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From Telepresence to the Metaverse – An Analysis of Trends in Immersive Media Research, 1990-2025

Od telepresence do metaverse – analiza trendów w badaniach nad mediami immersyjnymi w latach 1990–2025

Abstract

The article examines the evolution of research on immersive media between 1990 and 2025, tracing the shift from approaches focused on *telepresence*, understood as the technological illusion of presence, to the contemporary discourse on the *metaverse*, conceptualized as a platform-based, social, and algorithmic environment. The aim of the study was to reconstruct the dominant concepts across successive decades, identify thematic clusters present in the literature, and outline the conceptual trajectory leading from *telepresence* to the *metaverse*. The analysis employed the co-word method, rooted in the tradition of social network analysis (SNA), using VOSviewer software and a dataset of 42,704 articles retrieved from the Scopus database. The findings indicate that the 1990s were dominated by technological and ergonomic perspectives, the early 2000s by educational applications, the period 2010—2019 by social and platform-related aspects, and the post-2020 era by hybrid approaches combining VR, AR, artificial intelligence, pedagogy, and social contexts. The trajectory from *telepresence* to the *metaverse* confirms that immersion is no longer solely a technological issue but rather a component of a complex ecosystem of communication, education, and digital culture.

Keywords

immersive media; *telepresence; metaverse*; network analysis; Scopus; VOSviewer

Abstrakt

Przedmiotem artykułu jest ewolucja badań nad mediami immersyjnymi w latach 1990–2025, począwszy od ujęć, koncentrujących się na *telepresence*, czyli technologicznej iluzji obecności, po współczesny dyskurs wokół *metaverse*, rozumianego jako przestrzeń platformowa, społeczna i algorytmiczna. Celem badania było zrekonstruowanie dominujących pojęć w kolejnych dekadach, identyfikacja klastrów tematycznych, obecnych w literaturze oraz ukazanie trajektorii pojęciowej, prowadzącej od *telepresence* ku *metaverse*. Analizę przeprowadzono w oparciu o metodę współwystępowania słów kluczowych (co-word analysis), zakorzenioną w tradycji social network analysis (SNA), wykorzystując narzędzie VOSviewer i próbę 42 704 artykułów z bazy Scopus. Wyniki wskazują, że w latach 90. XX wieku dominowały ujęcia technologiczne i ergonomiczne, w pierwszej dekadzie XXI wieku aplikacje edukacyjne, w latach 2010–2019 istotne były aspekty społeczno-platformowe, a po 2020 roku hybrydowe, łączące VR, AR, sztuczną inteligencję, dydaktykę i konteksty społeczne. Ewolucja od *telepresence* do *metaverse* potwierdza, że immersja nie jest już wyłącznie kwestią technologiczną, lecz stanowi element złożonego ekosystemu komunikacji, edukacji i kultury cyfrowej.

Słowa kluczowe

media immersyjne; *telepresence*; *metaverse*; analiza sieciowa; Scopus; VOSviewer

Introduction

Research on immersive media has been developing for more than three decades, accompanying both the evolution of digital technologies and the transformations in how communication is experienced. Beginning in the 1990s, scholarly discourse concentrated on the technical conditions of immersion and the illusion of presence. Over time, and particularly in contemporary analyses of platforms commonly referred to as the *metaverse*, there has been a shift not only in the subject of inquiry but also in the very language used to describe these phenomena. Early studies defined immersion primarily through technological parameters and user interfaces, emphasising the significance of *telepresence* as the sensation of being present in a digitally generated environment (Minsky, 1980; Steuer, 1992). Recently, however, research on immersive media has increasingly highlighted the social and cultural dimensions of immersion, with the concept of the *metaverse* emerging as a symbol of co-presence, interaction, and participation in digital environments. Illustrative examples include studies demonstrating how the *metaverse* supports cultural education and the preservation of heritage through virtual reconstructions and immersive narratives (Buragohain et al., 2024; Anwar et al., 2025), how it enhances engagement and social satisfaction in the context of virtual tourism (Inmor et al., 2025), and how its acceptance depends on cognitive and cultural factors (Sharma et al., 2025).

Accordingly, the concepts of *telepresence* and *metaverse* serve in this article as interpretative frames, symbolising the shift in research from technological immersion towards its social and cultural dimensions. *Telepresence* denotes the phase in which technical categories dominated, particularly those related to interfaces, simulation, and ergonomics. The *metaverse*, by contrast, represents the contemporary stage, in which scholarly reflection has moved towards social interaction, platformisation, and the cultural as well as educational applications of immersion.

Previous studies on immersive media have often focused on case analyses of specific technologies, such as virtual and augmented reality. They have typically examined selected areas of practice, including gaming, education, and communication. Attention has also been paid to user-oriented aspects, such as user experience, ergonomics, and emotions (Cipresso et al., 2018; Moinnereau et al., 2022; Linares-Vargas & Cieza-Mostacero, 2024; Siwak, 2016; Żyrek-Horodyska, 2021; Majewska, 2023; Welskop, 2025a; Welskop, 2025b). Far less frequently, scholars have attempted to reconstruct the evolution of the conceptual network. Such an approach makes it possible to capture not only changes in individual categories, but also transformations in their interrelations, connections, and meanings within scholarly discourse. At present, there is a lack of studies that systematically compare successive decades. This gap concerns, in particular, how the transformation of the research field is reflected in the language of academic description, for example through shifts in dominant terms

and the restructuring of their conceptual networks (Benaben et al., 2025; Chang & Suh, 2025).

The aim of this article is to analyse the evolution of research on immersive media between 1990 and 2025. Particular emphasis is placed on reconstructing the dominant concepts of each decade, identifying and comparing thematic clusters, and demonstrating the transition from the category of *telepresence* to that of the *metaverse*.

Research Method

The primary aim of the study was to analyse trends in research on immersive media between 1990 and 2025. The study adopted the perspective of co-word network analysis, derived from the methodology of social network analysis (SNA), which made it possible to reconstruct the academic discourse surrounding immersive media. This approach allows not only for the identification of the most frequently occurring concepts, but also for the examination of their co-occurrence, the strength of their associations, and the configuration of thematic clusters, thereby revealing changes in the structure of research across successive decades (Callon et al., 1983; Van Eck & Waltman, 2014). The analytical tool used to process the material was the VOSviewer software (Van Eck & Waltman, 2010). This programme enables the visualisation of relationships between concepts, the identification of thematic clusters, and the determination of the position of particular terms within the structure of the network.

The study is based on bibliometric data from the Scopus database covering the years 1990–2025, comprising 42,704 records of academic publications containing keywords related to immersive media. The analysis spanned four time intervals (1990-1999, 2000-2009, 2010-2019, 2020-2025), allowing for a comparison of the evolution of the conceptual network across successive decades. This approach enabled the formulation of the following set of research questions, which structure the subsequent stages of the analysis:

RQ1. What concepts dominated research on immersive media in each decade between 1990 and 2025?

RQ2. What thematic clusters can be identified in the literature on immersive media, and how have these clusters changed over time?

RQ3. How has the conceptual network evolved from the category of *telepresence* to the category of the *metaverse*, and what implications does this evolution carry for research on immersive media?

In the next step, the database was selected and a set of keywords was defined to retrieve all documents related to the subject under study. The analysis was carried out using the Scopus database, which is one of the largest, most frequently utilised, and widely recognised bibliographic sources (Klapka & Slaby, 2018).

The research took place on 15 June 2024. In the Scopus database search, the following keywords were applied (OR): "telepresence", "immersive media", "immersive journalism", "virtual reality", "augmented reality", "extended reality", "metaverse". Besides this set of terms referring to immersive media, a thematic filter (using AND) was also introduced, including keywords such as "communication", "media", "visual communication", "storytelling", and "audience". The purpose of this procedure was to focus the analysis primarily on publications within the field of communication and media studies. The selected phrases were searched in the titles, abstracts, and keywords of the publications. The search strategy used the operators AND and OR to narrow results to publications containing all specified terms, or to broaden them with synonyms. Quotation marks ensured retrieval of complete phrases, increasing the precision of results (*Scopus – Advanced Search | Signed In*, n.d.).

The scope of the search was limited to the field of social sciences and to peer-reviewed journal articles, with other types of publications excluded. Only texts published in English were included, ensuring that global research trends were properly represented, and the time frame was set to 1990-2025. The analysis employed the following set of keywords and search operators:

> „telepresence" OR „immersive media" OR „immersive journalism" OR „virtual reality" OR „augmented reality" OR „extended reality" OR „metaverse" AND („communication" OR „media" OR „visual communication" OR „storytelling" OR „audience") AND PUBYEAR > 1989 AND PUBYEAR < 2026 AND (LIMIT-TO (SUBJAREA , „SOCI")) AND (LIMIT-TO (DOCTYPE , „ar")) AND (LIMIT-TO (SRCTYPE , „j")) AND (LIMIT-TO (LANGUAGE , „English"))

A total of 42,704 articles were ultimately identified (N = 42,704). For the purposes of analysis, the entire dataset was divided into four time intervals corresponding to successive decades: (1) 1990-1999 – 462 publications, (2) 2000-2009 – 2,151 publications, (3) 2010-2019 – 8,490 publications, and (4) 2020-2025 – 31,601 publications. For each of these periods, separate datasets were prepared and exported from Scopus in CSV format, compatible with the VOSviewer software (version 1.6.20), and subsequently subjected to analysis.

During the creation of the research maps, keywords were selected (see table 1). The application of minimum thresholds made it possible to eliminate marginal concepts and to focus on terms of greatest importance within the conceptual network. The threshold criteria were adjusted to the size of the analysed dataset (Van Eck & Waltman, 2014), which renders the results methodologically sound. Before the analysis, a data-cleaning procedure removed technical and indexical terms that were part of Scopus metadata rather than the substantive content of the studies.

The study comprised three stages, corresponding to the formulated research questions. In the first stage, keywords were selected and organised within the four

time intervals (1990-1999, 2000-2009, 2010-2019, 2020-2025), which enabled the identification of the dominant concepts in each decade (RQ1). The second stage involved the reconstruction of thematic clusters and the comparison of their structure and dynamics across different periods, making it possible to capture the process by which research areas have taken shape (RQ2). The final stage consisted of analysing the evolution of the entire conceptual network, from the category symbolically defined as *telepresence* to the category of the *metaverse*. Particular attention was given to interpreting the implications of this shift for the further development of research on immersive media (RQ3).

A significant methodological limitation of this analysis lies in its exclusive reliance on article metadata available in the Scopus database, namely titles, abstracts, and assigned keywords. The absence of full-text analysis and the exclusion of other sources naturally narrow the scope of possible conclusions.

Research Findings

The sampling procedure, presented in Table 1, serves as the starting point for the co-word network analysis. The data were organised according to four time intervals (1990-1999, 2000-2009, 2010-2019, 2020-2025) as well as for the entire study period. This approach made it possible to compare the evolution of the conceptual network across successive decades. It also allowed the capture of both quantitative changes, reflected in the growing number of publications and keywords, and qualitative shifts, evident in the transformation of dominant terms and in the structure of thematic clusters.

Table 1. Sample selection for the co-word network analysis

Period	Number of publications	Number of keywords	Occurrence threshold (min.)	Number of terms included in the analysis
1990–1999	462	1171	5	51
2000–2009	2151	8507	25	86
2010–2019	8490	23 892	50	101
2020–2025	31 601	50 757	120	84
1990–2025 (entire period)	42 704	56 667	140	94

Source: Author's own compilation based on data from the Scopus database (1990–2025).

The first stage of the analysis involved identifying the concepts most frequently occurring in research on immersive media across successive decades. This procedure made it possible to indicate the categories central to each period and to capture the shifting areas of scholarly interest. The tables below present the fifteen keywords with the highest number of occurrences (TOP 15), together with their total link strength within the network and their cluster affiliation.

Table 2. Most frequently occurring keywords in research on immersive media (1990-1999)

No.	Keyword	Number of occurrences	Total link strength	Cluster
1	*virtual reality*	94	164	2
2	*internet*	21	38	5
3	*information technology*	20	29	3
4	*computer simulation*	18	45	1
5	*user interfaces*	15	51	3
6	*computer aided instruction*	14	41	5
7	*ergonomics*	12	40	2
8	*cyberspace*	11	13	1
9	*interactive computer systems*	11	29	5
10	*human computer interaction*	10	36	1
11	*world wide web*	10	31	5
12	*artificial intelligence*	9	11	1
13	*computer networks*	7	15	2
14	*communication*	6	7	1
15	*information processing*	5	16	4

Source: Author's own compilation based on data from the Scopus database (1990–1999).

The analysis of the 1990s indicates a clear dominance of the concept of *virtual reality*, which during this period served as a central category both in terms of frequency of occurrence and total link strength within the network. Alongside it, significant roles were played by terms referring to technological infrastructure and interfaces, such as *user interfaces*, *computer simulation*, and *human–computer interaction*. The emergence of keywords such as *internet* and *world wide web* signalled the beginnings of research into digital networked environments, which would gain increasing importance in subsequent decades. From a methodological perspective, the conceptual network of the 1990s reveals a research area firmly rooted in technology and ergonomics, with relatively less emphasis placed on social or cultural aspects.

In the first decade of the twenty-first century, research on immersive media gained markedly greater momentum. Although *virtual reality* continued to serve as the central category, concepts related to education (*teaching*, *education*, *learning*) became increasingly prominent, reflecting growing interest in the application of immersion in didactics and higher education. At the same time, technical terms such as *human–computer interaction* and *user-computer interface* held an important position, underlining the role of interface design in shaping immersive experience. During this period, particular attention should also be drawn to the high ranking of the term *internet*, which reflected the integration of immersive technologies with networked communication, thereby laying the groundwork for later interest in social media and online environments. The presence of terms such as *controlled study* and *human experiment* indicates the growing frequency of empirical research in which

immersive technologies were tested under controlled conditions. The conceptual network of this decade therefore reveals a research field developing along two parallel trajectories: on the one hand, deepening the technical aspects of human-computer interaction, and on the other, opening towards educational and social contexts.

Table 3. Most frequently occurring keywords in research on immersive media (2000-2009)

No.	Keyword	Number of occurrences	Total link strength	Cluster
1	*virtual reality*	662	1661	1
2	*internet*	265	678	2
3	*user-computer interface*	129	602	2
4	*human computer interaction*	118	334	1
5	*computer simulation*	121	472	3
6	*teaching*	96	382	3
7	*information technology*	96	233	1
8	*education*	95	339	3
9	*learning*	72	262	3
10	*communication*	76	215	2
11	*controlled study*	77	319	2
12	*human experiment*	57	241	2
13	*learning systems*	62	228	1
14	*computer program*	46	236	2
15	*computer interface*	41	219	2

Source: Author's own compilation based on data from the Scopus database (2000–2009).

Table 4. Most frequently occurring keywords in research on immersive media (2010-2019)

No.	Keyword	Number of occurrences	Total link strength	Cluster
1	*virtual reality*	1067	2191	1
2	*education*	433	1284	3
3	*augmented reality*	393	526	1
4	*teaching*	339	1146	3
5	*e-learning*	326	923	3
6	*internet*	220	338	4
7	*human computer interaction*	178	420	1
8	*computer aided instruction*	211	814	3
9	*social media*	204	246	4
10	*social networking (online)*	196	472	4
11	*communication*	121	304	2
12	*computer interface*	146	615	2
13	*controlled study*	137	492	2
14	*computer simulation*	136	401	2
15	*learning systems*	134	504	3

Source: Author's own compilation based on data from the Scopus database (2010–2019)

Between 2010 and 2019, *virtual reality* remained the central concept in research on immersive media, dominating both in terms of frequency of occurrence and total link strength within the conceptual network. Strongly represented were also terms from the field of education, such as *education*, *teaching*, *e-learning*, *computer-aided instruction*, and *learning systems*. Their prominence confirms that immersive technologies were increasingly treated not only as a field of technological innovation but also as a didactic tool, particularly in the context of remote and simulation-based learning. At the same time, the emergence of the category *augmented reality* signalled a broadening of research beyond classical VR towards solutions that combine the physical and digital realms. Concepts relating to communication and social spaces, including *internet*, *social media*, and *social networking (online)*, also gained significance, reflecting the growing integration of immersive experiences with digital culture and networked practices. The presence of terms such as *controlled study* and *computer simulation* points to the consolidation of empirical and experimental research, which made it possible to evaluate both the effectiveness and the practical impact of immersive technologies.

Table 5. Most frequently occurring keywords in research on immersive media (2020-2025)

No.	Keyword	Number of occurrences	Total link strength	Cluster
1	*virtual reality*	1970	2566	2
2	*augmented reality*	831	955	2
3	*artificial intelligence*	822	958	3
4	*education*	612	1239	4
5	*e-learning*	500	941	5
6	*learning*	454	1067	4
7	*sustainability*	440	630	1
8	*teaching*	440	1008	5
9	*perception*	363	617	1
10	*social media*	351	361	1
11	*metaverse*	335	384	2
12	*technology*	298	345	1
13	*gamification*	287	363	5
14	*decision making*	285	497	3
15	*motivation*	270	415	5

Source: Author's own compilation based on data from the Scopus database (2020–2025)

Between 2020 and 2025, *virtual reality* continues to dominate, accompanied by a marked rise in *augmented reality* and the very high ranking of *artificial intelligence*. This points to the convergence of immersion with AI methods and adaptive systems. The educational core (*education*, *teaching*, *e-learning*, *learning*) remains prominent,

confirming the stable embedding of immersive technologies in didactics and train-ing. At the same time, themes such as *sustainability* and *social media* come to the fore, signalling the expansion of the research agenda into the social dimension. The emer-gence and strong position of the *metaverse* anchor the contemporary discourse, while *gamification*, *motivation*, and *decision making* highlight the psychological and design perspective, focusing on engagement and choices. Overall, the conceptual network in this period shifts away from purely technical aspects towards a hybrid structure that integrates technology, education, and the social frameworks of use.

The analysis of four decades of research on immersive media reveals clear shifts in emphasis. In the 1990s, technological approaches dominated, focusing on *virtual reality*, interfaces, and digital infrastructure. In the first decade of the twenty-first century, the educational and methodological dimension became increasingly visi-ble, marking a transition from technology itself to its practical didactic applications. The years 2010-2019 saw the consolidation of the educational strand, the introduc-tion of *augmented reality*, and a marked opening towards social contexts, includ-ing *social media* and digital communication. By contrast, in the period 2020-2025, *artificial intelligence* took centre stage, and research assumed a hybrid character that combined technology, didactics, digital culture, and issues of sustainability. This evolution thus leads from technical and infrastructural foundations towards an increasingly broad sociocultural and user-oriented perspective.

The second stage involved examining the structure of the conceptual network in terms of clusters. This made it possible to identify the main thematic areas of research on immersive media and to trace their changes over time. Through the *network visualisation* function in VOSviewer, keywords could be grouped accord-ing to their co-occurrence. This, in turn, enabled the mapping of the entire field, together with its divisions and relationships, thereby complementing the analysis of central concepts.

Figure 1 shows the structure of the conceptual network in the years 1990-1999, divided into five thematic clusters. The largest cluster (green) is centred on *vir-tual reality* together with issues of ergonomics and human–computer interaction, highlighting the central role of research on user experience. The red cluster brings together simulation- and computation-related concepts, while the purple cluster focuses on educational and networked themes. The blue cluster is linked to com-munication infrastructure, complemented by the yellow cluster, which concentrates on visualisation and information processing. This structure reflects the technical character of early research on immersion, in which VR occupied a central position, while at the same time early signals of educational and network applications also became visible.
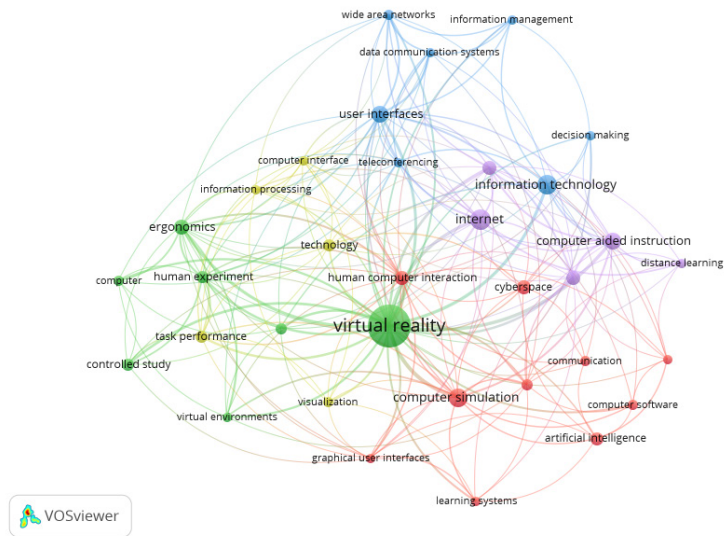
Figure 1. Network visualisation of the keyword network (1990-1999)

Source: Author's visualisation based on Scopus data, created with VOSviewer (version 1.6.20).

Figure 2 presents the structure of the conceptual network in the years 2000–2009. The cluster analysis reveals three main research areas: technological–networked (red), methodological–psychosocial (green), and educational (blue). The first cluster is centred on *virtual reality* and *human–computer interaction*, linking them with the development of the internet and early forms of online education. The second encompasses empirical and psychological studies of user interaction, with *user-computer interface* at its core, connected to categorises such as *controlled study*, *human experiment*, and *motivation*. The third cluster brings together terms related to didactics (*education*, *teaching*, *medical education*), indicating the expanding use of immersion in education. The network structure of this decade shows that research on immersive media was becoming increasingly interdisciplinary, moving beyond technology towards educational applications and the analysis of psychosocial aspects of immersion.

Figure 3 presents the structure of the conceptual network in the years 2010-2019, organised around four main clusters. The red cluster focuses on immersion technologies, with *virtual reality* at its centre and the growing importance of *augmented reality*. The blue cluster encompasses the broad educational strand, highlighting the integration of VR and AR with didactics and e-learning. The green cluster reflects empirical and medical research, in which VR is used as a tool for experiments and simulations. The yellow cluster is centred on social media, showing a shift in research towards digital platforms and online communication. The network structure of this decade illustrates the interdisciplinarity of research on immersive media, combining technology, education, psychology, and the social sphere.
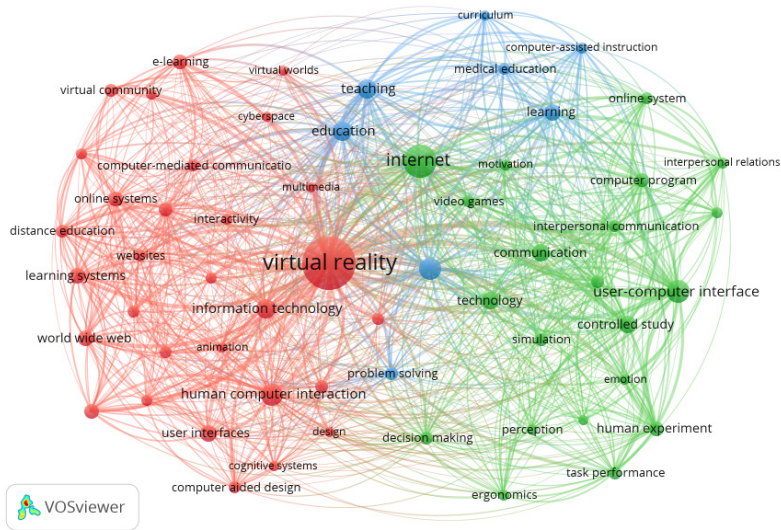
Figure 2. Network visualisation of the keyword network (2000-2009)

Source: Author's visualisation based on Scopus data, created with VOSviewer (version 1.6.20).
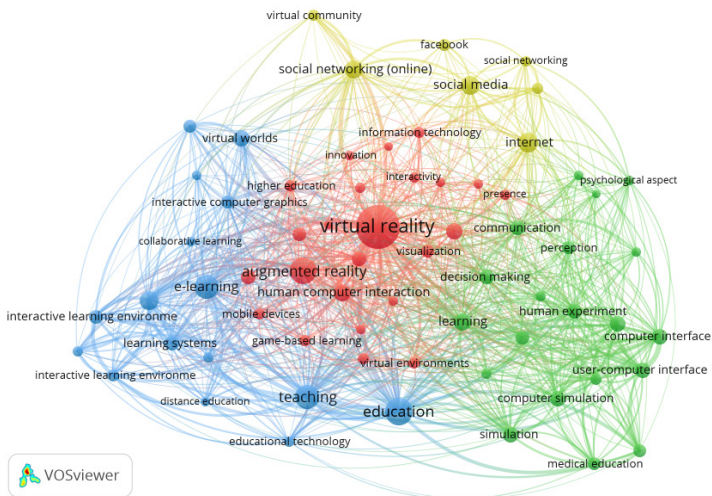

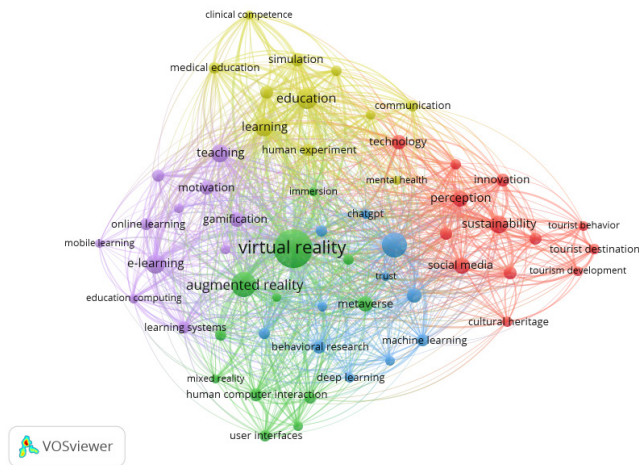**Figure 3. Network visualisation of the keyword network (2010-2019)**

Source: Author's visualisation based on Scopus data, created with VOSviewer (version 1.6.20).

Figure 4 presents the structure of the conceptual network in the years 2020-2025, organised around five main clusters. The green cluster contains the technological core of immersion (*virtual reality*, *augmented reality*, *metaverse*). The yellow cluster reflects broad educational and medical applications, while the red cluster illustrates the turn towards social and cultural contexts (*sustainability*, *social media*, *tourism*,

Figure 4. Network visualisation of the keyword network (2020-2025)

Source: Author's visualisation based on Scopus data, created with VOSviewer (version 1.6.20).

cultural heritage). The blue cluster points to the growing role of artificial intelligence (*AI*, *machine learning*, *chatGPT*) and research on technology acceptance (*trust*, *technology acceptance model*). Complementing this is the purple cluster, which focuses on digital didactics, gamification, and motivation. This network structure confirms that in this decade, research on immersive media has assumed a hybrid character, combining technology with education, culture, artificial intelligence, and global social challenges.

The cluster analysis across successive decades reveals a gradual transformation in the structure of research on immersive media. It shows a shift from the initial focus on technologies and ergonomics towards a contemporary hybridity that combines technology with education, artificial intelligence, digital culture, and global social challenges. Between 1990 and 1999, the conceptual network was dominated by clusters of a technical character. Central importance was attached to research on *virtual reality*, complemented by clusters related to interfaces, ergonomics, and computer simulation. A separate cluster focused on network infrastructure (*wide area networks*, *teleconferencing*), while a smaller one was concerned with early educational applications (*computer-aided instruction*, *distance learning*). The structure was techno-centric, with the first signs of a didactic orientation. In the decade 2000-2009, alongside the technological core, educational and methodological–psychological clusters clearly emerged. Research no longer focused solely on VR itself but also on its applications in teaching (*education*, *teaching*, *medical education*) and on empirical testing (*controlled study*, *human experiment*). The network structure became interdisciplinary, bringing together computer science, pedagogy, and psychology. The years 2010-2019 brought further diversification. Four clusters became

distinct: technological (*virtual reality*, *augmented reality*), educational (*education*, *e-learning*), methodological–medical (*simulation*, *medical education*, *perception*, *emotion*), and social (*social media*, *social networking*, *Facebook*). For the first time, the socio-platform dimension was emphasised so strongly, demonstrating a shift towards research on immersion in the context of social media and digital culture. Finally, in the period 2020-2025, the network structure became the most complex and hybrid. In addition to the technological core (*VR*, *AR*, *metaverse*) and educational clusters, a distinct block related to artificial intelligence (*AI*, *machine learning*, *chatGPT*, *trust*) emerged, as well as a socio-cultural cluster (*sustainability*, *tourism*, *cultural heritage*, *social media*). Complementing these was the area of digital didactics (*gamification*, *motivation*, *mobile learning*). This is a configuration in which immersion is no longer merely a technology but rather a space where technology, education, artificial intelligence, and global social processes converge.

The third stage of the analysis aimed to capture the conceptual trajectory leading from the category of *telepresence* to the notion of the *metaverse* between 1990 and 2025. Two maps covering the entire research period were examined, both generated using VOSviewer: the *network visualisation*, which displays the thematic structure of the network, and the *overlay visualisation*, which shows the temporal dimension of when particular concepts entered the discourse.

The network map covering the entire period shows a clear centre dominated by the concept of *virtual reality*, which constitutes the core foundation of the field's development. Four main thematic axes extend from this centre. The first is the interaction–design axis, encompassing terms such as *human–computer interaction*, *user interfaces*, *design*, *interactivity*, and *perception*. This area is directly responsible for shaping the experience of presence and represents the closest reference point to the category of *telepresence*. The second axis is formed by the educational cluster, with central terms including *education*, *teaching*, *e-learning*, *learning systems*, and *educational technology*. Their strong connections with VR and *simulation* (*simulation*, *training*) demonstrate that education has become a lasting and stable application of immersive technologies, evolving in parallel with research on the experience of presence. The third element of the network is the empirical–methodological strand, centred on concepts such as *controlled study*, *human experiment*, *computer interface*, *decision making*, and *perception*. This represents the area of research in which the development of immersion was systematically tested and verified through empirical studies, pointing to the process of institutionalisation within the field.

The analysis of the network structure makes it possible to reconstruct the pathways leading from *telepresence* to the *metaverse*. The starting point lies in *virtual reality*, *human–computer interaction*, and *user interfaces*, which are subsequently linked with perceptual and empirical categories such as *presence*, *perception*, and *controlled study*. The next stage involves the opening towards networked
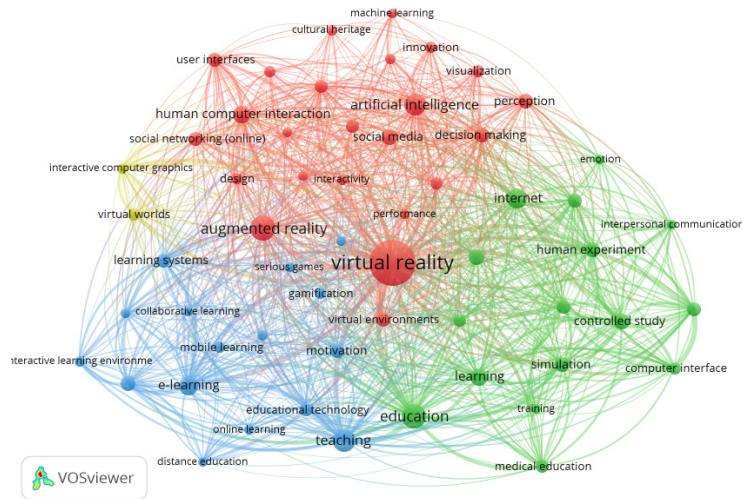
Figure 5. Network visualisation of the keyword network (1990–2025)

Source: Author's visualisation based on Scopus data, created with VOSviewer (version 1.6.20).

environments (*internet*, *social networking*, *social media*). Finally, the addition of an algorithmic component (*artificial intelligence*, *machine learning*) culminates in the most recent decade with the consolidation of the concept of the *metaverse*.

The temporal map (see Fig. 6) complements the structural analysis with a dynamic dimension, showing when particular concepts gained significance in scholarly discourse. The oldest layer (darker colours) consists of terms related to infrastructure and methodology, such as *internet*, *controlled study*, *human experiment*, and *distance education*. This was the period in which the development of immersion relied on building technological foundations and making the first attempts at application. The next phase (mid-range colours) reflects the consolidation of the field around *virtual reality* and the expansion of educational concepts (*education*, *teaching*, *learning*, *e-learning*). At the same time, community-related terms (*social media*, *social networking*) entered the discourse, shifting research towards the analysis of interaction in networked environments. The most recent layer (lighter colours) is formed by categories linked to new technologies and the algorithmisation of immersion: *augmented reality*, *artificial intelligence*, *machine learning*, *decision making*, and in the last decade also the *metaverse*. Their emergence indicates a change in the logic of research, from the construction of environments of presence to the analysis of platforms and intelligent immersive systems that generate and structure user experiences.

The analysis of the maps for the period 1990-2025 confirms that the conceptual trajectory in research on immersive media leads from *telepresence* to the *metaverse*. In the initial phase, central importance was attached to studies of the experience
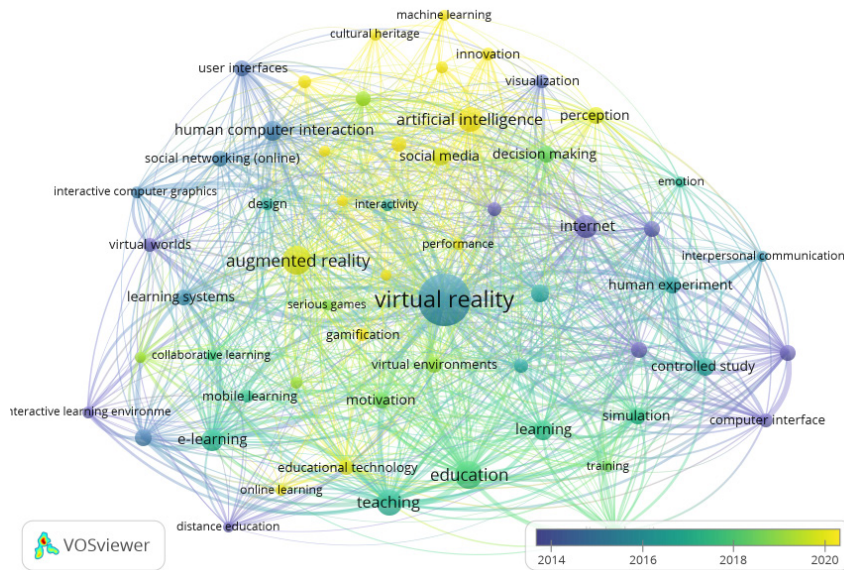
Figure 6. Overlay visualisation of the keyword network (1990–2025)

Source: Author's visualisation based on Scopus data, created with VOSviewer (version 1.6.20).

of presence, human-computer interaction, and interface design – a configuration that may be described as the logic of *telepresence*. Over time, concepts related to education and digital didactics gained prominence, followed by those associated with networked environments and social platforms. In the most recent decade, categories linked to artificial intelligence and machine learning entered the network, merging with VR and AR in the discourse surrounding the *metaverse*. Thus, the evolution of the field of immersive media research reveals a progression from technologically constructed presence to platform-based, networked, and algorithmic immersion, with the *metaverse* emerging as its symbolic label.

Conclusions

The analysis of the data makes it possible to reconstruct the evolution of research on immersive media in three dimensions. First, the answer to the question regarding dominant concepts in successive decades (RQ1) shows that *virtual reality* initially occupied the centre, while in later periods new aspects emerged: in 2000-2009, educational terms; in 2010-2019, socio-platform categories (*social media*, *social networking*); and in 2020-2025, *augmented reality*, *artificial intelligence*, and the *metaverse*. The research field has thus become interdisciplinary and hybrid in nature (Mystakidis, 2022; Lee et al., 2024).

The cluster analysis (RQ2) revealed that the research network was not a monolith but divided into relatively coherent areas. It evolved from the technological cluster

of the 1990s, through educational and psychosocial clusters in 2000-2009, to a distinct socio-platform block in 2010-2019, and finally to a hybrid structure in 2020-2025 that combined VR/AR, AI, education, and social issues. The evolution of clusters confirms the gradual opening of the research field to new contexts and applications (Dionisio et al., 2013; Park & Kim, 2022).

The analysis of the entire research period (RQ3), revealed a trajectory from the logic of *telepresence*, grounded in the design of presence and the study of human-interface interaction, towards the logic of the *metaverse*, understood as platform-based and algorithmic immersion intertwined with social media, artificial intelligence, and global challenges. Between these two poles, intermediary concepts (*user interfaces*, *internet*, *social media*, *artificial intelligence*) played a pivotal role, marking successive stages in the transformation of discourse. This direction confirms earlier findings that the development of immersive media cannot be analysed in isolation from broader cultural and technological processes (Slater & Sanchez-Vives, 2016).

The findings presented have important implications for research on immersive media. First, they demonstrate that the evolution of this field is not limited to technological development alone, but encompasses a shift from studies of presence and individual interaction to analyses of immersion in social, educational, and algorithmic contexts. Second, the cluster analysis indicates that the research field is not a monolith but is dynamically reorganised in response to new technologies and cultural practices. Third, the trajectory from *telepresence* to the *metaverse* indicates that contemporary immersion operates as a complex ecosystem, bringing together VR/AR technologies, artificial intelligence, social platforms, and global challenges. This evolution confirms that immersion is no longer merely a technological matter, but an element of a broader ecosystem of digital communication and culture. Such a shift sets new tasks for researchers, including the need to analyse not only individual user experiences but also the wider social, cultural, and ethical consequences associated with the development of immersion. The trajectory from *telepresence* to the *metaverse* shows that research on immersion is becoming a space where technology, society, and global cultural processes intersect. The future of this field requires an interdisciplinary and critical approach, capable of capturing both the micro-experiences of users and the macrostructures of platform-based digital ecosystems.

It is important to note, however, that the present analysis, aimed at identifying key research areas related to immersive media and capturing the dynamics of scholarly interest in this field, was based exclusively on data retrieved from the Scopus database. While Scopus is one of the most recognized and widely used sources of scholarly information, relying solely on this platform inevitably entails certain limitations. As a result, relevant publications indexed in other repositories, such

as Web of Science or Google Scholar, which also gather valuable contributions, may have been omitted. Another limitation concerns the exclusive focus on scientific articles. Although this approach enables the analysis of peer-reviewed research output, the exclusion of other forms of publications may narrow the perspective and result in an incomplete picture of the field's development. The language criterion restricting the analysis to English-language texts constitutes yet another limitation. This may have led to the omission of studies conducted in other linguistic and cultural contexts. Such research, particularly in relation to local applications, could provide important insights into the specificities of immersive media practices. It should also be emphasized that the study relied on article metadata available in Scopus, rather than on the full content of the publications. Such an approach allows for the identification of dominant trends and areas of interest among researchers, but does not fully capture the complexity of the issues discussed or the nuances present in comprehensive studies.

All these factors point to potential directions for further research. Future analyses could profit from expanding the scope to include other databases, a broader spectrum of publication types, and literature in different languages. Complementing metadata-based analyses with full-text examination may, in turn, enable a more in-depth reflection on the conceptualization of immersive media and contribute to the development of a more multifaceted understanding of this rapidly evolving research field.

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Biogram

Wojciech Welskop – dr hab., prof. Uniwersytetu Śląskiego w Instytucie Dziennikarstwa i Komunikacji Medialnej, politolog, socjolog. Jego zainteresowania badawcze dotyczą globalizacji mediów, w tym mediów immersyjnych i ich wykorzystania w edukacji i dziennikarstwie oraz społecznego wymiaru sztucznej inteligencji w mediach. Członek Polskiego Towarzystwa Komunikacji Społecznej.