intelligence, critical thinking, and social responsibility among its graduates (Borchardt et al., 2022) (Dredge, 2016).

4. KEY CHARACTERISTICS AND PILLARS OF INDUSTRY 5.0

The core tenets of Industry 5.0 revolve around enhancing human potential through technology, fostering resilient industrial systems, and promoting sustainable practices (Lewandowska et al., 2023). More specifically, key aspects include human-machine collaboration, cognitive AI, and cognitive cyber-physical systems designed to complement human qualities like creativity and critical thinking with the speed and precision of machines (Fitsilis et al., 2024). This shift signifies a transition from technology-centric automation to a human-in-the-loop paradigm where advanced robotics and AI serve to augment, rather than replace, human ingenuity and decision-making (Costa, 2024). This human-centric approach prioritizes values such as trust, security, openness, and inclusiveness in technological development, facilitating joint design of processes, systems, and work environments (Davim, 2024). This integration moves from purely Cyber-Physical Systems in Industry 4.0 to more expansive Cyber-Physical-Social Systems in Industry 5.0, where human interaction and societal impact are deeply embedded into technological frameworks (Mahiri et al., 2023). This evolution necessitates a re-evaluation of educational frameworks to prepare future professionals for a landscape where human ingenuity is synergistically combined with technological prowess (Kővári, 2024). This paradigm also demands that graduates possess interdisciplinary knowledge, including sustainable development, and the ability to manage product, process, and system complexity (Borchardt et al., 2022). This approach specifically highlights the significance of developing workers' skills, knowledge, and capabilities to facilitate collaboration among humans, robots, and other automated systems, thereby improving the adaptability of manufacturing processes while ensuring a safe production environment (Górny, 2023). The integration of Cognitive Artificial Intelligence, which merges AI with human-like cognition, further supports decision-making and reduces information overload, thereby enhancing product sustainability by enabling machines to learn and re-learn in a human-like manner (Fitsilis et al., 2024). This involves leveraging artificial intelligence to empower machines to learn from human operators and apply acquired knowledge effectively in task execution, thereby enhancing production efficiency and mitigating potential network overloads (Górny, 2023).

5. INDUSTRY 5.0 AND THE FUTURE OF HIGHER EDUCATION

The advent of Industry 5.0 necessitates a transformative shift in higher education, particularly within fields like tourism and hospitality management, moving beyond traditional curricula to foster a human-centric, resilient, and sustainable approach to learning (Verma, 2024). This paradigm shift demands the cultivation of interdisciplinary skills, emotional intelligence, and critical thinking alongside technological competencies to prepare graduates for complex, collaborative human-AI work environments (Priyadarshini et al., 2024). This reorientation emphasizes personalized learning experiences facilitated by AI-driven platforms and virtual collaboration tools, nurturing a workforce adept at integrating sustainable practices and understanding the broader societal implications of their actions (Ghobakhloo et al., 2024).

6. ANTICIPATED SHIFTS IN EDUCATIONAL PARADIGMS

A critical shift will involve curriculum adaptation to incorporate cutting-edge technologies like artificial intelligence, IoT, and robotics, alongside crucial human-centric skills (Bushuyev et al., 2024). This includes the development of both advanced technical skills and essential soft skills, enabling graduates to engage in effective human-robot collaboration and navigate complex cyber-physical-human production systems (Vukelić et al., 2024) (Hajime et al., 2025) (Yitmen & Almusaed, 2024). Furthermore, universities will need to integrate immersive learning environments, such as virtual and augmented reality, to simulate real-world scenarios in tourism and hospitality, allowing students to practice and refine their skills in a safe and controlled setting (Matušíková & ŠAFFOVÁ, 2024). This prepares them for real-world application, offering hands-on experience without the inherent risks or logistical challenges of live operational environments. Additionally, the curriculum must evolve to include modules on smart materials, bio-inspired technologies, and cyber-safe data transmission to address the holistic challenges of Industry 5.0 (Goggins et al., 2013). The rapid evolution of AI, particularly next-generation AI, will necessitate curricula that are continuously updated to reflect more intuitive and adaptive learning capabilities, closely aligning with human cognitive processes (Kővári, 2024). This ongoing adaptation will ensure that graduates are well-versed in both current and emerging AI applications, preparing them for an increasingly automated and interconnected professional landscape (George, 2024). Educational institutions must implement a multi-pronged approach encompassing curriculum integration, pedagogical innovation, infrastructure development, industry collaboration, and faculty development to achieve Industry 5.0 readiness (Bushuyev et al., 2024).

7. SKILLS AND COMPETENCIES FOR THE INDUSTRY 5.0 WORKFORCE

The emerging industrial landscape demands a workforce proficient in digital fluency, data analytics, and adaptability, alongside robust critical thinking and problem-solving capabilities (George, 2024). These competencies extend to include data ethics, sustainability, and trust in technology, which are crucial for navigating the complex

interplay of human and artificial intelligence in future work environments (Borchardt et al., 2022). Moreover, the curriculum must evolve to foster not only technical prowess but also cultivate transversal skills and invisible capabilities crucial for diverse work situations, emphasizing critical thinking, creativity, and effective communication (Octaviano et al., 2022). These skills will empower students to engage with emergent technologies while maintaining an ethical and human-centric perspective (Baltà-Salvador et al., 2025). Such preparation will ensure graduates are equipped to innovate responsibly within the tourism and hospitality sectors, leveraging advancements like virtual tourism to reduce mass tourism while understanding consumer satisfaction with virtual experiences (Matusíková & ŠAFFOVÁ, 2024). The transformation of the hospitality and tourism industry into an AI-dominated environment necessitates a re-evaluation of workforce preparation, focusing on innovative approaches to ensure future professionals are adept at leveraging AI while upholding human-centric values (Gidumal & Buhalis, 2025). This requires a concerted effort to reskill and upskill existing workers and to integrate new competencies such as data analysis, AI, and digital marketing into educational programs to mitigate job displacement risks (George, 2024). Furthermore, the strategic integration of digital transformation in education is pivotal for small and medium-sized enterprises in tourism to enhance customer experiences and operational efficiency (Bolesnikov, 2025).

8. IMPACT OF INDUSTRY 5.0 ON TOURISM AND HOSPITALITY HIGHER EDUCATION

The integration of Industry 5.0 principles will profoundly reshape the pedagogical approaches and operational frameworks of higher education institutions specializing in tourism and hospitality management, necessitating a comprehensive re-evaluation of current educational models (Bushuyev et al., 2024). This re-evaluation will focus on developing curricula that emphasize human-robot collaboration, sustainable practices, and ethical AI applications, moving beyond purely technical skills to foster a more holistic understanding of the industry's future trajectory. Universities of applied sciences will need to proactively address the challenges of integrating advanced technologies like artificial intelligence by developing comprehensive training programs to enhance AI awareness among students and faculty, alongside establishing suitable work environments that foster technological literacy (Çolak, 2023). This also involves overcoming barriers such as a lack of knowledge regarding technology utilization, insufficient trained personnel, and limited time for implementation, particularly within small and medium-sized enterprises (Velentza & Metaxas, 2023). A significant challenge for higher education in this context will be to adapt pedagogical strategies that address the varying levels of technological acceptance and perceived risk among students and educators, ensuring an inclusive transition to AI-driven learning environments (Budeanu et al., 2024). Moreover, educational institutions must develop comprehensive training programs to upskill and reskill tourism professionals in digital competencies such as data analytics, artificial intelligence, and social media marketing (George, 2024).

9. CURRICULUM REDESIGN AND PEDAGOGICAL INNOVATIONS

To effectively integrate these advancements, curricula must be critically re-evaluated to incorporate modules focusing on data science and analytics, addressing the growing importance of big data in the tourism industry and closing existing digital skills gaps (Sharma & Egger, 2025). This includes the development of curricula focusing on specialized large language models and generative AI applications for destination-specific tourism marketing (Gidumal & Buhalis, 2025). These programs will focus on equipping students with the capabilities to design, implement, and manage AI-powered marketing campaigns, leveraging personalized content and real-time analytics to enhance customer engagement (Driving Digital Transformation: Challenges, Opportunities, and Marketing Impact for Serbian Tourism SMEs, n.d.) (Velentza & Metaxas, 2023). Furthermore, integrating data science into tourism curricula is crucial for enabling students to analyze and interpret big data, thereby bridging the current skills gap among tourism graduates and professionals (Sharma & Egger, 2025). This emphasis on data-driven decision-making will empower future tourism professionals to develop innovative strategies for enhancing customer experiences and optimizing operational efficiencies (Driving Digital Transformation: Challenges, Opportunities, and Marketing Impact for Serbian Tourism SMEs, n.d.).

10. TECHNOLOGICAL INTEGRATION IN LEARNING ENVIRONMENTS

The integration of advanced technological infrastructure, such as AI-powered learning platforms and virtual reality simulations, will be crucial for creating immersive and interactive educational experiences that mirror real-world industry scenarios (Mogaji et al., 2024). These technologies can provide practical experience in managing complex tourism operations and customer interactions within a simulated environment (Gidumal & Buhalis, 2025). Furthermore, the development of targeted short courses and flexible online training programs will be essential to provide continuous professional development for industry practitioners, ensuring they remain competitive in a rapidly evolving technological landscape (Li et al., 2025). Such offerings are vital for addressing the digital competency gaps among both younger and older students, ensuring all learners are equipped with the necessary skills to adapt to new technological trends (Deniz & Bayram-Öz, 2025). This necessitates a shift towards digital learning environments, which proved valuable during the COVID-19 pandemic, alongside investments in digital technologies to meet the

evolving demands of the tourism sector (Mandalia, 2023). These digital environments also present opportunities for personalized learning pathways, catering to diverse learning styles and paces, and fostering a more engaging educational experience (Mandalia, 2023). Additionally, the use of virtual reality and augmented reality in training, particularly in areas like hospitality, offers immersive learning experiences that traditional methods cannot replicate (Gidumal & Buhalis, 2025). For instance, 360-degree virtual reality videos can significantly enhance cultural understanding and cross-cultural competence among tourism students by offering immersive virtual tours of global heritage sites and cultural experiences (Vaishnavi & Ajit, 2024). This immersive approach enables students to develop a deeper appreciation for diverse cultures and enhances their ability to cater to an international clientele, which is crucial for future tourism professionals (Wan et al., 2024). Furthermore, educational institutions must develop comprehensive strategies for integrating digital tools and platforms, including web and social media analytics, into their curricula to better understand and optimize online engagement and inform digital marketing strategies (Velentza & Metaxas, 2023).

11. INDUSTRY-ACADEMIA COLLABORATION IN THE INDUSTRY 5.0 ERA

Effective collaboration between academia and industry stakeholders will be paramount to ensure that educational programs remain aligned with the rapidly evolving demands of the tourism and hospitality sectors, fostering a symbiotic relationship that drives innovation and workforce readiness (Yıldırım et al., 2025). This collaboration should extend to co-developing curricula, facilitating internships, and conducting joint research projects to bridge the gap between theoretical knowledge and practical application, ensuring graduates possess both foundational understanding and hands-on experience (Wan et al., 2024). Such partnerships are critical for preparing graduates for the dynamic tourism landscape by fostering adaptability, continuous learning, and forward-thinking mindsets (Wan et al., 2024). These collaborations also enable the integration of real-world case studies and live projects into academic programs, providing students with invaluable exposure to industry challenges and innovative solutions (Wan et al., 2024). For instance, educational institutions can collaborate with industry partners to offer virtual tours and digital service platforms, allowing students to experience and analyze real-world digital marketing strategies and customer journeys before entering the workforce (Matušíková & ŠAFFOVÁ, 2024) (Velentza & Metaxas, 2023). This synergy helps in identifying emerging skill gaps and allows for the proactive development of specialized training modules, thereby ensuring that graduates are immediately employable and contribute effectively to the industry's digital transformation.

12. POTENTIAL DANGERS AND CHALLENGES

While the integration of advanced technologies and collaborative educational models presents numerous opportunities for the future of tourism and hospitality higher education, it also introduces several significant dangers and challenges that warrant careful consideration. These include concerns regarding technological fit, the availability of human resources, and the substantial costs associated with adopting new digital infrastructures (Suleman et al., 2024). Moreover, the rapid pace of technological change necessitates continuous curriculum updates and faculty retraining, posing a significant financial and logistical burden on academic institutions (George, 2024). The potential for a widening digital divide, where access to advanced technology and training is unevenly distributed, further threatens to exacerbate inequalities within the educational landscape. Additionally, the imperative for specialized human resources capable of managing data and modern technologies, coupled with the monetary cost and lack of knowledge in digital marketing, poses considerable obstacles to the widespread adoption of these innovations within the tourism sector (Velentza & Metaxas, 2023).

13. SWOT ANALYSIS OF UNIVERSITIES OF APPLIED SCIENCES IN TOURISM AND HOSPITALITY EDUCATION

Strengths

Universities of Applied Sciences possess inherent strengths, including a strong vocational focus and practical orientation, which facilitate the development of curricula directly relevant to industry needs (Vasconcelos et al., 2022). This practical emphasis often results in a higher proportion of knowledge transfer through internships and real-world projects, preparing students more effectively for immediate employment (Moura et al., 2024). The competency-based approach inherent in these institutions ensures graduates acquire specific skills highly valued by employers, aligning academic outcomes directly with industry demands (Adekuajo et al., 2023). Furthermore, their close ties with local and regional industries enable swift adaptation to emerging trends and the incorporation of cutting-edge technologies into their educational programs (Suleman et al., 2024).

Weaknesses

However, these institutions often face limitations in research funding and resources compared to traditional universities, potentially hindering their capacity for theoretical advancements and innovation (Samad, 2022). This can lead to a less robust research output, which might impact their global ranking and attractiveness to prospective faculty

and students interested in research-intensive careers. Additionally, the emphasis on practical skills may sometimes overshadow the development of critical thinking and analytical abilities, which are crucial for navigating complex, multifaceted industry challenges in the long term (Balula et al., 2019). Moreover, their curricula might lack the agility required to swiftly integrate emergent technologies, potentially leaving graduates unprepared for rapidly evolving digital landscapes (Balula et al., 2019).

Opportunities

The accelerated adoption of digital technologies, such as AI, VR, AR, and IoT, presents significant opportunities for these institutions to innovate their educational offerings and prepare students for the digitally transformed tourism and hospitality sectors (Dikhanbayeva, 2025). This digital transformation, driven by innovations like big data analytics and mobile applications, allows universities to enhance customer experiences and improve operational efficiencies in their educational delivery (Driving Digital Transformation: Challenges, Opportunities, and Marketing Impact for Serbian Tourism SMEs, n.d.). Moreover, the growing demand for specialized skills in areas like data analytics, cybersecurity, and sustainable tourism offers a fertile ground for developing niche programs and certifications, thereby increasing graduate employability (Matušiková & ŠAFFOVÁ, 2024). Furthermore, the shift towards online learning platforms, accelerated by recent global events, provides an opportunity for Higher Education Institutions to expand their reach, offer flexible learning pathways, and incorporate diverse pedagogical approaches, such as blended learning and gamification, to engage a wider student demographic (Sincharoenkul & Witthayasirikul, 2022).

Threats

The primary threats facing these institutions include intense competition from alternative educational providers and the rapid obsolescence of technical skills, necessitating continuous curriculum revision and faculty development (Lugosi & Jameson, 2017). Furthermore, economic downturns or global crises can severely impact student enrollment and institutional funding, thereby jeopardizing long-term sustainability (Lugosi & Jameson, 2017). The dynamic nature of industry demands and the increasing digitalization of business processes also present a constant threat, requiring educational institutions to rapidly adapt their curricula to remain relevant and competitive (Séraphin et al., 2022).

14. STRATEGIES FOR ADAPTATION AND RESILIENCE

Fostering Human-Centric Education

A core strategy for resilience involves integrating human-centric design principles into educational frameworks, emphasizing the development of adaptability, creativity, and ethical reasoning alongside technological competencies. This approach ensures that graduates are not only proficient in utilizing advanced tools but also possess the critical soft skills necessary to navigate the complex social and ethical dimensions of Industry 5.0 (Alshamsi et al., 2020). Such an educational philosophy aims to cultivate well-rounded professionals who can leverage technology for societal benefit while maintaining a focus on human well-being and sustainable practices (Costello et al., 2024).

Promoting Lifelong Learning and Upskilling

The volatile nature of the tourism and hospitality sectors, exacerbated by crises, underscores the importance of continuous learning and skill enhancement among professionals (Estiria et al., 2022). This necessitates the development of flexible, modular learning pathways and micro-credentials that enable rapid upskilling and reskilling to address evolving industry demands (Alshamsi et al., 2020). This includes embracing virtual reality with empathy training and gamification for sustainable tourism to instill human-centric values and ethical considerations, aligning with the core tenets of Industry 5.0 (George, 2024). To further facilitate this, universities of applied sciences must strategically integrate adaptable pedagogical models, encompassing hybrid education, to ensure comprehensive global access and flexibility in course offerings (Wan et al., 2024).

Leveraging Emerging Technologies Responsibly

Universities of applied sciences should strategically incorporate cutting-edge technologies like AI, IoT, and big data analytics into their curricula, not merely as tools, but as subjects for critical examination regarding their ethical implications and societal impact. This approach prepares students to be responsible innovators, capable of harnessing technological advancements while upholding human-centric values (George, 2024). Furthermore, process simulation techniques can be integrated to analyze and optimize future operational designs within tourism and hospitality, ensuring that technology serves efficiency goals without compromising the human element (Andrés et al., 2022).

Developing Agile and Responsive Educational Models

This entails creating flexible curricula that can quickly incorporate new industry trends and technological advancements, often through modular course structures and interdisciplinary programs. Such models foster a dynamic learning environment, enabling students to engage with real-world challenges through case studies and project-based learning, which are crucial for adapting to the rapidly evolving landscape of Industry 5.0.

15. CONCLUSION

The preceding discussions underscore the imperative for universities of applied sciences in tourism and hospitality to embrace proactive adaptation strategies to thrive amidst the transformative forces of Industry 5.0. This

involves a concerted effort to integrate human-centric approaches, foster lifelong learning, responsibly leverage emerging technologies, and cultivate agile educational models to ensure graduates are well-equipped for future challenges (Hajal, 2025). This comprehensive approach will not only prepare students for the complexities of an increasingly digitalized and automated world but also position these institutions as key drivers of innovation and sustainable development within the tourism and hospitality sectors (Wan et al., 2024). This strategic recalibration of higher education, particularly within the post-pandemic context, is critical for addressing the evolving expectations of Generation Z and Alpha students, who are increasingly digital-native and demand innovative, flexible learning environments (Eskinat & Tekler, 2024) (Wan et al., 2024). Moreover, a shift towards human-centric values in education is pivotal as the tourism industry prepares for Industry 5.0, demanding critical thinking and problem-solving skills to navigate technological advancements (George, 2024). The advent of Industry 5.0 also necessitates that tourism and hospitality educational programs focus on developing digital marketing competencies, given its increasingly vital role in business performance and customer engagement within the sector (Driving Digital Transformation: Challenges, Opportunities, and Marketing Impact for Serbian Tourism SMEs, n.d.) (Samad, 2022). This emphasis on digital proficiency extends beyond marketing to include broader digital literacy, data analytics, and the ability to effectively utilize technology to enhance guest experiences and optimize operations (George, 2024). Furthermore, the ongoing digitalization of the tourism industry requires that educational institutions continually update their curriculum to address evolving ethical considerations and ensure equitable digital access for all students (Mandalia, 2023). The imperative for a robust digital transformation within these educational frameworks is further reinforced by the documented impact of digital technologies on enhancing customer experiences, improving operational efficiency, and enabling sophisticated marketing strategies in the tourism sector (Driving Digital Transformation: Challenges, Opportunities, and Marketing Impact for Serbian Tourism SMEs, n.d.).

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