

# A Bibliometric Study on the Rising Trends of Metaverse Literature in Asia-Pacific Countries

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## Research Article

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# Abstract

The present research employs bibliometric analysis to investigate past and current trends in research and forecast potential areas of research in Metaverse Literatures within the Asia-Pacific region. The bibliometric method was utilized to gather a total of 571 academic publications from the Web of Science database in this study. This research employs co-citation and co-word analyses to identify the most impactful publications, explicate the knowledge framework, and predict emerging trends. The analysis of co-citation revealed the presence of four primary clusters, whereas the analysis of co-word identified three clusters. The significance of Metaverse Literatures research is on the rise in the Asia-Pacific region; however, further investigation is required to furnish a more comprehensive perspective of the research landscape. This study essentially illuminates the research on metaverse and offers a perspective on the prospective future advancement of the domain in the Asia-Pacific regions. This study is distinctive in that it represents the initial attempt to construct a knowledge structure of metaverse in the Asia-Pacific region by means of a science mapping technique.

## Introduction

The concept of the metaverse has gained significant attention in recent years, capturing the imagination of individuals and industries alike. Coined by Neal Stephenson in his science fiction novel "Snow Crash," the metaverse refers to a virtual reality space where people can interact with each other and digital environments (Abbate et al., 2023). With the advancement of technology and the increasing integration of virtual and augmented reality, the metaverse has evolved from a fictional concept to a potential reality. As the metaverse continues to emerge as a significant aspect of our digital future, it is crucial to understand the trends and developments surrounding this phenomenon. In particular, the metaverse has emerged as a potential frontier for innovation and transformation across various industries, such as education, healthcare, business and finance (Koohang et al., 2023; Parcu et al., 2023; Allam et al., 2022). This emerging virtual space offers a solution to the limitations of the current online environment, including a lack of interactivity, immersion, and social presence (Mitra, 2023; Tanucan, 2023). By providing a shared virtual space where users can interact in real-time with each other and digital objects, the metaverse has the potential to facilitate new forms of collaboration, communication, and creativity (Buhalis et al., 2022).

This study aims to conduct a comprehensive bibliometric analysis specifically focused on the Asia-Pacific region. The Asia-Pacific region is known for its rapid technological advancements and diverse cultural contexts, making it an ideal area for investigating metaverse research (Julian et al., 2023). By employing bibliometric techniques, this research seeks to identify the major contributors and institutions engaged in metaverse research within the Asia-Pacific region. The primary objective of this study is to analyse publication patterns, including the growth of literature over time and the distribution of publications across different subfields or topics related to the metaverse. Thought examining the publication landscape, the research will provide a detailed overview of the current state of metaverse research in Asia-Pacific countries. The findings will shed light on key themes and emerging areas of interest within the field. In addition, this analysis will offer valuable insights into the potential implications

and future directions for metaverse research. By understanding the existing knowledge base and research trends, policymakers, researchers, and industry professionals can make informed decisions and identify opportunities for further exploration and development in the field of metaverse.

## Literature Review

The literature on the metaverse in Asia-Pacific countries showcases a growing interest in its diverse applications (Uddin et al., 2023). Researchers have conducted studies and investigations to explore the specific application areas, including education, healthcare, e-commerce, retail and entertainment (Bawack et al., 2022; Kye et al., 2021; Chengoden et al., 2023; Park & Kim, 2022). These studies shed light on the potential of the metaverse to enhance experiences, create new opportunities, and transform industries across different sectors (Yemenici, 2022; De Giovanni, 2023).

One prominent area of application for the metaverse in Asia-Pacific countries is in the field of education and training. Its application in this field offers interactive and engaging environments that empower learners to explore various subjects, collaborate with peers, and acquire practical skills (Shu & Gu, 2023). By immersing students in virtual learning environments, the metaverse enables experiential learning through realistic simulations and scenarios, fostering deeper understanding, critical thinking, and problem-solving abilities (Chen et al., 2023). A key advantage of the metaverse in education is its ability to personalize the learning experience (Han et al., 2023). With customizable avatars and settings, students can adapt their learning environment to suit their individual needs, learning styles, and interests (Suh et al., 2023). This personalized approach promotes student engagement and motivation, leading to improved learning outcomes. The metaverse also transcends physical boundaries, connecting learners and educators globally (Wang et al., 2022). Regardless of geographical location, students can access a vast array of educational resources and engage with experts and peers from around the world. This global connectivity cultivates cross-cultural understanding, collaboration, and the exchange of knowledge and ideas (Yuan et al., 2023). Moreover, the metaverse equips educators with powerful tools to enhance their teaching methodologies (Hwang & Chien, 2022). They can create interactive lessons, virtual field trips, and simulations that enable students to apply knowledge in real-world contexts (Zhang, 2023). Educators can monitor student progress, provide real-time feedback, and customize learning pathways to address individual learning needs (Shu & Gu, 2023).

In the healthcare sector, researchers in Asia-Pacific countries have explored its applications in medical training, patient care, and healthcare access (Murphy et al., 2021). Virtual reality simulations within the metaverse offer a promising tool for medical training, enabling healthcare professionals to practice complex procedures and scenarios in a realistic virtual environment (Farahat et al., 2023). This immersive training experience allows practitioners to enhance their skills, improve patient safety, and gain practical experience before working with real patients (Ali et al., 2023). One of the significant advantages of the metaverse in healthcare is its ability to overcome geographical barriers and enhance access to healthcare services (Tan et al., 2022). Through virtual healthcare consultations, patients in remote or underserved

areas can receive medical advice and treatment remotely, eliminating the need for physical visits to specialized healthcare professionals (Castillo et al., 2023). This remote approach reduces costs associated with traditional healthcare delivery models and improves patient outcomes by enabling timely interventions and proactive healthcare management.

The metaverse also has emerged as a captivating subject of research in the e-commerce and retail industry within the Asia-Pacific region. Researchers have directed their attention towards exploring the potential of virtual shopping platforms within the metaverse to enhance the online shopping experience for consumers (Dwivedi et al., 2023). Virtual shopping platforms within the metaverse offer a unique and immersive environment where users can explore virtual stores, interact with products, and make purchases (Yoo et al., 2023). This interactive and visually appealing setting provides a more engaging and personalized shopping experience compared to traditional online platforms (Koohang et al., 2023). One notable feature facilitated by the metaverse is the integration of augmented reality (AR) technologies. Customers can virtually try on clothes, accessories, and other items, allowing them to visualize how the products would look or fit in real life (Park & Lim, 2023). This augmented reality experience bridges the gap between online and offline shopping, providing customers with a better understanding of the products and facilitating informed purchase decisions. For retailers, the metaverse presents opportunities to create personalized and interactive shopping experiences (Spajić et al., 2022). They can customize their virtual stores, showcase their products in innovative ways, and offer exclusive promotions or virtual events to attract and engage customers (Kaur & Singh, 2023). Furthermore, the metaverse allows retailers to gather valuable data and insights about customer preferences and behaviour. With advanced analytics and tracking capabilities, retailers can gain a deeper understanding of customer interactions within the virtual shopping environment (Adams, 2022). This data can inform marketing strategies, product development, and inventory management, leading to improved customer satisfaction and business growth (Kar & Varsha, 2023).

The comprehensive literature review on the metaverse in Asia-Pacific countries uncovers a diverse array of application domains, emphasizing the region's burgeoning enthusiasm for harnessing the potential of this emerging technology in education, healthcare, e-commerce, retail, and entertainment. As research progresses, it becomes imperative to address challenges surrounding technology, regulations, user acceptance, ethical considerations, and security to fully unlock the metaverse's transformative capabilities in these sectors (Yang, 2023). Consequently, there is a strong anticipation for continued exploration of the metaverse's capacities and its profound implications for various industries in the Asia-Pacific region.

## **Present Study**

The objective of this research is to gain a thorough comprehension of the extant body of literature concerning the metaverse within the Asia-Pacific region. In order to attain this objective, a bibliometric approach is employed to systematically analyze literature on the metaverse in the Asia-Pacific region.

The present research endeavors to bridge a gap in knowledge and furnish significant perspectives on the past, current, and future research domains in the Asia-Pacific region concerning the metaverse. This is achieved through the utilization of two distinct bibliometric analyses. The research objectives that follow are derived from the bibliometric analyses conducted.

1. To conduct a co-citation analysis in order to evaluate the significant past influences and investigate the present trends in the topic of metaverse within the Asia-Pacific regions.
2. To employ co-word analysis in order to identify emerging trends in metaverse research within the Asia-Pacific region.

## **Methods**

### **Bibliometric Technique**

The bibliometric technique is a quantitative analysis method employed in academic research to evaluate scholarly literature (Shaikh et al., 2023). This methodology enables scholars to monitor the development and patterns in a particular area of research, evaluate the influence of academic publications, and comprehend the trends of dissemination, among other facets (Biju et al., 2023). The process entails a range of approaches, including citation analysis, co-citation analysis, co-word analysis, and bibliographic coupling analysis. These approaches are frequently employed to scrutinize extensive collections of scholarly literature.

#### **Co-citation analysis**

The phenomenon of co-citation is observed when a pair of documents are cited together by a third document at the same time (Baraza, 2023). Within the scope of our study, a co-citation analysis would entail the accumulation of a substantial literatures pertaining to the metaverse originating from Asia-Pacific nations, followed by an examination of the interconnections between these publications in terms of their citation patterns. The identification of co-citations among influential works can provide insights into significant past research influences (Tang et al., 2023; Wider et al., 2023). Additionally, analyzing co-citation patterns over a period of time can offer valuable insights into the development of the discipline and highlight present-day tendencies in the exploration of the metaverse within these nations.

#### **Co-word analysis**

Co-word analysis is a bibliometric technique that involves the examination of the frequency with which two words occur together in the same documents (Nyakurukwa & Seetharam, 2023). This methodology is employed for the purpose of detecting nascent patterns and the progression of scholarly themes throughout a given period (Díaz et al., 2023). The initial step in our investigation would entail the identification of a cluster of keywords pertaining to the metaverse. Subsequently, conduct an analysis of Metaverse literature originating from the Asia-Pacific region, focusing on the co-occurrence rate of specific terms within the same textual documents. The analysis can potentially uncover growing patterns

and significant themes in the scholarly investigation of the metaverse within these nations (Gupta et al., 2023).

## Design of the study and data collection methods

Table 1 provides an overview of the parameters employed for conducting the literature search and selection. The "WOS Database" section provides an account of each database included in the Web of Science (WOS). Yan and Zhiping (2023) advocate for the use of WOS databases in bibliometric studies due to their reputation for high-quality and comprehensive content. The criterion of "Time Period" denotes the inclusion of publications that have been released from the database's inception up until June 4, 2023. The search function was restricted to the topic field, encompassing the title, abstract, and keywords of a publication, as indicated by the "Search Field" section. The column labeled "Search Keywords" indicates a focus on articles that feature the term "metaverse". The inclusion criteria for this study limited the scope to solely those countries situated within the Asia-Pacific region, as explicitly stated in the "Countries/Regions" column. The study incorporated all meso-level topics associated with the designated keywords in the "Citation Topics Meso" column. The label "Document Type" denotes the comprehensiveness of all types of documents in the search process, whereas "Languages" pertains to the incorporation of articles in any linguistic medium. The screening process was carried out meticulously, resulting in the identification of 574 articles that were deemed appropriate for subsequent bibliometric analysis. The bibliometric software VOSviewer version 1.6.18 was utilized to perform the data analysis.

Table 1  
*Search String*

<b>WoS Database</b>	<b>ALL</b>
Time Period	Up to June 4, 2023
Search field	TOPIC
Search keywords	Metaverse
Citation Topics Meso	ALL
Document Type	ALL
Languages	ALL
Countries/Regions	Asia-Pacific Countries

## Result and Discussion

### Descriptive Analysis and Publication Trends

The search of the Web of Science database yielded a total of 2,155 citations for the chosen publications (N = 574), with 1,361 of them being without self-citations. The average citation count per article was 3.77, accompanied by an H-index value of 22. The Asia-Pacific region has exhibited an increasing interest in

metaverse research, as evidenced by the 574 publications on this topic. Despite the fact that this line of research was initiated in 2008, noteworthy advancements were not achieved until 2021. Between the years 2021 and 2022, there was an exponential increase in the quantity of publications, rising from 18 to 342. The graphical illustration in Fig. 1 depicts the quantity of academic publications that have been published and the corresponding number of citations received within the timeframe spanning from 2008 to 2023.

## **Co-citation Analysis**

The co-citation analysis was performed utilizing a citation threshold of 51, leading to a cumulative count of 12 cited references. The network analysis based on the aforementioned sources is illustrated in Fig. 2. Table 2 presents a compilation of the ten most frequently cited references that exhibit the highest total link strength. The study conducted by Park and Kim (2022) received a total of 71 citations, while the research conducted by Lee et al. (2021) received 63 citations. Additionally, Dionisio et al. (2013) received 62 citations.

Table 2  
*Top 10 documents based on their co-citation and total link strength.*

No.	Documents	Citation	Total link strength
1	Park, S. M., & Kim, Y. G. (2022). A metaverse: taxonomy, components, applications, and open challenges. <i>IEEE access</i> , 10, 4209–4251.	71	391
2	Lee, L. H., Braud, T., Zhou, P., Wang, L., Xu, D., Lin, Z., ... & Hui, P. (2021). All one needs to know about Metaverse: A complete survey on technological singularity, virtual ecosystem, and research agenda. <i>arXiv preprint arXiv:2110.05352</i> .	63	370
3	Dionisio, J. D. N., III, W. G. B., & Gilbert, R. (2013). 3D virtual worlds and the metaverse: Current status and future possibilities. <i>ACM Computing Surveys (CSUR)</i> , 45(3), 1–38.	62	348
4	Mystakidis, S. (2022). Metaverse. <i>Encyclopedia</i> , 2(1), 486–497.	62	318
5	Ning, H., Wang, H., Lin, Y., Wang, W., Dhelim, S., Farha, F., ... & Daneshmand, M. (2021). A survey on Metaverse: The state-of-the-art, technologies, applications, and challenges. <i>arXiv preprint arXiv:2111.09673</i> .	41	270
6	Kye, B., Han, N., Kim, E., Park, Y., & Jo, S. (2021). Educational applications of Metaverse: possibilities and limitations. <i>Journal of educational evaluation for health professions</i> , 18.	35	218
7	Duan, H., Li, J., Fan, S., Lin, Z., Wu, X., & Cai, W. (2021, October). Metaverse for social good: A university campus prototype. In <i>Proceedings of the 29th ACM international conference on multimedia</i> (pp. 153–161).	41	217
8	Dwivedi, Y. K., Hughes, L., Baabdullah, A. M., Ribeiro-Navarrete, S., Giannakis, M., Al-Debei, M. M., ... & Wamba, S. F. (2022). Metaverse beyond the hype: Multidisciplinary perspectives on emerging challenges, opportunities, and agenda for research, practice and policy. <i>International Journal of Information Management</i> , 66, 102542.	32	216
9	Falchuk, B., Loeb, S., & Neff, R. (2018). The social Metaverse: Battle for privacy. <i>IEEE Technology and Society Magazine</i> , 37(2), 52–61.	28	206
10	Mozumder, M. A. I., Sheeraz, M. M., Athar, A., Aich, S., & Kim, H. C. (2022, February). Overview: Technology roadmap of the future trend of Metaverse based on IoT, blockchain, AI technique, and medical domain Metaverse activity. In <i>2022 24th International Conference on Advanced Communication Technology (ICACT)</i> (pp. 256–261). IEEE.	20	160
Source: Author interpretation based on VOSviewer analysis			

The assessment of co-citations has unveiled three discrete clusters, each characterized by its own thematic focus. The aforementioned clusters denote sets of publications that exhibit thematic similarities



and are interrelated. Clusters containing publications with comparable themes are identified by nodes of identical color. Each cluster is identified and characterized in the following manner:

- Cluster 1, denoted by the color red, comprises of 21 publications that explore the **application and impact of metaverse across various domains**. The publications demonstrate a growing trend towards the incorporation of Metaverse into various industries, including education, business, tourism, and social interaction, with the aim of achieving both experiential and functional goals. Numerous scholars have underscored the prospective applications of the Metaverse in generating captivating, immersive, and interactive encounters (Mystakidis, 2022). The aforementioned practices encompass museum exhibitions (Choi & Kim, 2017), university campus prototyping (Duan et al., 2021), and gamified collaborative learning (Jovanović & Milosavljević, 2022). In addition, scholars have identified that it is being utilized for innovative business practices (Kraus et al., 2022), innovative marketing techniques (Hollensen et al., 2022), and improved consumer involvement (Shen et al., 2021).
- Cluster 2, denoted by the color green, comprises a total of 16 publications that are titled "**technological foundations and development of Metaverse**". The literature within this cluster explores the intricate technological terrain of the Metaverse. Bourlakis et al. (2009) provide a comprehensive analysis of the spatial evolution of retailing from traditional to Metaverse formats. The study examines the transformative impact of technological advancements on retailing formats. This aids in comprehending the evolving nature of commerce within the Metaverse, establishing a framework for forthcoming retail strategies. The centrality of privacy and security is emphasized in the discussions of Di Pietro & Cresci (2021) and Falchuk et al. (2018), as these aspects are fundamental to any digital platform, especially in complex, immersive environments such as the Metaverse. The aforementioned highlights the necessity of implementing strong privacy and security protocols in order to safeguard the well-being of users. Xu et al. (2022) and Yang et al. (2022) have expanded the scope of technological discussion by incorporating nascent technologies such as edge computing, blockchain, and artificial intelligence (AI). The integration of these technologies has the potential to optimize the exchange of data, improve security measures, and facilitate real-time interactions, thereby enhancing the overall experience of the Metaverse. The significance of AI in shaping intelligent interactions and experiences within the Metaverse cannot be overstated, as analyzed by Huynh-The et al. (2022). The integration of AI serves as the foundation for the creation of sophisticated and automated systems, which contribute to the inherent dynamism of the Metaverse.
- Cluster 3, denoted by the color blue, comprises a total of 14 publications featuring the title "**Metaverse-enabled healthcare and medical education transformation**". A noteworthy pattern that can be observed from these publications pertains to the convergence of Metaverse, AI, and healthcare. The utilization of metaverse systems, facilitated by blockchain technology and AI, for various healthcare and educational objectives is a notable trend. The Metaverse is currently being investigated as a potentially advantageous pathway for providing medical education, surgical instruction, and enhancing the provision of healthcare services. Almarzouqi et al. (2022) have made a forecast regarding the inclination to employ metaverse systems in medical education. On the other

hand, Koo (2021) and Thomason (2021) have conducted research on the utilization of the Metaverse in lung cancer surgery training and the wider healthcare transformation, respectively. Additionally, Suh and Ahn (2022) have suggested that they may have a significant impact on learner-centered education in a post-pandemic context. Furthermore, Skalidis et al. (2022) have highlighted the potential of these technologies in specific medical domains, such as cardiovascular medicine, while Tan et al. (2022) have identified their potential applications in ophthalmology.

Table 3 provides a summary of co-citation analysis of metaverse research conducted in the Asia-Pacific region. The table presents cluster labels, publication counts, and representative publications.

Table 3  
*Co-citation clusters of metaverse in Asia-Pacific countries*

Cluster	Cluster label	Number of publications	Representative publications
1 (Red)	Application and impact of Metaverse across various domains	21	Choi & Kim (2017); Duan et al. (2021); Hollensen et al. (2022); Jovanović & Milosavljević (2022); Kraus et al. (2022); Shen et al. (2021); .
2 (Green)	Technological foundations and development of Metaverse	16	Bourlakis et al. (2009); Di Pietro & Cresci (2021); Falchuk et al. (2018); Huynh-The et al. (2022); Xu et al. (2022); Yang et al. (2022).
3 (Blue)	Metaverse-enabled healthcare and medical education transformation	14	Almarzouqi et al. (2022); Koo (2021); Skalidis et al. (2022); Suh & Ahn (2022); Tan et al. (2022); Thomason (2021)
Source: Author's interpretation derived from VOSviewer analysis			

## Co-occurrence of keyword

At least seven occurrences were detected for the 61 keywords that were identified. Based on the results of the co-word analysis, the term "metaverse" has been identified as the most frequently utilized keyword, with a total of 308 occurrences. The terms "virtual reality" and "augmented reality" ranked second and third, respectively, with 85 and 53 occurrences each. Table 4 presents the 15 most frequently co-occurring keywords. Figure 3 illustrates the network configuration of keyword co-occurrences, comprising five distinct clusters that appear to be interrelated. The characteristics of each cluster are assessed and analyzed in the following discussion.

Table 4  
*15 most frequently occurring keywords*

Rank	Keyword	Occurrences	Total link strength
1	Metaverse	308	648
2	Virtual reality	85	259
3	Augmented reality	53	209
4	Blockchain	58	193
5	Artificial intelligence	24	124
6	Virtual-reality	33	116
7	System	24	109
8	Extend reality	19	94
9	Internet	20	92
10	Education	26	90
11	Model	24	89
12	Digital twin	19	82
13	Virtual worlds	14	75
14	Technology	21	74
15	challenges	16	73

- Cluster 1 (Red): This cluster contains 14 keywords under the title “**digital wellness in the Metaverse era**”. The COVID-19 pandemic has accelerated our dependence on digital technologies, making it more important than ever to consider their impact on mental health (Kane et al., 2022). The rise of the Metaverse, an amalgamation of virtual, augmented, and mixed realities, has provided innovative ways for individuals to connect, learn, and entertain (Allam et al., 2022). However, the extent and manner in which these technologies interact with users have major implications for mental health. In response, a focus on "digital wellness" has emerged. This involves using AI and AR/VR technologies to provide immersive, tailor-made mental health care and therapy (Sestino & D'Angelo, 2023). Personalized virtual reality environments offer solace and therapies for stress and anxiety management (Pizzolo et al., 2021), while AI powers empathetic chatbots that deliver round-the-clock psychological support (Lim et al., 2022).
- Cluster 2 (Green): This cluster contains 13 keywords that are broadly related to the topic of “**advanced digital convergence**”. This cluster represents the intersection of cutting-edge technologies in transforming various aspects of life and business. At its core, AI encompassing deep learning and

machine learning, forms the bedrock of this digital revolution (Zaidi, & El Naqa, 2021). AI's ability to self-learn, adapt and improve over time is powering numerous applications (Dellosa & Palconit, 2021), from advanced gaming experiences (Yakan, 2022) to predictive models within Big Data (Zhao et al., 2022). The Internet of Things (IoT) is rapidly proliferating, as everyday devices become interconnected, delivering a more seamless user experience (Ahmed & Alheetim, 2022). The concept of a 'Digital Twin', essentially a virtual replica of physical assets, is an innovative extension of IoT (Shahzad et al., 2022), permitting real-time monitoring and predictive maintenance (Futai et al., 2022). Blockchain technology offers a robust response to the growing privacy and security challenges within this hyperconnected ecosystem (Kalla et al., 2022). By distributing transaction records across a network, blockchain provides an inherently secure, transparent, and immutable system, ensuring the integrity of digital interactions (Rahman et al., 2022).

- Cluster 3 (Blue): This cluster of 13 keywords focuses on the theme of **“acceptance of digital twins in virtual education”**. In the intersection of advanced technology and increased acceptance, a new paradigm has begun to reshape education and healthcare, marked by the rise of 'Digital Twins' and immersive 'Virtual Worlds'. Digital Twins - virtual replicas of physical entities - and avatars, their personal counterparts, are being used to revolutionize these sectors, offering innovative models and opportunities that were previously unthinkable. In education, students are now interacting with complex systems and concepts through their avatars, in richly detailed, engaging virtual worlds (Vallis et al., 2023). This interactive, dynamic learning approach provides an enhanced understanding of subject matter, catering to various learning styles, and promoting inclusivity (Saab et al., 2022). Simultaneously, it is reshaping traditional pedagogical models, increasing the accessibility of quality education to a global audience (Wang et al., 2022).
- Cluster 4 (Yellow): This cluster of 11 keywords focuses on the theme of **“integrated digital design and management systems in architecture”**. The emergent trend from these keywords seems to be the integration of Building Information Modelling (BIM) with digital communication networks, optimization algorithms, quality management, and systems design to revolutionize architecture and construction (Baghalzadeh Shishehgarkhaneh et al., 2022; Habibi, 2022; Ziani et al., 2023; Zhou et al., 2023). This trend is facilitating a shift towards a 0-error or zero-defect approach, where the goal is to minimize errors, inefficiencies, and waste in the building process (Nath, 2022). This integration is essentially creating an internet-based system where all elements of a construction project, from design to management, are unified into a single digital model. Advanced BIM systems, combined with powerful optimization algorithms, allow for high-quality designs that are both efficient and sustainable (Pan & Zhang, 2023).
- Cluster 5 (Purple): This cluster of 10 keywords focuses on the theme of **“virtual learning ecosystems”**. The recent surge in digital education has led to the development of an interconnected, extended learning framework that merges gamification, e-learning, and social media platforms to create immersive virtual worlds (Behl et al., 2022; Vali et al., 2023). These environments, akin to the concept of "Second Life," offer a modern, interactive, and engaging form of education (Mandi, 2023). Users utilize personalized avatars to navigate these realms, enhancing their sense of presence and

connection (Szolin et al., 2023). These virtual learning ecosystems are structured to not only present information but also to facilitate knowledge construction, collaboration, and social interaction (Cui et al., 2023). Emphasizing the "learn by doing" philosophy, gamification elements are integrated, making complex educational content more approachable and enjoyable (Radianti et al., 2020). By tying together gamification and e-learning within a comprehensive online framework, learners are exposed to an extended learning experience that surpasses traditional limitations. This is coupled with the strategic use of social media tools to encourage learner participation, sharing, and interaction, adding a communal dimension to the learning experience.

Table 5 provides a summary of the co-word analysis for sports psychiatry, including cluster labels, the number of keywords, and representative keywords.

Table 5  
*Co-word analysis on metaverse in Asia-Pacific countries*

<b>Cluster No and colour</b>	<b>Cluster label</b>	<b>Number of keywords</b>	<b>Representative Keywords</b>
1 (Red)	Digital wellness in the Metaverse era	14	Artificial-intelligence, augmented reality, care, COVID-19, experience, impact, mental health, metaverse, mixed reality, nft, performance, virtual reality
2 (Green)	Advanced digital convergence	13	Artificial intelligence, big data, blockchains, challenges, deep learning, digital twin, games, internet of things, machine learning, privacy, security
3 (Blue)	Acceptance of digital twins in virtual education and healthcare	13	Acceptance, avatar, digital twins, education, model, opportunities, reality, students, system, technology, virtual worlds
4 (Yellow)	Integrated digital design and management systems in architecture	11	0, building information modelling, communication, design, internet, management, networks, optimization, quality, systems
5 (Purple)	Virtual learning ecosystems	10	Avatars, e-learning, extended learning, framework, gamification, information, online, second life, social media, virtual world.

Source: Author's interpretation derived from VOSviewer analysis

## Implications

### Theoretical Implications

The present study provides valuable insights that contribute to the advancement of theoretical knowledge in the field of metaverse research, particularly within the Asia-Pacific region. By employing bibliometric analysis, this study highlights critical past influences, emerging trends, and potential future research directions in the domain of the metaverse. The findings have several important theoretical implications:

**Expansion of the metaverse research landscape:** This study offers a comprehensive overview of metaverse literature within the Asia-Pacific context, previously unexplored in existing research. Through the analysis of co-citations and co-words, a structured knowledge framework of metaverse research is presented, enhancing our understanding of key trends and thematic clusters in the field. This serves as a vital reference for future research endeavors.

**Uncovering the multi-domain nature of metaverse research:** The findings illuminate the versatile nature of metaverse research, which encompasses various domains such as education, healthcare, business, technology, and architecture. This multidisciplinary approach underscores the transformative potential of the metaverse as a valuable resource across multiple sectors. Furthermore, it emphasizes the necessity for future research to integrate expertise from various fields to expand the theoretical understanding of metaverse applications and challenges.

**Identification of research gaps:** Through analyzing the current state of metaverse research, this study uncovers potential research gaps, providing new avenues for exploration in the field. For instance, the findings suggest the need for in-depth research on the human factors associated with metaverse use, including privacy, security, and digital wellness. Such research has significant implications for developing policies, ethical guidelines, and user-centered design principles.

**Bridging the theory-practice gap:** The study highlights the convergence of advanced technologies, such as AI, IoT, and blockchain, within the metaverse. The identification of these multidimensional synergies contributes to bridging the theory-practice gap and establishes a robust theoretical foundation for the development and implementation of innovative metaverse applications.

**Integration of metaverse in the context of education and healthcare:** The study identifies a growing trend in the deployment of metaverse technologies within the realms of education and healthcare. This necessitates future research to explore the pedagogical, psychological, and social implications of metaverse use in various educational and healthcare environments. Such exploration will contribute to an expanded theoretical understanding of the benefits and challenges associated with integrating metaverse technologies in these sectors.

## **Practical Implication**

The findings of this study provide valuable insights for policymakers, industry professionals, and researchers, facilitating their understanding of promising research directions in the field of the metaverse. The analysis has identified key trends and emerging areas of interest within the Asia-Pacific region, enabling stakeholders to make well-informed decisions and prioritize efforts related to metaverse

applications, technological advancements, educational and healthcare transformations, and digital wellness. The practical implications derived from the analysis are outlined below:

**Identifying and prioritizing metaverse applications:** Organizations and industries should carefully consider the potential benefits and challenges associated with utilizing metaverse technologies in various sectors and explore their applicability to specific domains. This could involve the development of collaborative and interactive virtual environments to enhance user experiences, foster innovation, and address accessibility and inclusivity concerns in sectors such as education, healthcare, tourism, and business.

**Technological advancements and security:** As the metaverse continues to evolve, stakeholders in the technology industry must address the security and privacy concerns raised in emerging research. This may require developing and implementing advanced security protocols, utilizing distributed ledger technologies like blockchain to ensure data integrity and privacy, and resolving technological complexities to facilitate seamless integration and adoption of metaverse technologies.

**Transforming education and healthcare:** Educational institutions and healthcare providers should actively embrace metaverse-based interventions and tools to provide enhanced learning experiences, personalized treatment alternatives, and immersive training scenarios. This may involve developing and implementing virtual learning ecosystems, digital twin representations, and interactive AI-powered solutions to ensure holistic, learner-centered, inclusive educational experiences and effective healthcare services.

**Promoting digital wellness:** As the metaverse expands and integrates into everyday life, the impact on mental health and well-being must be carefully considered. Policymakers and professionals in the healthcare sector should prioritize research on digital wellness, addressing the psychological impact of extensive virtual interactions and developing AI-driven mental healthcare solutions adapted to the metaverse environment.

**Supporting national and regional policies:** Governments and regional policymakers should invest in initiatives that support metaverse-related research, development, and implementation in their respective countries and regions. This may include funding opportunities for research, fostering collaboration between academia and industry, and developing frameworks supporting metaverse-centered innovation and entrepreneurship.

To sum up, this study highlights the significance of stakeholders in the Asia-Pacific region working together and strategically planning to maximize the metaverse's potential. By addressing the identified trends and emerging areas of interest, the Asia-Pacific region can benefit immensely from metaverse advancements, ultimately fostering societal progress and economic growth. To harness the potential of the Metaverse and revolutionize industries in the Asia-Pacific region, it's important for practitioners, researchers, and policymakers to comprehend how it can be practically applied across various sectors. This will ultimately result in an improved quality of life for individuals.

## Conclusion, Limitations and Future Avenues

The bibliometric analysis of metaverse literature in the Asia-Pacific region shows that the field is still in its early stages of development but is growing rapidly. The most active research areas are digital wellness, advanced digital convergence, integrated digital design systems in architecture, and virtual learning ecosystems. These areas will likely remain important as the metaverse evolves and becomes more widely adopted. The analysis also identifies several challenges that need to be addressed to accelerate the development and adoption of the metaverse in the Asia-Pacific region. These challenges include the need for more research on the potential benefits and risks of the metaverse, including its impact on society; the need for more collaboration between researchers, industry, and policymakers to develop and deploy metaverse applications; and the need for more investment in metaverse infrastructure, technologies, and research. Despite these challenges, the bibliometric analysis suggests that the metaverse can be a transformative technology for the Asia-Pacific region. By addressing the challenges identified in this study, researchers, industry, and policymakers can help ensure that the metaverse realizes its full potential to benefit society.

It is important to note that this study's analysis is based on a limited dataset of published papers in Web of Science journals and those written in English. This means that the results may not represent all metaverse research in the Asia-Pacific region, including unpublished research. Future studies should consider expanding the dataset to include papers published in other journals and languages and unpublished research. This would ensure that future studies represent the state of metaverse research in the Asia-Pacific region. Additionally, since the metaverse has the potential to be a powerful tool for economic development in emerging markets, the research could focus on how the metaverse can be used to improve education, healthcare, and access to financial services. In addition, the metaverse also has the potential to promote cultural preservation and sustainability. The metaverse could be used to create virtual replicas of cultural heritage sites, such as museums, archaeological sites, and historic buildings. This would allow people worldwide to experience these sites, even if they cannot travel to them in person. People could also use the metaverse to attend meetings, shop, and socialize without leaving home. This would reduce the need for travel, which would help reduce greenhouse gas emissions. Overall, the metaverse has the potential to be a powerful tool for economic development, cultural preservation, and sustainability. Future research should focus on exploring the potential benefits of the metaverse in these areas.

## Declarations

### Ethical approval

Not applicable.

### Competing interests

The authors declare no competing interests.



## Authors' contributions

Conceptualisation, [WW], [LLJ], and [MAF]; methodology, [WW] and [MAF]; software, [WW]; formal analysis, [WW]; investigation, [WW] and [LLJ]; resources, [WW] and [LLJ]; data curation, [WW] and [LLJ]; writing—original draft preparation, [WW]; writing—review and editing, [LLJ], [JLJ], [JCMT], and [MAF]; supervision, [WW]. All authors have read and agreed to the published version of the manuscript.

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## Availability of data and materials

The datasets used and/or analyzed during the current study are available on reasonable request.

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## Figures

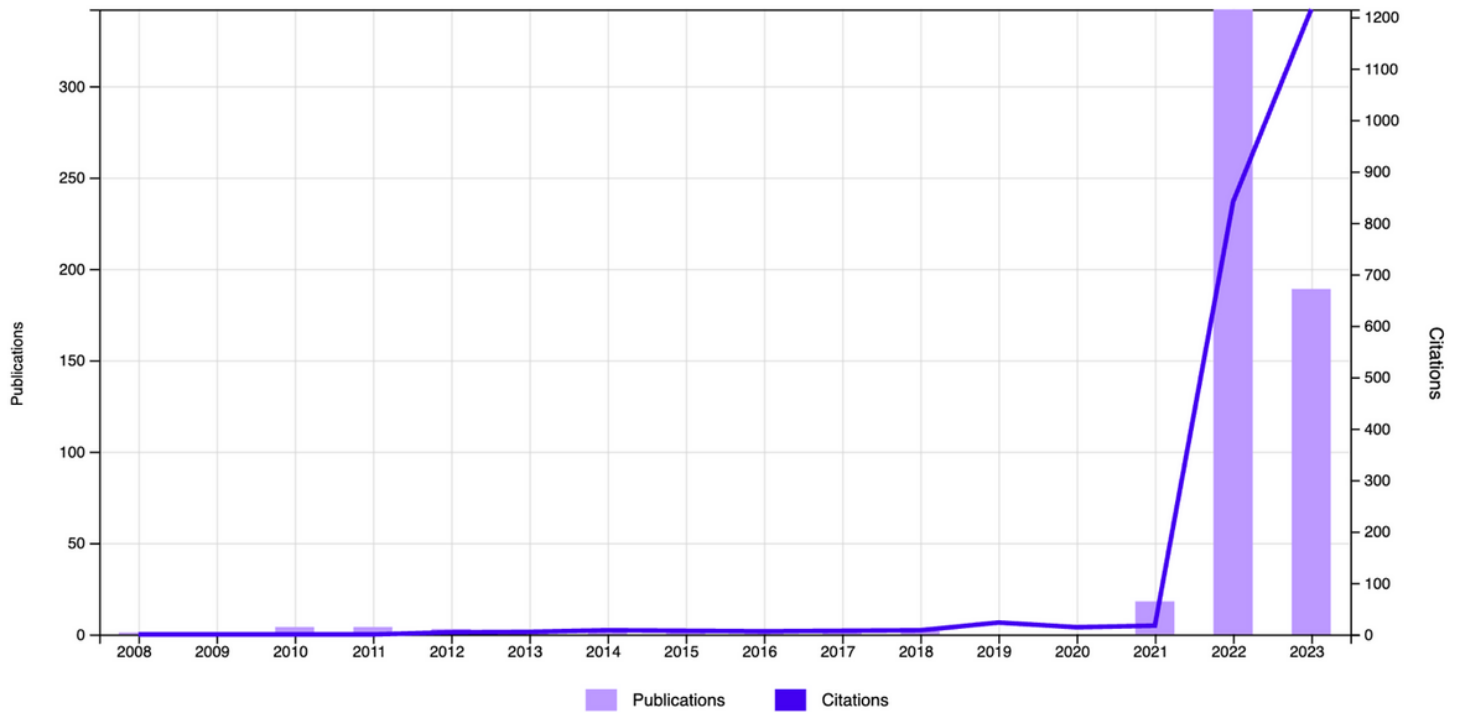


Figure 1

Number of articles published and cited between 2008 and 2023

(source: Web of Science)

