Exploring Virtual and Augmented Reality in Hospitality Education through the Lens of AI and Human-Computer Interaction: A Bibliometric Review

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ABSTRACT: Globally popular and Powered by AI, novel technologies Virtual Reality and Augmented Reality have made great progress recently, providing creative solutions in areas such as tourism and hospitality. This bibliometric research examines the academic environment connected to the use of Virtual and Augmented Reality, VR & AR respectively in the education and training in the tourism and hospitality industries. A search was conducted on the Scopus database for publications published from 2014 to 2024. The analysis seeks to detect trends, major research themes, renowned authors, influential journals, and regional distributions of research output. Citation analysis offers insights into the influence and dissemination of research in this field. This study examines how VR and AR technology have evolved to improve educational practices and training methods in the tourist and hospitality industries.The findings highlight the evolution of immersive technologies in education, pointing to increasing integration with Artificial Intelligence (AI), gamification, wearable technologies, and Human-Computer Interaction (HCI) frameworks. These advancements promise to enhance learner engagement through personalized and interactive training environments. Notably, future directions include the development of realistic simulations, haptic feedback for deeper immersion, and collaborative social VR environments. Although progress has been achieved, there are still gaps in the scientific field. One significant deficiency is the lack of emphasis on assessing the efficacy and enduring effects of VR and AR teaching initiatives in the tourist and hospitality sector. There is a need for interdisciplinary collaboration that includes insights from psychology, sociology, and HCI to better understand user behavior and learning outcomes in immersive settings.

The study analyzed 233 documents from 2014 to 2024, with a growth rate of 11.61% per year, an aggregate 9.908 per article citations, and 785 associated authors. Jung T and Scott C are among most influential authors are country in this domain was Spain, with 142 citations and an aggregate article citation of 47.3. The paper also highlighted the most significant information sources, such as the "Proceedings of the International Joint Conference on Computer Vision, Imaging and Computer Graphics Theory and Applications"[1], CEUR Workshop Proceedings, and "Communications in Computer and Information Science".

The outcome of this study provides valuable insights into the future growth and expansion of innovative technologies, particularly through the integration of computer vision and human-computer interaction (HCI), which in turn stimulate advancements in educational training.

Keywords: Virtual Reality; Augmented Reality; Tourism; Hospitality; Education.

I.   INTRODUCTION

Augmented Reality and Virtual Reality known as (AR) and (VR), AI integrated technologies have caused significant changes in the travel & hospitality industry [1]. These technologies provide immersive experiences for travelers to preview destinations, lodgings, and attractions before booking, improving their decision-making process and overall pleasure.

Moreover, VR and AR applications in tourism allow businesses to present their products in creative ways, such as virtual hotel tours or interactive maps of tourist spots [2]. Cognitive computing-based VR and AR are transforming training methods in the hotel industry by offering authentic simulations of guest encounters, emergency situations, and service protocols. Employees can participate in immersive training sessions that simulate real-world scenarios, enhancing their skills and confidence. The incorporation of VR and AR in tourism and hospitality is transforming the industry by improving client experiences, optimizing processes, and establishing higher service standards. Integrating VR and AR for tourism training education has a potential for transforming learning experiences through immersive, interactive, and engaging content [3]. Here are some progressions and advantages linked to

their integration: Enhanced Immersion: Virtual Reality enables students to enter virtual environments that can replicate real-world situations or abstract ideas. This absorption enhances comprehension and memory of the topic matter.

Interactive Learning: Augmented Reality superimposes digital content over the physical environment, generating interactive experiences.

The progress of technology, namely the inclusion and merging of AR and VR, has spurred substantial development in education. Immersive technologies provide innovative methods to involve learners, changing conventional educational encounters into interactive and dynamic adventures[13]. Virtual reality immerses students in simulated worlds, enabling them to visit historical locations, do virtual experiments, and navigate inside the human body, thus improving their comprehension through experience learning. Augmented reality superimposes digital content over the physical environment, enhancing classroom conversations and tasks with interactive features. Integrating VR and AR into education enhances students' understanding of complicated subjects, improves knowledge retention, and fosters essential skills like problem-solving, critical thinking, and cooperation.

Augmented Reality (AR) and Virtual Reality (VR) are altering [3] the tourism and hospitality sector by providing immersive experiences that captivate and appeal to travelers in distinct ways [22]. Here are some of the main applications of AR and VR in this industry: Virtual Reality Tours enable passengers to virtually explore destinations, hotels, and attractions prior to making a reservation [21]. This aids passengers in gaining a more comprehensive understanding of the location and facilities available, hence improving their decision-making process.

Intelligent algorithm-based AR and VR technology can provide immersive destination experiences by digitally transporting users to other locations, enabling them to perceive the sights, sounds, and even the scents of a place without being there physically [19]. This interactive experience aids in advertising destinations and enticing potential visitors[7].

Uplift the marketing campaigns: Tourism boards and hospitality organizations use AR and VR in marketing campaigns to provide interactive and unique experiences for potential guests. AR-enabled brochures or advertisements can offer further details about a destination when scanned with a smart phone. *VR is utilized for teaching hospitality employees* in several situations, including customer service, emergency protocols, and language proficiency. It offers a secure and supervised setting for staff to hone their abilities prior to engaging with customers in actual scenarios.

AR and VR technologies facilitate virtual participation in events and conferences, enabling attendees to engage with speakers, visit virtual exhibits, and connect with other participants globally. This broadens the scope of activities and minimizes the necessity for in-person travel.

AR apps enhance historical and cultural immersion by superimposing information, facts, and tales onto real-world surroundings, allowing users to gain a more profound appreciation of the cultural importance of sites and attractions. *Customized trip Experiences*: these technologies can be utilized to develop tailored trip plans according to individual tastes and interests. Businesses can improve customer happiness by providing personalized recommendations and experiences based on the analysis of user data and behavior. *VR can offer inclusive travel experiences* for persons with mobility difficulties or disabilities, enhancing accessibility. Virtual tours and experiences allow individuals to discover areas and sites that may be difficult to visit in person. *Hotel Room Previews*: Augmented Reality (AR) applications enable consumers to see virtual representations of hotel rooms and facilities superimposed over their real environment by using their smartphones or AR glasses. This assists tourists in making well-informed judgments regarding lodging choices that align with their interests and requirements.

Virtual Concierge Services: Hotels and resorts are utilizing AR and VR to provide customers personalized suggestions, room service orders [4] and local details via immersive interfaces.

II. LITERATURE REVIEW

Automated using AI Virtual reality (VR) technologies are extensively used for the tourism sector, giving consumers with unique and an engaging experience [5]. VR in tourism has the ability to improve the travel experience and involve travelers in novel ways. Yet, the utilization of virtual reality by elderly travelers remains rather minimal [6]. Senior tourists' resistance [7] and skepticism regarding VR in tourism are influenced by barriers such as perceived risk [16], perceived incompatibility, technology anxiety, inertia, and a lack of human [7] engagement. Although facing obstacles, VR has the capacity to enhance virtual tourism to unparalleled levels. Despite concerns about the technological aspects of VR, most respondents are curious and willing to try virtual tourism. Virtual reality immersion and seamless experience are closely linked to the quality of tourism experiences and visitors' behavioral goals [8]. VR technology enhances customer experience in the hospitality and tourist sectors by resolving client concerns and creating enjoyable experiences. Utilizing VR in tourism and hospitality has the potential to offer a novel and distinctive experience for users.

The study on Virtual Reality and Augmented Reality in the tourist and hospitality industry has progressed considerably in recent decades, in response to technical improvements and shifting consumer trends. VR and AR were first explored in tourism and hospitality in the 1990s, aligning with their introduction [9] in several sectors.

Initial applications were primarily designed to offer virtual tours of various places and hotel buildings, enabling users to explore locales from a distance [8].

Research during this period mainly concentrated on the technological feasibility and user experience aspects of VR and AR amalgamation in the tourism and hospitality sectors [10].

Discussions regarding the impact of Virtual Reality (VR) on tourism and hospitality management and marketing have been present in tourism literature over the past three decades, as evidenced by many studies (e.g., Cheong 1995; Dewailly 1999; Guttentag 2010; Huang et al. 2016; Williams & Hobson 1995).The phrase was coined in the mid-1970s by Myron Kruger to describe the theoretical relationship between human-computer interfaces (Williams & Hobson, 1995). Tourists can experience any physical location, including protected or dangerous places, using virtual reality, delivering a sensation of physical presence and immersion in an unreal environment (Loureiro et al., 2020).

Due to continuous advancements in this highly dynamic field, multiple definitions of virtual reality systems may be found in the literature by Fuchs et al. (2011), Guttentag (2010), and Burdea & Coiffet (2003).Virtual reality is a cutting-edge technology increasingly used in tourism and hospitality promotion to enhance travelers' experience [9] [11]. Furthermore, it has been implemented in several sectors such as business, education, historical preservation, archeology, museums, promotional marketing, and entertainment. Ware and Osborn (1990) conducted research on the assessment of three different metaphors for exploration and management of aerial cameras within virtual platforms. They utilized a six degree of freedom input device in their study titled "Exploration and Virtual Camera Control in Virtual Three Dimensional Environments". The research during this period mainly concentrated on the technological feasibility and user experience aspects of VR and AR applications in the tourist and hospitality sectors. During the 2000s, there were notable developments in VR and AR technologies, such as enhancements in hardware capabilities and the creation of more advanced software.

Researchers and business professionals have begun investigating more immersive

experiences, such as virtual simulations of travel and interactive augmented reality guides[21]. Technological advancements in the mid-2000s led to tremendous progress in object detection and tracking, which greatly improved augmented reality applications. Studying natural feature tracking and real-time picture processing enhanced the precision and resilience of augmented reality systems. During the late 2000s and early 2010s, there was a significant increase in mobile AR applications due to the widespread use of smart phones.

Dan Wang et al. [2012] in "The Role of Smartphone's in Mediating the Touristic Experience" Smart phones are advanced mobile devices that function as smart computers, providing a variety of information services that may be accessed from practically any location at any time[11]. As the number of Smart phone users grows and they become more integrated into people's lives, cell phones have an ability to highly impact the tourism adventure. Study investigates how smart phones mediate travelers' experiences by analyzing the stories they share about using smart phones and associated applications for travel. Cell phones can influence tourists' behavior and emotions by providing a range of information. Instant information support from cell phones helps tourists solve problems, share experiences, and save memories more efficiently.

Studies during this period started to explore the possible influence of VR and AR on consumers in more detail. Dingyu Ye et al. (2022) indicate that virtual tourism greatly enhances the desire to travel. Content quality, system quality, and interaction quality have a favorable impact on tourists' travel intention[12]through the mediations of tourism experience and virtual attachment. System quality also directly enhances travel intention [13]. Tourism experience has no impact on virtual attachment. The current research expands on previous studies on virtual tourism by using the Stimulus-Organism-Response (SOR) model as a general framework for studying field tourism experiences. It also shows how virtual tourism can effectively increase visitors' intention to go. The findings are valuable for aiding governments in formulating pertinent laws and services, and for enabling tourism corporations to comprehend virtual tourism as a means to boost tourist travel intentions, so supporting the revival of the tourism industry in the post-COVID-19 period.

Lucie Rohlíková et al.(2022) explores the utilization of virtual reality (VR) to strengthen the communication skills training of hotel personnel in the tourism sector in his paper" Innovating in the Tourism Industry Through Virtual Reality (VR) and Education in the Hotel Business [13]".

 A 3D training module was developed for simulating hotel reception scenarios. The communication skill development model was validated.

The training technique for enhancing communication skills of hotel staff through virtual reality tools was developed based on foreign research on the use of virtual reality in training programs. The tool is a pilot test designed to enhance the communication skills of tourist staff when interacting with clients. The study thoroughly describes a model of virtual greeting and methods for developing communication skills. The model was tested on tourism learners and experienced hotel staff.

Luis Alfaro [2023] in his study" 360° Virtual reality video tours generation model for hospitality, tourism and education using case-based reasoning" introduces a software framework for creating customized tours utilizing 360° immersive virtual reality (IVR) with a Case-Based Reasoning (CBR) element[14]. The model was created by capturing 360° videos and images of hotels in the Arequipa region, designing immersive application user interfaces, developing a visualization layer in Unity for VR goggles, and integrating an intelligent layer using a CBR engine and a Rest API.

Kairat Zhoya et al.[2024] Structural approach for developing geo ecological competency in tourism studentsThe structural and functional approach for developing geo ecological competences is demonstrated for its efficiency [15]. The professional competencies of the

academic topic "Geoecology and tourism" develop in three stages[19]. Enhancing geo ecological competency leads to an improvement in knowledge and abilities, resulting in a higher quality of training. The geo ecological competence model for tourism students enables [20].

Ongoing research in virtual reality (VR) and augmented reality (AR) in the hospitality and tourism sectors is advancing quickly[18], aiming to improve immersive experiences, customization, and the incorporation of new technology like artificial intelligence and wearable devices.

Future study should focus on exploring the enduring effects of VR and AR on destination competitiveness, sustainability, and stakeholder collaboration. It should also aim to tackle issues of data protection, accessibility, and technological infrastructure.

The research on VR and AR in tourism and hospitality shows a progression of scientific advancements, rising consumer approval, and a growing acknowledgment of the transformative capabilities of these technologies for the business

III. METHODOLOGY

Main consideration for the research analysis is to explore the advancement of AI facilitated novel revolutionary technologies in tourism and hospitality field for its training and education. This section outlines the increasing significance of virtual reality (VR) and augmented reality (AR) in education and training in the tourist and hospitality sector. It emphasizes the importance of performing a bibliometric study to comprehend the research environment and patterns in this field.

This study aims to provide a thorough bibliometric analysis of [18] literature produced from 2014 to 2024 about the improvement of Virtual Reality and Augmented Reality in the teaching and training of tourism and hospitality. Scopus database because of its comprehensive coverage of academic literature. In this research, search technique that includes terms like "virtual reality," or "augmented reality," "education," "training," "tourism," or "hospitality" in the title box to make sure the content is relevant to our topic. The analysis steps included collection of scopus dataset of articles published from 2013 to 2024 on 20th Feb 2024. Overall 269 articles that explore the application of virtual reality and augmented reality in educational and training in the tourist and hospitality domain were found. Out of 269 articles, 10 were review papers which are excluded, leaving 255, and 21 conference reviews were excluded, and finally 238 documents are left. There are four papers in Spanish and one in Chinese that were also excluded.

Total of 233 articles dig out and analyzed using R-studio. Using the extensive data from the Scopus research database, this bibliometric study seeks to uncover important contributors, emerging topics, and changing trends that illustrate the complex relationship between immersive technology and education. The study uncovers the flow and expansion of VR, AR in educational environments of tourism and hospitality domain.

IV. RESULTS

The bibliometric review revealed significant outcomes in enhancing AI-simulated reality applications within hospitality and tourism education and training. Emerging technologies such as virtual reality (VR) and augmented reality (AR), when integrated with artificial intelligence (AI) and human-computer interaction (HCI), are elevating education and training methodologies to unprecedented levels. This review underscores how novel, intelligent systems are reshaping instructional practices by enhancing immersion, interactivity, and engagement. The analysis provides a comprehensive overview of the evolving research landscape, highlighting the increasing role of VR and AR in enriching learning experiences, improving training outcomes, and driving innovation across the hospitality and tourism

sector. Furthermore, the study identifies global research trends, key contributors, and thematic clusters, while also addressing challenges and barriers to effective technological adoption. These insights reflect a growing academic and practical interest in leveraging AI and HCI to redefine the future of hospitality education and training.

The conclusions of the Scopus dataset studies are as follows.

A. DATA OVERVIEW

Table.1 shows the analysis covers a ten-year span from 2014 to 2024, utilizing 177 main sources such as journals, books, and scholarly publications. During this period, 233 documents have been carefully examined, providing a significant amount of study on improving immersive technology for educational and training purposes in the tourist and hospitality industries. The annual growth rate is a remarkable 11.61%, highlighting the steady increase in scholarly output over time.

A. Table 1. DATA OVERVIEW

Description	Outcome
Information of the Data set	
Decade	2014-2024
Key sources including Journals, Books, etc	177
Total Documents	100
Yearly Growth Rate %	11.61%
Article Mean Age	3.18
The average number of citations per document	9.906
References	8009
Document Content	
Most Influential keyword	1479
Writers Keywords (DE)	714
Writers data	
Authors	785
Number of documents authored by a single author	20
Number of co-authors per document	3.59
Percentage of international co-authorships	17.17%
Diversification of documents	
Included articles	86
books	4
book chapters	24
conference paper	115
editorial	3
note	1

The average age of papers is 3.18 years, showing a preference for recent publications and indicating academics' interest in researching the latest breakthroughs in the subject. The research has an average of 9.906 citations per document, indicating substantial reputation and influence in the scholarly world, demonstrating its relevance and impact. An in-depth study of 8009 references in all publications underscores the extensive and profound interaction with

current literature, showcasing the broad scope of the analysis and the strong basis for future research in this field.

B. *Yearly Scientific Production Output*

The statistics mentioned in the Yearly scientific output in Table II showcase the figures in the tourism and hospitality domain utilizing hi-tech methods in providing its educational training. Dataset explores total number of articles published per year. Data examined is taken from year 2013 to 2024. Fig.1 data indicates a consistent upward trend in annual scientific production from 2014 to 2023. There are distinct phases of substantial growth in scientific output, especially starting from 2018. The number of articles increased by almost 100% from 2018 to 2020 and continued to rise in the following years.
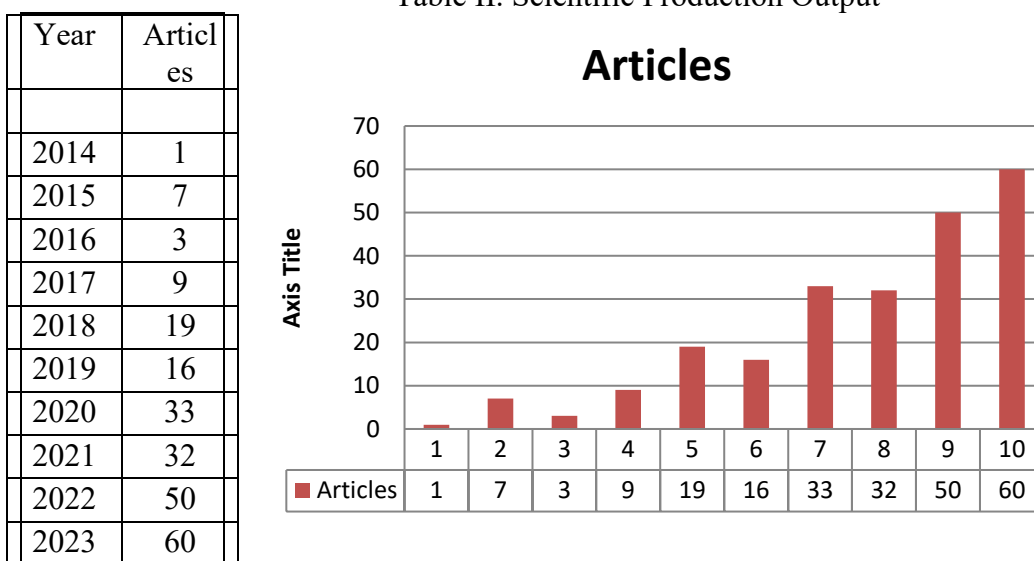
Table II. Scientific Production Output

Year	Articles
2014	1
2015	7
2016	3
2017	9
2018	19
2019	16
2020	33
2021	32
2022	50
2023	60

Articles

	1	2	3	4	5	6	7	8	9	10
Articles	1	7	3	9	19	16	33	32	50	60

Fig. 1. Yearly Scientific Production

The most rapid growth took place from 2020 to 2023, with a notable increase in the annual number of published papers. During this time, there was a notable increase in research efforts and enthusiasm for utilizing augmented or virtual reality in educational and training aspects of the tourist and hospitality industry. Despite oscillations in article numbers from 2014 to 2017, there has been a continuous rise in scientific production, demonstrating an increasing interest and acknowledgment of the significance of VR and AR in this field. The years 2022 and 2023 are highlighted as peak years for scientific productivity, with 50 and 60 publications produced in each year, respectively. These years probably indicate times of concentrated research efforts and important advancements in the subject. The rising research output indicates a growing emphasis on utilizing VR and AR technology to improve education and training in the tourist and hospitality sector. The statement acknowledges the potential advantages of these technologies in better learning outcomes, improving user experiences, and fostering innovation in the industry.

C. *Top Authors with Maximum No. Of Publications*

Table III Analyzing the data to identify the most relevant authors based on characteristics such as the number of papers authored and fractionalized authorship. Authors with a greater number of articles may be seen more significant because of their prolific work in the subject.

Table III. *Top Authors with Maximum Publications*

Authors	Articles	Articles Fractionalized	Authors	Articles	Articles Fractionalized
JUNG T	4	1.6	ITO T	3	0.428571429
BALDIRIS S	3	0.833333333	KLEFTODIMOS A	3	0.658333333
EVAGELOU A	3	0.658333333	SCHOTT C	3	2
FLOTYŃSKI J	3	1.833333333	TOSIDA ET	3	0.583333333
GARZOTTO F	3	1.033333333	ACEVEDO J	2	0.5
HASSAN A	3	1.5	ALFARO L	2	0.833333333

JUNG T has written the most articles out of all the listed authors, with a total of 4. SCHOTT C has the highest fractionalized score of 2, showing a considerable contribution to the articles despite being the author of 3. FLOTYŃSKI J has the highest overall fractionalized authorship value of 1.833. Even if the number of articles authored is equal to others at 3, the fractionalized figure indicates a significant contribution to these pieces.
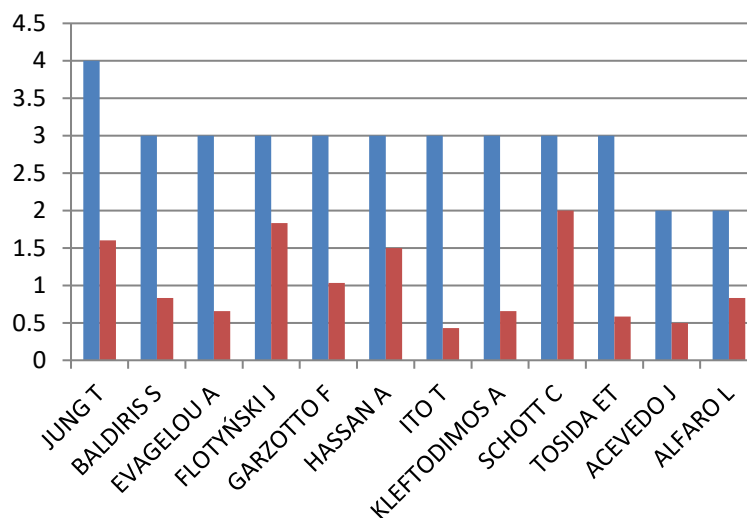

Fig. 2.. *Top Authors with Maximum No. of Publications*

Fig.2, highlights that authors such as JUNG T, SCHOTT C, and FLOTYŃSKI J are considered highly relevant in the subject due to their significant contributions. Relevance can be subjective and vary based on individual research interests and evaluation criteria. Additional study considering characteristics like citation counts and the influence of their work in the field could offer a more thorough evaluation of author relevance.

D.   Mean Yearly Citations

Table IV highlights data for mean yearly citations per article and yearly mean total citation. Also it shows the number of articles per year. The Mean Total Citations per Article (MeanTCperArt) is the aggregate citations received by publications published in a specific

year.

Table IV. Annual Citations per Year

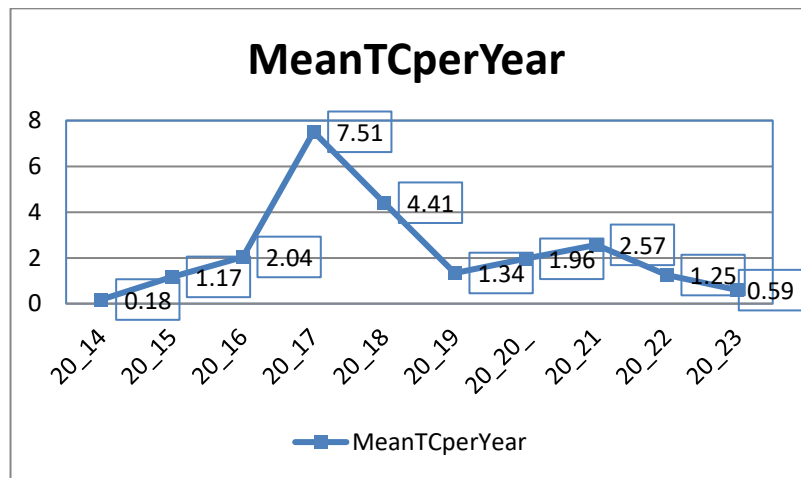| Year	MeanTCperArt	N	MeanTCperYear
2014	2	1	0.18
2015	11.71	7	1.17
2016	18.33	3	2.04
2017	60.11	9	7.51
2018	30.89	19	4.41
2019	8.06	16	1.34
2020	9.82	33	1.96
2021	10.28	32	2.57
2022	3.76	50	1.25
2023	1.18	60	0.59

Fig. 3. Mean Total Citation per Year

It indicates the comprehensive influence and acknowledgment of research in the topic. The Mean Total Citations per Year (MeanTCperYear) is the aggregate citations received yearly, calculated by evaluating the total citations for all publications published in a specific year. It indicates the sustained significance and impact of research as time progresses. Fig.2 presents the variation in citation with mean values ranging from 0.18 to 7.51. The average total number of citations per article varies over the years, with significant peaks in 2017 (60.11) and 2016 (18.33), suggesting these years were particularly influential in terms of citation counts per item. Mean total citations per year show fluctuations, peaking in 2017 (7.51) and 2018 (4.41), indicating years of increased citation activity in all publications. The decline in citable years over time indicates the decreasing effect and relevance of articles as they age.

The examination of yearly citations offers useful insights into the reception and continuous influence of research in the VR and AR field within the education and training sectors of tourism and hospitality. It highlights the value of analyzing citation patterns over time to assess the enduring importance and relevance of academic contributions in this field.

E. Main Affiliations

Table V displays the countries with highest number of articles. Examining the connections of publications concerning the improvement of virtual reality (VR) and augmented reality (AR) in the education and training of tourism and hospitality offers valuable information about the institutions leading research in this area. The University of Western Macedonia stands out as a significant contributor, with 13 articles authored by its researchers. The institution's significant production highlights its dedication to promoting knowledge and innovation in VR, AR, and their utilization in the tourist and hospitality industry.

Table V. Countries with Highest Citation

Affiliation	Articles
University Of Western Macedonia	13
University Of Miyazaki	11
Aristotle University Of Thessaloniki	9
Nanchang Hangkong University	9

University Of Central Florida	7
Cnr Ispc	6
Department Of Electronics	6
Information Technologies Institute	6
Shanghai University	6
Sri Ramakrishna Engineering College	6

The University of Miyazaki and Aristotle University of Thessaloniki have each contributed 11 and 9 articles, respectively, showcasing their active role in shaping research and scholarship in this field. Nanchang Hangkong University has 9 papers, and the University of Central Florida has 7 articles focusing on the convergence of VR, AR, and education in the tourism and hospitality sector. Additional significant affiliations consist of CNR ISPC, Shanghai University, and Sri Ramakrishna Engineering College, each presenting 6 articles. These institutions from around the world are actively involved in promoting research and innovation in VR and AR technologies for educational applications in the tourism and hospitality industry. Partnerships between these universities promote interdisciplinary communication and further the knowledge and application of VR and AR solutions in educational environments globally.

V. FUTURE PROSPECTS

The possibilities that advanced AI alongside HCI will usher in learning assistive systems capable of emotion recognition and AI will provide effective, real-time Physiological feedback in behavioral analytics will further the learning outcomes. Automatic content delivery and engagement guidance will actively enhance the virtual education environment. Structural enhancements of HCI like gesture control, interaction, and eye-tracking will facilitate attainment and increase the simplicity of immersive experiences. For user behavior research in virtual environment constructed per psychology, sociology, education interdisciplinary cooperation will be crucial as dealing with in missing psychological features ignition. Also, defendable design and caregiving frameworks that capture the long-term result and outcome-based research serve as boundaries ensuring scalability in hospitality for these technologies will serve to caregiver's responsive support hospitality training needs.

VI. CONCLUSION

This bibliometric review underscores the growing academic and practical interest in the integration of Virtual Reality (VR) and Augmented Reality (AR) within tourism and hospitality education and training. The findings highlight not only the transformative potential of these immersive technologies in enhancing learning experiences and overcoming geographical barriers but also the critical role of Artificial Intelligence (AI) and Human-Computer Interaction (HCI) in driving this evolution. The interdisciplinary nature of current research emphasizes the need for collaborative efforts across technology, education, and industry sectors. Moving forward, future studies should focus on evaluating the effectiveness of immersive and intelligent systems in diverse educational settings, improving accessibility, promoting inclusivity, and addressing emerging ethical considerations. This review provides valuable guidance for researchers, educators, and practitioners seeking to leverage the synergy of AI, HCI, and simulated reality to innovate and elevate tourism and hospitality education in an increasingly digital world.

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