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Virtual Tour Research Trends in Education: A Systematic Literature Review and Bibliometric Analysis Using Bibliometrix R and Biblioshiny

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ABSTRACT

This study systematically examines the landscape of virtual tour research in education from 2020 to 2026 using a combined approach of systematic literature review and bibliometric analysis with Bibliometrix R and Biblioshiny. The research aims to identify publication trends, conceptual and thematic structures, intellectual patterns, and research gaps. Data were collected from Scopus-indexed journal articles, filtered using inclusion and exclusion criteria, and analyzed through co-citation, co-occurrence, and thematic mapping. Results indicate rapid growth in publication volume, from 22 articles in 2020 to 135 in 2025, with interdisciplinary contributions spanning tourism, cultural heritage, urban studies, and educational technology. Intellectual and conceptual structures remain fragmented, with dominant themes on tourism, heritage, and facility-oriented training, whereas pedagogical strategies, assessment, and learning transfer are underexplored. Keyword co-occurrence reveals a reliance on virtual reality frameworks while emerging themes include responsible AI, digital twins, and ethics, suggesting a shift toward socially and ethically informed research directions. Findings highlight that virtual tours have transitioned from niche technological tools to integral pedagogical instruments, yet pedagogical applications require further consolidation. The study contributes to the field by mapping research evolution, identifying knowledge gaps, and guiding future research agendas toward systematic, pedagogically beneficial applications in education.

Keywords*: *virtual tour, education, bibliometric analysis, systematic literature review, immersive learning

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INTRODUCTION

Digital transformation has already changed the world across various sectors, including education (Yang & Kaiser, 2022). Embracing the 4.0 education era places meaningful learning experiences integrated with technology as the foundation of contemporary learning (Marougkas et al., 2023a). Immersive technology has become the main focus and attention Crogman et al., (2025) state that the educational systems can be transformed through the pedagogically grounded integration of immersive technologies if technology is integrated into its implementation process. Various benefits of using technology include the ability to expand knowledge representation (Fussell & Truong, 2021), enhance student interactivity, and support contextual learning (Rojas-Sánchez et al., 2023). This is important in making the delivery more interactive and more effective, as it can provide meaningful engagement in classroom activities. This development is reflected in the increasing attention of academic practitioners to enrich students' learning experiences, one of which is through the use of virtual tours in education.

This enables more interactive, contextual, and cognitively engaging learning experiences, as it can provide meaningful engagement in classroom activities. This development is reflected in the increasing attention of academic practitioners to enrich students' learning experiences, one of which is through the use of virtual tours in education (Mallek et al., 2024). In education, virtual tours have evolved beyond merely replacing physical visits; they serve as pedagogical tools that provide direct access to locations, facilities, and the introduction of objects and artifacts that are difficult to reach Various studies show the benefits of using virtual tours, such as providing concrete learning experiences that enable users to explore an object

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(Corrales et al., 2024a; Sakr & Abdullah, 2024). Through virtual tours have strategic value for cross-context educational experiences and should continue to be used in the field of education.

The pedagogical potential of virtual tours offers a practical learning experience (Makransky & Mayer, 2022). This is supported by studies that found that learning using virtual tours can enhance an exploratory and flexible learning experience. Various studies have shown positive improvements after using virtual tours, including increased student motivation, enhanced learning experiences, and good visual understanding even without direct visits. Masruroh et al (2024) state that the development of virtual tours in education can be applied across various interdisciplinary learning fields. Virtual tours can be applied in various fields such as STEM (Wolf et al., 2023), science and ecology (Gestiada et al., 2025), geography and environmental studies (Masruroh et al., 2024b), history and cultural heritage (Corrales et al., 2024a; Hulusic et al., 2023). Virtual tours can also be used as flexible learning tools across various educational levels and fields (Nemtinov et al., 2023).

Previous studies have provided an important foundation for the development of immersive technology in education, but most still place virtual tours within broader categories, such as virtual reality, augmented reality, 360° video, or virtual field trips. Hamilton et al., (2020) broadly mapped VR in education, while Tan et al., (2022) focused on VR and AR in education thru Web of Science data. Radianti et al., (2020) also mapped VR research trends in education, but did not isolate virtual tours as a pedagogical object with its own characteristics. Meanwhile, Evens et al., (2022) reviewed 360° video as a learning medium, while Cardona et al., (2023) reviewed virtual tours in educational facilities, such as laboratories, campuses, and industrial sites. These limitations indicate that previous studies have not specifically mapped virtual tours in education as a standalone research field, particularly in relation to intellectual structure, conceptual structure, dominant themes, core publication sources, and pedagogical gaps.

A new bibliometric review is necessary because the growth of virtual tours in education not only shows an increase in the number of publications but also reveals the spread of themes across fields, such as tourism, cultural heritage, urban studies, learning technology, and facility-based training. This condition can obscure the position of virtual tours as pedagogical instruments if not systematically mapped. This article fills that gap by combining a systematic literature review and bibliometric analysis based on Bibliometrix R and Biblioshiny to map the development of virtual tour research in education during the period 2020–2026. The main contribution of this article lies in the specific mapping of virtual tours as educational objects, the identification of their intellectual and thematic structures, and the formulation of a research agenda that focuses more on learning strategies, assessment, knowledge transfer, retention, and pedagogical integration.

Nevertheless, the development of virtual tour studies in education still appears unclear and widespread. Bibliometric mapping of virtual tours in education as a whole has not been extensively explored, although Makransky and Mayer (2022) have conducted a narrower review of virtual tours for specific educational purposes, particularly those related to facilities. Therefore, there is still no map that specifically examines the trends in virtual tour research in education as a whole, which includes the intellectual structure, conceptual and thematic structure, application areas, and research gaps (Zhao et al., 2023). Therefore, the approach of a systematic literature review complemented by bibliometric analysis becomes relevant to produce a more transparent picture of the research landscape.

Previous reviews of immersive learning have largely examined virtual reality, augmented reality, 360-degree videos, or virtual field trips as broad categories of technology. Although these studies provide important insights into immersive learning environments, they do not sufficiently isolate virtual tours as distinct pedagogical objects characterized by navigable spatial representations, learner-controlled exploration, and contextual mediation. These limitations create conceptual ambiguity because virtual tours are often treated as a subcategory of VR rather than as a learning environment with specific instructional advantages. Therefore, a new bibliometric review is needed to clarify how virtual tour research in education has developed, which intellectual traditions have shaped this field, what themes dominate the literature, and which pedagogical issues remain underexplored. This study contributes by mapping the landscape of

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publications, core journals, conceptual structure, thematic evolution, authorship patterns, and research gaps emerging from virtual tour studies in education from 2020 to March 2026. Unlike previous reviews that focused on immersive technology in general, this article positions virtual tours as an independent pedagogical domain and identifies future directions related to instructional design, assessment, learning transfer, retention, accessibility, and ethical implementation.

Based on that argument, the aim of this study is to analyze and map the development of virtual tour literature in education through a systematic literature review (SLR) approach supported by bibliometric analysis using Bibliometrix R and Biblioshiny. This study focuses on identifying publication trends, intellectual structure, conceptual and thematic structure of application areas, as well as research gaps that shape the direction of virtual tour research development in the field of education. This method adopts a transparent SLR and science mapping, allowing for a more systematic knowledge analysis. The following research questions frame this systematic literature review:

RQ1: how is the landscape of Virtual Tour research publications in Education?
RQ2: how is the conceptual, intellectual, and thematic structure of the field of virtual tour research in education mapped through bibliometrics?
RQ3: In Education, what is the most dominant study theme in virtual tour research?
RQ4: What gaps and development directions have future prospects in the field of education?

LITERATURE REVIEW

Virtual Tour as a Learning Media

Virtual Tour is a part of Virtual Reality, which allows someone to access spaces, objects, or spatial contexts without physical presence (Kuna et al., 2023; Marougkas et al., 2023a). According to Cardona et al., (2023) virtual tours present spatial panoramas that users can explore. In the context of learning, a virtual tour provides a learning experience that involves navigation and selecting viewpoints. Garcia et al., (2023) found that virtual tours can enhance the understanding of contextual exploration. This makes virtual tours relevant as a medium of digital representation with meaningful learning experiences. Virtual Tours can even be used for some difficult learning subjects such as mathematics, history, and culture, which have geographical, cost, time, or certain risk limitations (Valencia-Arias et al., 2025).

In the educational literature, virtual tours are viewed as instruments that expand access (Hulusic et al., 2023). Furthermore, Rosendahl and Wagner (2023) found that the use of virtual tours can enhance visualization and increase learning engagement. The virtual tour environment that produces a 360-degree panorama enables students to interact with spatial representations more realistically (Rosendahl & Wagner, 2023). Garcia et al., (2023) study shows that virtual tours support observation-based learning, enhancing spatial orientation and independent exploration. virtual tour has a primary value that can present three abilities, namely ability, immersion, interactivity, and contextuality (Choi et al., 2018). This aspect is important because technology not only serves as a provider of effective learning experiences but also offers cognitive and affective facilities for students toward learning objects.

In this study, virtual tours are viewed as a learning medium that operates through three main mechanisms: representational realism, exploratory agency, and contextual mediation. Representational realism, according to Gestiada et al., (2025) s the media's ability to present objects or locations visually close to real conditions. According to McGivney, (2025) exploratory agency is the user's freedom to navigate and build an active learning experience. According to Fink et al., (2023) contextual mediation is the ability of the media to connect the subject matter with real-world contexts to make it more concrete. This framework makes virtual tours different from other digital media and explains why this field is rapidly developing in education. This supports the rapidly changing educational landscape by adopting visual and remote technology-based learning (Sakr & Abdullah, 2024).

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Theoretical Foundations of Virtual Tour-Based Learning

Virtual tour-based learning can be theoretically grounded in constructivism, situated learning theory, experiential learning, and the cognitive theory of multimedia learning (Marougkas et al., 2023b). From a constructivist perspective, learners actively construct meaning through interaction with digital environments, objects, and spatial representations rather than passively receiving information. This makes virtual tours relevant for inquiry-based and exploratory learning because learners can observe, navigate, compare, and interpret learning objects within a contextualized environment (Smith-Glaviana, 2023).

Situated learning theory further explains the pedagogical value of virtual tours by emphasizing that learning is shaped by authentic contexts and meaningful participation. leBrasseur, (2023)Virtual tours can simulate access to museums, heritage sites, laboratories, ecosystems, industrial facilities, and geographical locations that may be difficult to access physically. Through this mechanism, virtual tours help bridge the gap between abstract classroom concepts and situated real-world contexts. Lave and Wenger's situated learning framework emphasizes legitimate participation in sociocultural practices, which supports the use of contextual digital environments in learning design. Experiential learning also provides a strong foundation for virtual tour pedagogy (Corrales et al., 2024b). In this perspective, learning occurs through the transformation of experience into knowledge. Virtual tours support this process by allowing learners to engage in concrete observation, reflective interpretation, conceptual understanding, and further exploration. This is particularly relevant for field-based learning, environmental education, cultural heritage education, and professional training where direct experience is central to knowledge construction. Kolb's experiential learning theory remains a foundational reference for explaining how experience functions as a source of learning and development (Liritzis et al., 2021).

The cognitive theory of multimedia learning strengthens the explanation of how virtual tours may support learning outcomes (Mayer, 2024). Virtual tours integrate visual, spatial, textual, auditory, and interactive elements, which can facilitate learning when designed according to cognitive principles. However, poorly structured virtual tours may also create cognitive overload if navigation, visual complexity, and learning tasks are not pedagogically aligned. Mayer's multimedia learning framework emphasizes evidence-based design principles for learning with words and graphics, making it relevant for evaluating how virtual tour environments should be designed instructionally. Together, these theories suggest that virtual tours should not be treated merely as technological innovations. Their educational value depends on how spatial immersion, learner agency, contextual authenticity, and multimedia design are integrated into coherent instructional strategies.

METHOD

This study uses a Systematic Literature Review to analyze the factors influencing the implementation of Virtual Tours. SLR was chosen because it provides a transparent and structured approach to synthesizing previous research (Putra et al., 2026). Additionally, SLR reflects the entire scope of available literature and avoids bias. This is because SLR applies in-depth inclusion and exclusion criteria. Bibliometrics is used to identify patterns of scientific production, intellectual structure, conceptual structure, and thematic evolution in the field of research (Jing et al., 2023). The combination of the two is increasingly commonly used in literature-based studies because it can identify and integrate procedural rigor with metadata-based mapping of science.

Scopus was selected as the sole bibliographic database because it provides broad multidisciplinary coverage across education, social sciences, computer science, engineering, arts and humanities, environmental studies, and technology-related fields. This coverage is relevant because virtual tour research is not confined to education journals but is distributed across interdisciplinary domains such as tourism, cultural heritage, urban studies, geography, and educational technology. Scopus is also a curated abstract and citation database with content selection procedures and independent subject review, which supports the reliability of bibliometric metadata used in science mapping (Cheng et al., 2023). Then, Biblioshiny is used to extract

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bibliometric variables such as authors, publication year, place, sources, keyword occurrences, and citation metrics.

Biblioshiny is a bibliometric analysis application developed by Aria and Cuccurullo (2017) using the R programming language. The study by Roelofsen and Carter-White (2022) states that collaboration analysis is useful because it tracks co-authorship trends in various countries, providing insights into research networks and the global distribution of knowledge. This enables co-citation analysis, co-occurrence mapping, and thematic visualization. This study focuses on scientific publications that discuss virtual tours in education. The documents included are limited to journal articles indexed in Scopus, while documents such as editorial notes, erratum books, book chapters, and conference papers are excluded to prevent the synthesis results from being distorted by heterogeneous documents. This is done to maintain academic quality. In this study, no formal bias risk assessment was conducted because the study focuses on bibliometric synthesis rather than critical appraisal. Because all variables were obtained from indexed metadata and processed using biblioshiny, there are no assumptions regarding missing data.

Source of Information and Search Strategy.

The Scopus database was chosen due to its wide coverage and extensive data set. The search was conducted using keywords relevant to the study theme found in the article title, abstract, and keywords. The selected articles are publications from the years 2020 to 2026, studies in English, and explicitly discuss the use of virtual tours in education. Biblioshiny is used to remove irrelevant or duplicate studies.

The first step is to identify keywords relevant to the study theme from previous research. Theoretical frameworks such as media learning theory and immersive technology are used to build a reference map regarding the use of virtual tours in education. The search was conducted using structured Boolean Combinations combined with CSGs. The search strategy targeted the core term “virtual tour” and related terminological variants commonly used in immersive and field-based learning studies, including “virtual field trip,” “360 virtual tour,” “360-degree virtual tour,” “immersive virtual tour,” and “interactive virtual tour.” These terms were combined using Boolean operators to broaden the retrieval scope while maintaining a controlled corpus within the Scopus Social Sciences subject area, English-language publications, and the 2020–2026 publication period. The selected data is 2020 as the analysis boundary in the phase of virtual tour development in education, while the end boundary is March 2026 as the cut-off date for data collection. The complete search string and Boolean operators used in this study are presented in Table 1.

Table 1. Keyword combinations and Boolean operators used in the literature search

Combination group selection (CSG)	String combinations and Boolean operators
Group 1	TITLE-ABS-KEY ("virtual tour" OR "virtual field trip" OR "360 virtual tour" OR "360-degree virtual tour" OR "immersive virtual tour” OR "interactive virtual tour”)) AND PUBYEAR > 2019 AND PUBYEAR < 2027 AND (LIMIT-TO (SUBJAREA, "SOCI") AND (LIMIT-TO (LANGUAGE, "English")

The expanded terminology was used to clarify the retrieval scope and align the search strategy with the terminology commonly used in the literature, while the final corpus remained based on the screened Scopus records that met all predefined eligibility criteria. To improve transparency, reproducibility, and screening consistency, the eligibility criteria were defined before the screening process. The inclusion criteria were used to ensure that all selected records were directly relevant to virtual tour research in educational, pedagogical, or learning contexts. The exclusion criteria were applied to remove records outside the conceptual scope, publication type, language boundary, database coverage, and metadata quality required for bibliometric analysis. The complete inclusion and exclusion criteria are presented in Table 2.

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Table 2. Inclusion and exclusion criteria used for corpus selection

Criteria type	Inclusion criteria	Exclusion criteria
Database	Records indexed in Scopus	Records from non-Scopus databases
Publication period	Publications from 2020 to March 2026	Publications before 2020 or after the cut-off date
Document type	Journal articles	Conference papers, book chapters, editorials, notes, errata, reviews, and books
Language	English-language publications	Non-English publications
Topical relevance	Studies explicitly addressing virtual tours, virtual field trips, 360-degree virtual tours, immersive virtual tours, or interactive virtual tours in educational, pedagogical, or learning contexts	Studies discussing virtual environments without educational relevance or without a clear virtual tour component
Metadata quality	Records with complete bibliographic metadata, including title, abstract, keywords, source, author information, and publication year	Records with incomplete, duplicated, or non-exportable bibliographic metadata

These criteria were applied during title, abstract, keyword, and metadata screening. Open-access status was not used as an exclusion criterion because this study relied on bibliographic metadata exported from Scopus rather than full-text availability.

RESULTS AND DISCUSSION

Data Selection

The selection process was conducted using the Scopus database with a revised Boolean search string applied to the title, abstract, and keyword fields. The search combined the core term “virtual tour” with related terms, including “virtual field trip,” “360 virtual tour,” “360-degree virtual tour,” “immersive virtual tour,” and “interactive virtual tour.” The search was limited to publications from 2020 to 2026, English-language documents, and the Social Sciences subject area. The initial search identified 6,738 documents. Limited to publications from 2020 to 2026, documents in English, and the subject area of social sciences. The Social Sciences subject area was retained because education-related publications in Scopus are commonly indexed within this category, while the subsequent screening process ensured that the final corpus remained focused on educational and learning contexts.. The initial search identified 6,738 documents. Then at the identification stage, 1,981 non-article documents were removed, resulting in 4,757 articles for screening.

The screening stage excluded 3,174 articles outside the social science subject area. This process left 1,583 articles selected. From that number, there are 3 non-English articles that were not included, resulting in 1580 articles that were assessed for eligibility. At the eligibility stage, 1,027 records were excluded because they did not explicitly address virtual tours in educational or learning contexts, contained incomplete or non-exportable metadata, or fell outside the predefined conceptual scope of the study. No records were excluded solely on the basis of open-access status because the analysis was conducted using bibliographic metadata rather than full-text availability. In the end, only 553 articles were included in the final review. The complete selection process is presented in the PRISMA 2020 flow diagram in figure 1.

The final corpus consists exclusively of journal articles (n=553), with no review articles identified in the dataset. Based on the processing conducted on Biblioshiny, the dataset shows a publication growth rate of 20.69 per year. This indicates that scientific attention toward virtual tour studies has significantly increased during the research period. In addition, the dataset recorded an average of 3.66 citations per document, 83 single-author documents, 3.99 co-authors per document, and 3.84 authors per document, indicating that virtual tour studies are increasingly developing. See Table 2.

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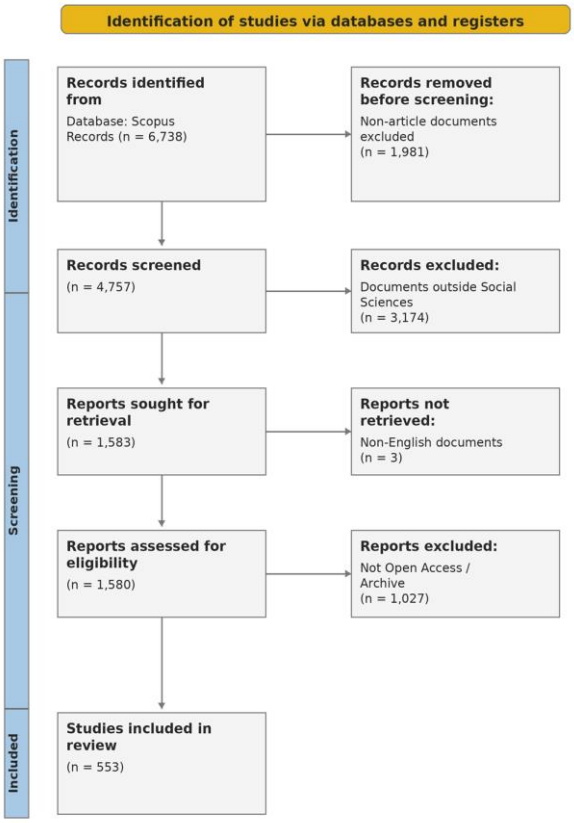


Figure 1. Prisma Flow 2020

Trend Publication

As shown in Table 2, interest in virtual tour research has clearly increased in recent years. This trend is reinforced by the annual scientific production presented in figure 2. Figure 2 illustrates a soaring trajectory in the volume of research output. This shows that virtual tours have significantly developed from 22 publications in 2020 to 135 publications in 2025, before eventually declining again to 68 publications in 2026. however, this decline must be interpreted carefully, as it likely not only reflects a decrease in research interest but also an incomplete indexing period.

Table 3. Descriptive statistics of the dataset used in the bibliometrix analysis

Sources type	Amount
Article	553
Review	0
Total document	553
Annual growth rate %	20.69%
Average citations per doc	3.66
Single-authored docs	83
Co-authors per doc	3.99

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Sources type	Amount
Authors per doc	3.84

Source: Scopus, processed with Biblioshiny, 2026.

Based on Table 3, the final corpus consists of 553 articles and does not include review documents. Table 2 also shows an annual growth rate of 20.69%, indicating a strong expansion of literature during the observation period. The pattern of author collaboration is also relatively intensive, as reflected in 83 single-author articles, 3.99 co-authors per document, and 3.84 authors per document. The data shows that virtual tour research is developing rapidly and is also collaborative. On the other hand, the average citations per document of 3.66 indicate that citations in the field are still growing and have not yet had a full impact. However, this is quite common for topics that are in a phase of rapid expansion.

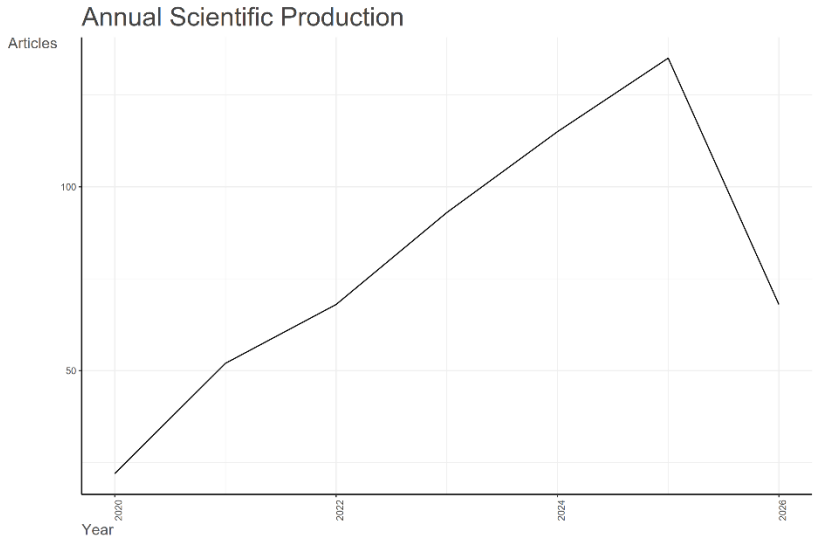


Figure 2. The yearly number of scientific studies.
sources: scopus created in Biblioshiny, 2026

In the publication trend, figure 2 supports the data that the scientific production of virtual tours increased significantly and consistently throughout the 2020-2025 period. Articles rose from 22 publications in 2020 to 52 publications in 2021, then increased to 68 in 2022, 93 in 2023, and 115 in 2024. It then peaked at 135 articles in 2025 (see table 3). Virtual tour shows that it has moved out of the initial phase toward the expansion phase, or from being niche to a more established phase. The pattern also indicates two things. First, virtual tours are not positioned merely as tools for physical visits but are evolving into relevant research objects in learning, spatial experiences, cultural heritage, tourism, and digital transformation. Second, the increase in publications signifies that this field is becoming more popular and is being more strongly legitimized across various domains.

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Table 4. The tren of article published

Year⇅	Articles⇅
2020	22
2021	52
2022	68
2023	93
2024	115
2025	135
2026	68

Source, Biblioshiny, 2026

From the perspective of citation impact, a fluctuating pattern is evident as reflected in Figure 3. The average citations per year were recorded at 0.0 in 2020, then increased to around 13.0 in 2021, 12.1 in 2022, 10.9 in 2023, dropped to around 6.3 in 2024, then surged to around 22.5 in 2025, before returning to 0.0 in 2026. The years 2021-2023 indicate a phase where the published articles began to gain stable academic attention, although there was a decline in 2024 before rising again in 2025. Specifically, in 2026, a score of 0.00 does not indicate a lack of impact, but rather this occurs due to the citation range being too short.

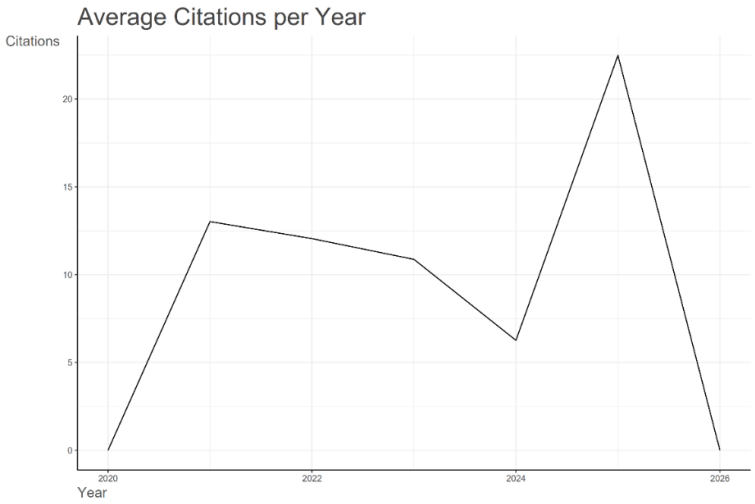


Figure 3. Average citations per year of scientific research.
Source : Scopus, created in Biblioshiny 2026

The distribution of core sources reveals that virtual tour research in education has not yet been fully consolidated within educational technology journals (See table 5). The dominance of tourism, cultural heritage, urban studies, and destination-related outlets suggests that the field initially developed from spatial experience, destination visualization, heritage accessibility, and remote visitation studies. This pattern explains why educational applications remain conceptually dependent on frameworks from tourism and cultural heritage rather than on instructional design, assessment, and learning sciences. The presence of Computers & Education: X Reality and Computers & Education among the most productive sources indicates an emerging pedagogical consolidation, but the field still requires stronger theoretical integration within education research. Annals of Tourism Research ranks first with 26 articles, followed by Computers & Education: X Reality with 24 articles, and Digital Applications in Archeology and Cultural Heritage with 23 articles. This composition affirms that the field of virtual tour research is strongly interdisciplinary. Meanwhile, the presence of Computers & Education: X Reality and Computers & Education indicates that this field is beginning to gain clearer articulation within the framework of pedagogy and learning technology. This means that virtual tour

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research in education still heavily borrows conceptual and methodological frameworks from other disciplines, but at the same time, it is moving toward a more specific academic consolidation in the realm of educational technology.

Table 5. The most relevant sources of research

Rank	Journal	Publisher	TP	PY start
1	Annals of Tourism Research	Elsevier	26	2020
2	Computers & Education: X Reality	Elsevier	24	2023
3	Digital Applications in Archaeology and Cultural Heritage	Elsevier	23	2020
4	Social Sciences & Humanities Open	Elsevier	20	2020
5	Transportation Research Procedia	Elsevier	16	2021
6	Cities	Elsevier	16	2020
7	International Journal of Geoheritage and Parks	KeAi Communications Co., Ltd.	15	2020
8	Annals of Tourism Research Empirical Insights	Elsevier	14	2021
9	Tourism Management	Elsevier	14	2022
10	Computers & Education	Elsevier	12	2020
11	Energy Research & Social Science	Elsevier	12	2021
12	Geoforum	Elsevier	12	2020
13	International Journal of Disaster Risk Reduction	Elsevier	12	2020
14	Journal of Destination Marketing & Management	Elsevier	12	2021
15	Transportation Research Interdisciplinary Perspectives	Elsevier	12	2020

Notes: TP = total publications
PY start = tahun awal kemunculan sumber
Source : Biblioshiny, 2026

Publication Sources and Core Journals (Bradford's Law)

The distribution of publication sources in virtual tour research shows a pattern consistent with Bradford's Law. In Figure 4, the article distribution follows a clear core-periphery structure, with 11 core sources, 24 sources in Zone 2, and 103 sources in Zone 3. The R^2 value = 0.9849 indicates a very high model fit, while the Bradford multiplier k = 3.24 means that the growth in the number of sources between zones occurs exponentially. In addition, the distribution conforms to the Bradford pattern with a KS p-value of 0.994. These findings indicate that the virtual tour literature has formed a strong core nucleus of journals, while at the same time remaining widely dispersed across various peripheral sources.

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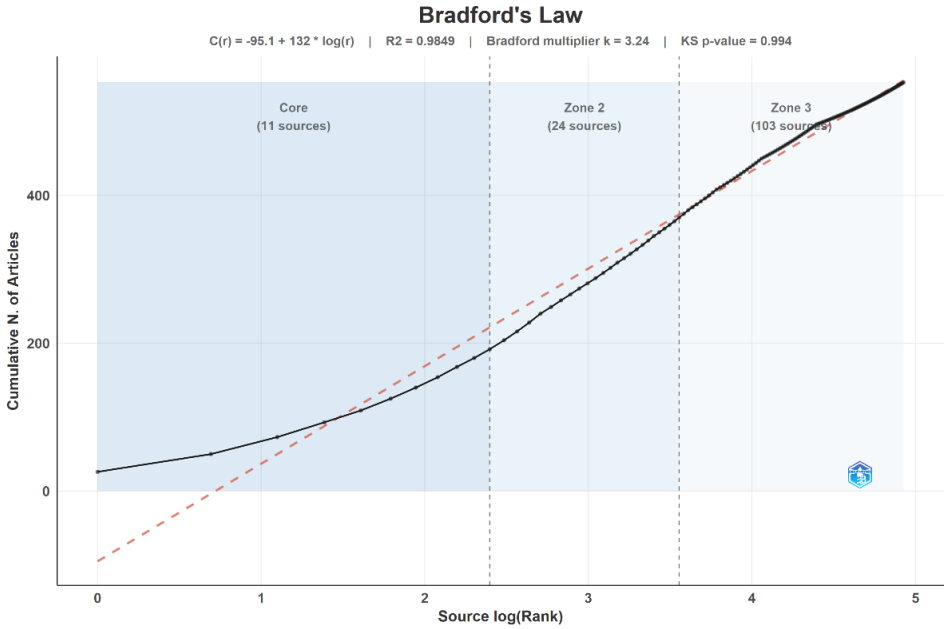


Figure 4. Bradford's law applied to research on the Virtual Tour
Source: **Scopus, Biblioshiny 2026**

The results of the core journal dominance are more clearly seen in figure 5. The journal with the highest number of documents is the Annals of Tourism Research with 26 articles, followed by Computers & Education: X Reality (24 articles), Digital Applications in Archeology and Cultural Heritage (23 articles), and Social Sciences & Humanities Open (20 articles). After that, Cities and Transportation Research Procedia each published 16 articles, while the International Journal of Geoheritage and Parks published 15 articles. The next positions are filled by Tourism Management and Annals of Tourism Research Empirical Insights with around 14 articles, as well as Computers & Education and Energy Research & Social Science with around 12 articles. This pattern shows that the main sources of publication do not only come from educational technology journals, but also from tourism, cultural heritage, urban studies, and applied social science journals.

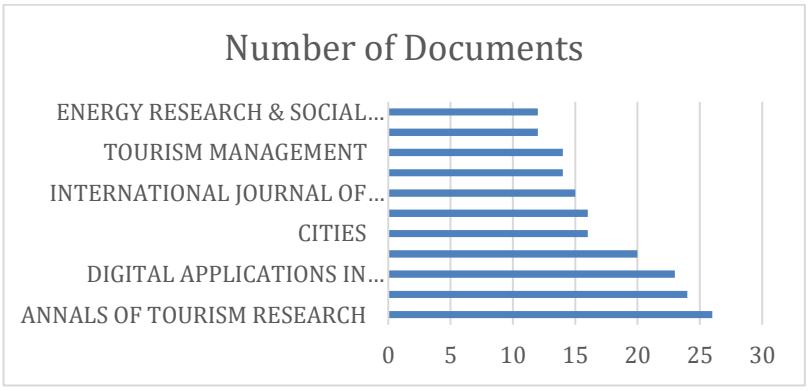


Figure 5. Numbers of documents
source: Biblioshiny, 2026

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Keyword Co-Occurence and Conceptual Structure Map

The keyword co-occurrence network indicates that "virtual tour" functions as a bridging concept connecting cultural heritage, higher education, user experience, augmented reality, immersive learning, and teaching strategies. This structure suggests that virtual tour research is multidisciplinary but not yet theoretically unified. The strong connection with cultural heritage and tourism-related terms reflects the spatial and experiential origin of the field, whereas the weaker presence of assessment, learning outcomes, retention, and instructional scaffolding indicates that pedagogical mechanisms remain underdeveloped. The clusters are interconnected with one dominant cluster as the center of the network, namely virtual tour. The virtual tour cluster is closely related to cultural heritage, higher education, user experience, augmented reality, and immersive learning. Outside of that, there are also several other clusters that have thematic similarities, such as with Covid-19 geoeducation and teaching/learning strategies. This pattern indicates that the virtual tour is multidisciplinary but remains open to cross-disciplinary interactions.

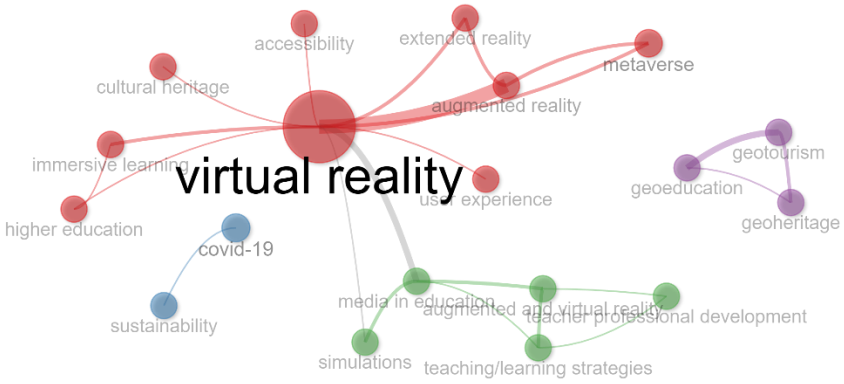


Figure 6. Co-occurrence network of research
Source : Biblioshiny, 2026

Thematic mapping

The results of the virtual tour research study can be mapped into a thematic research structure using thematic mapping. In figure 7, the virtual tour research is divided into two main dimensions: centrality and density. Centrality indicates the relevance level of a theme to the overall field. Density indicates the internal development level of that theme. There are 4 main groups: motor themes, niche themes, basic themes, and emerging or declining themes (see figure 7).

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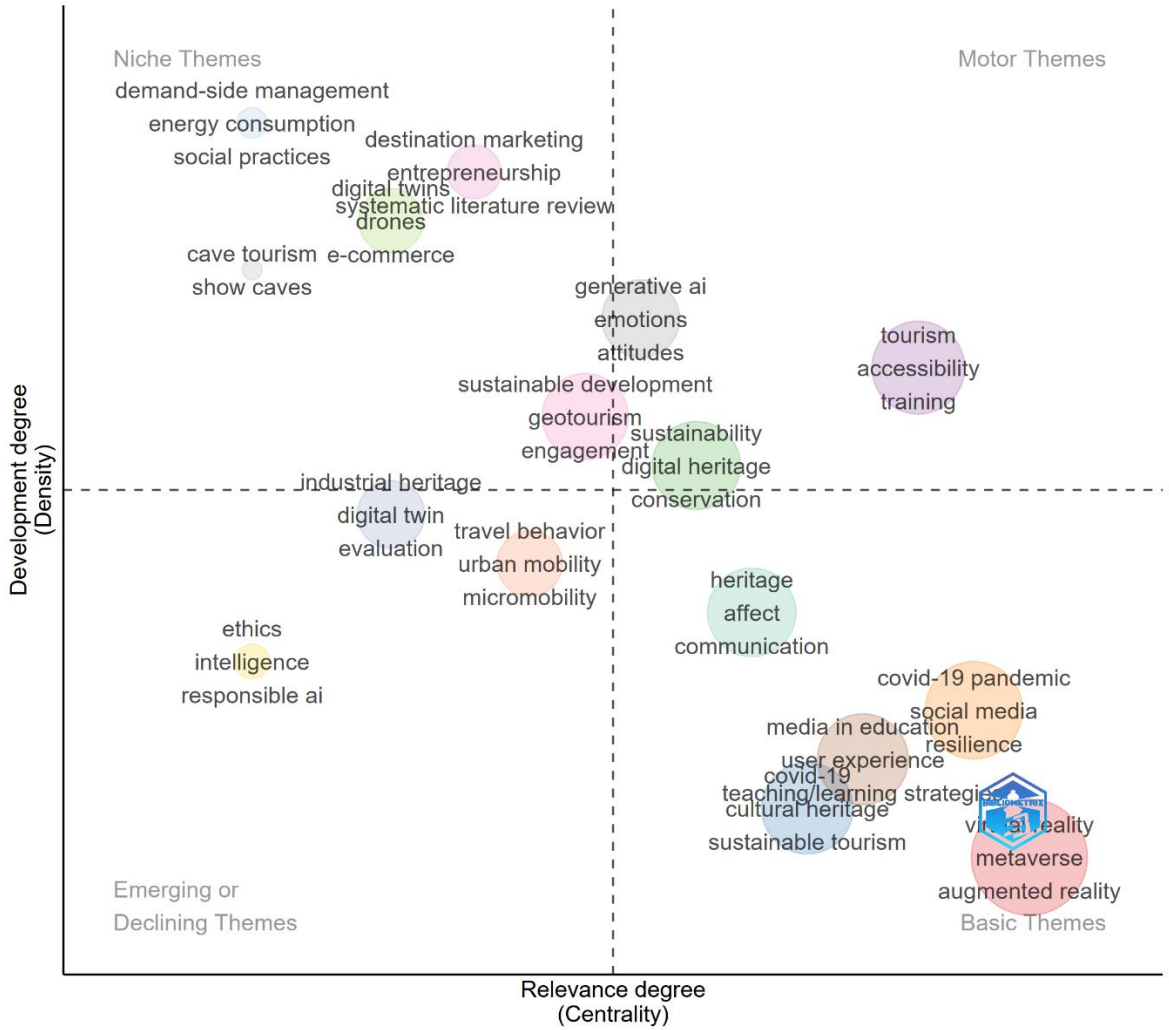


Figure 7. Thematic map of research
Source: Biblioshiny, 2026

The position of tourism, accessibility, and training as motor themes indicates that the most mature areas of virtual tour research are still associated with access to places, destination experience, and applied training contexts. This finding is pedagogically important because it shows that virtual tours have gained legitimacy as tools for experiential access, but their role as structured learning environments remains less developed. Themes directly related to instructional strategies, assessment, transfer, and retention do not appear as dominant motor themes, suggesting that educational research has not yet fully translated technological affordances into measurable learning models.

This indicates that these themes have high relevance and are developing in relation to the structure of virtual tour research. In the motor themes quadrant (top right), the most prominent themes are tourism, accessibility, and training. In the basic themes quadrant (bottom right), there is a large cluster containing virtual reality, augmented reality, and the metaverse, accompanied by supporting themes such as social media, the COVID-19 pandemic, media in education, user experience, teaching/learning strategies, cultural heritage, sustainable tourism, and resilience. In the niche themes quadrant (top left), there are themes such as demand-side management, energy consumption, social practices, destination marketing, entrepreneurship, digital

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twins, systematic literature review, drones, cave tourism, show caves, and e-commerce. Meanwhile, the emerging or declining themes quadrant (bottom left) contains themes such as ethics, intelligence, responsible AI, industrial heritage, as well as several transitional themes like digital twin, evaluation, travel behavior, urban mobility, and micromobility that are close to the central axis.

Authors Local Impact and Authors' Production Over Time

The local impact results of the authors in the virtual tour research corpus are still relatively low and scattered (see figure 8). Jaume Barcelo occupies the highest position with a local h-index of 2, while the others each have an h-index of 1. This indicates that the field is not yet dominated by authors with a significant influence. Meanwhile, the structure of its contributions is still distributed, meaning that the authors have not yet formed a solid core of authorship. This finding aligns with and supports the character of a rapidly developing field that has not yet fully consolidated.

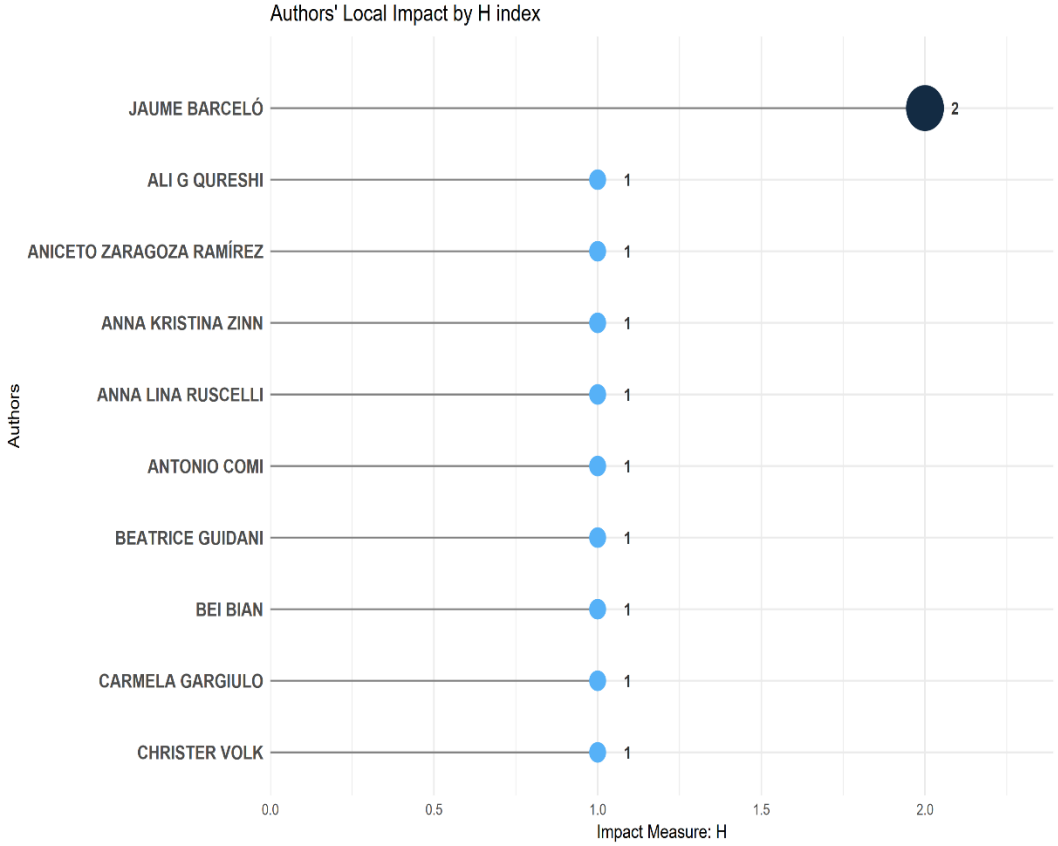


Figure 8. Authors' local impact by H-index in virtual tour research.
Source : Biblioshiny, 2026

Most of the main actors only appear within a limited time frame and produce one to three articles, as reflected in figure 9. This happens because the development of virtual tour literature is largely supported by episodic contributions. Thus, long-term dominance by a few authors does not occur. Giampaolo Viglia shows the most consistent publication track, while other authors such as Ramakrishnan Raman, Philipp A. Rauschnabel, Guido Makransky, and Aleksandar Antić appear in certain phases. In general, this pattern shows that the field of virtual tours is developing through the participation of many researchers across themes, but it does not yet have a very stable authorship structure.

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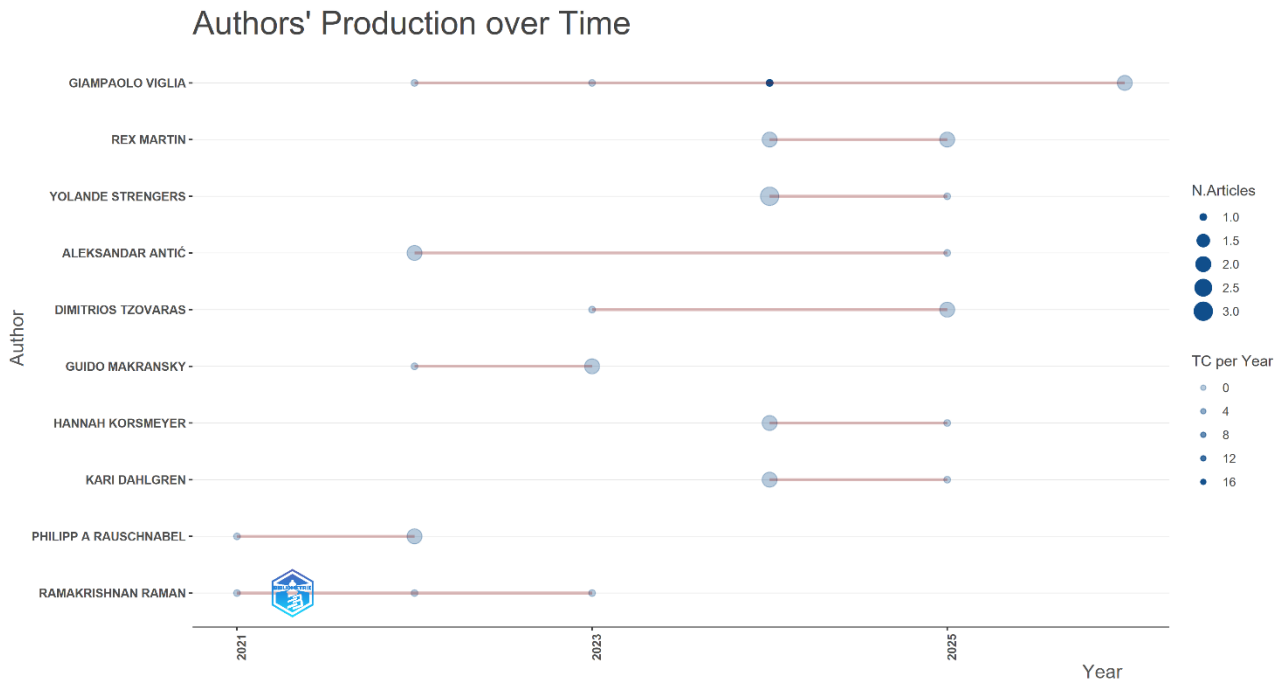


Figure 9. Authors' production over time in virtual tour research

Dominant Keywords in Treemap

Figure 10 shows the frequency distribution of keywords in the virtual tour research corpus. The most dominant theme is virtual reality with 42 occurrences (12%), far surpassing other keywords. This dominance confirms that the literature on virtual tours still heavily relies on the framework of immersive technology. After that, the keyword "na" appeared 21 times (6%), which likely reflects unstandardized metadata and lacks substantive analytical value. The next prominent themes are covid-19 and the metaverse, with 17 (5%) and 15 (4%) occurrences respectively, followed by sustainability with 12 (3%), tourism with 11 (3%), and accessibility and augmented reality with 10 (3%) each.

Additionally, keywords such as cultural heritage, artificial intelligence, media in education, higher education, digitalization, social media, and sustainable tourism also appear with significant frequency. This pattern shows that virtual tour research is developing at the intersection of virtual reality, tourism, cultural heritage, education, digitalization, and sustainability issues. Thus, the keyword frequency map confirms that this field is not only oriented toward technological aspects but is also moving toward broader contextual applications in learning, user experience, and digital representation of space.

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Figure 10. Treemap of dominant keywords in virtual tour research.
Source: Biblioshiny, 2026

Discussion

Bibliometric analysis shows that research on virtual tours has experienced rapid growth from 2020 to 2025, with publications increasing from 22 in 2020 to 135 in 2025. This trend indicates that virtual tours have shifted from a specialized technology to a mainstream object of academic inquiry. In line with the study by Makransky and Mayer (2022) which observed a surge in immersive learning studies following the global shift to remote learning during the COVID-19 pandemic, the observed annual growth rate was 20.69%, with an average of 3.99 co-authors per document. This is evidence that this virtual tour is collaborative and increasingly recognized across all disciplines.

From the perspective of journal distribution, the analysis results regarding virtual tours are dominated by tourism journals, urban studies, and educational technology. The journals Annals of Tourism Research, Computers & Education: X Reality, and Digital Applications in Archeology and Cultural Heritage are dominant journals reflecting the interdisciplinary nature of virtual tour research. Sakr and Abdullah (2024) emphasize that the integration of Virtual Tours in the context of cultural heritage and education demonstrates a convergence between technology and pedagogy. The presence of Computers & Education as a core outlet indicates that virtual tour studies are leading to specific educational applications and are no longer just general digital experiences.

The thematic mapping shows that motor themes, including tourism, accessibility, and training, are central and well-developed, while foundational themes such as virtual reality, augmented reality, the metaverse, and teaching/learning strategies continue to serve as guidelines supporting broader exploration. Emerging themes such as digital twins, responsible AI, and ethics indicate that the future direction of studies is steering toward social and ethical aspects. However, the study by Elaish et al., (2024) states that immersive experiences will remain a top priority in the future.

Regarding keyword dominance, bibliometric results indicate that authorship in the field of virtual tours remains fragmented and episodic. This indicates that research is still in the rapid exploration stage, where innovations largely emerge from short-term projects and have not yet formed a well-established research network. This pattern is consistent with the study by Cipresso et al., (2018) which also found that early virtual

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research was initially based on isolated case studies before eventually forming a more stable core research pattern.

The results of this study indicate that virtual tour research in education needs to shift from merely focusing on new technology to more precise and beneficial uses for learning. Publications on virtual tours have indeed increased rapidly, but the research structure is still scattered and the main focus remains on the term VR in general. The most researched themes are still related to tourism, cultural heritage, facilities, and training, while learning aspects such as teaching strategies, assessment, knowledge transfer, and retention have not been extensively studied. From here, there are four important things that need to be on the research agenda: unifying terms so that "virtual tour" is not mixed with other VR categories, strengthening experimental and long-term research designs including transfer measurement, creating balanced design models between realism, user roles, learning assistance, and feedback, and expanding studies to schools, teacher education, science and health education, and location-based learning. Challenges such as cost, safety, motion sickness, limitations in curriculum integration, and teacher readiness remain obstacles, so the success of this field depends on how innovative technology can be combined with effective and inclusive learning design.

Limitations of The Study

This study has several limitations. First, the analysis relied exclusively on Scopus-indexed journal articles; therefore, relevant publications indexed only in Web of Science, ERIC, Dimensions, Google Scholar, or other databases may not have been captured. Second, the study included only English-language publications, which may have excluded important regional studies published in other languages. Third, conference proceedings, book chapters, editorials, and other non-article documents were excluded to maintain metadata consistency, but this decision may have omitted emerging research that often appears first in conference venues. Fourth, bibliometric analysis depends on the quality and completeness of indexed metadata, including author keywords, abstracts, references, and citation records. Incomplete, inconsistent, or non-standardized metadata may influence keyword mapping, co-occurrence structures, and citation-based indicators. Finally, publications from 2026 should be interpreted cautiously because indexing and citation accumulation were incomplete at the time of data collection.

CONCLUSIONS AND RECOMMENDATION

Based on data analysis and findings from this study, it can be concluded that the agenda for educational virtual tour research is still dominated by a short-term technology and innovation orientation. In the pedagogical aspect, it has not yet become the main focus. The intellectual structure of the research is fragmented; although the initial exploration was intensive, it has not yet formed a cohesive research network. The dominance of keywords indicates a concentration on topics such as tourism, cultural heritage, facility orientation, and training, while themes of learning and evaluation remain minor. These findings answer the research question by asserting that the development of virtual tour literature tends to be rapid but dispersed, and highlight the need to focus research on more systematic pedagogical applications.

Based on the conclusion, it is recommended that future research focus on learning strategies and assessments in virtual tours. Collaboration between institutions is important to build a more cohesive research structure and reduce study fragmentation. Furthermore, diversifying topics to include formal education and professional training will expand academic contributions. Long-term evaluations using empirical data will strengthen the evidence of the impact of virtual tours on learning outcomes, while also enhancing the international relevance of the research.

Credit authorship contribution statement

Yahya Gunawan : Methodology, Formal analysis, Data curation, Conceptualization.
Melva Zainil : Resources, Project Administration, Methodology.

Declaration of competing interest

The authors declare that they have no financial conflicts of interest or personal relationships known to affect the work reported in this paper.

Ethical Declaration

This study used publicly available bibliographic metadata exported from Scopus and did not involve human participants, personal data, interviews, experiments, or interventions. Therefore, ethical approval and informed consent were not required.

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