

Avatars and Artificial Intelligence in education: A bibliometric analysis

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Abstract: *This study presents a bibliometric analysis of research on avatars and artificial intelligence (AI) in education using data from the Web of Science. A total of 189 articles were analyzed with WOS viewer to identify key trends, influential authors, frequently used keywords, and global research distribution. The findings indicate that China, the USA, and Germany are leading contributors. The most frequently used keywords include "artificial intelligence," "metaverse," "virtual reality," and "avatar," reflecting a strong focus on immersive learning technologies. Citation analysis highlights influential authors such as Graesser, Dwivedi, Wang, and Yee. Additionally, the study explores alignment with Sustainable Development Goals (SDGs), particularly Goal 3 (Good Health and Well Being). By mapping research patterns and gaps, this study provides insights for scholars, educators, and policymakers to enhance the integration of avatars and AI in education, ensuring effective and inclusive learning environments.*

Keywords: Artificial intelligence, Avatar, Bibliometric analysis, Education, Immersive learning.

1. Introduction

Artificial intelligence (AI) and avatar integration in education are revolutionizing instruction by improving accessibility personalization and engagement (Rizvi, 2024). While AI-driven tools personalize instruction automate tasks and provide real-time feedback avatars as digital representations encourage motivation and teamwork. Even though there is growing interest in this area the studies that are currently available are frequently dispersed and concentrate on particular applications rather than offering a thorough global synthesis.

By performing a bibliometric analysis that methodically maps the research landscape on avatars and AI in education, this study adds to the body of literature. In contrast to earlier research that looks at discrete features of these technologies, this study offers a comprehensive viewpoint by examining worldwide patterns identifying significant writers and publications and emphasizing new themes.

Empirical insights are provided beyond narrative reviews by utilizing bibliometric techniques offering a data-driven understanding of the evolution of the field (Halim et al., 2024; Kniňová, 2024).

Examining how research on avatars and AI aligns with the Sustainable Development Goals (SDGs) of the United Nations especially Goal 4 (Quality Education) and Goal 3 (Good Health and Well-Being) is a significant innovation of this study. The role of AI and immersive technologies in education has been recognized by earlier research but their wider societal impact and contribution to global educational goals have received less attention (Beecken, 2024). By filling in this gap our research not only charts the fields intellectual framework but also emphasizes its applicability to educators and policymakers looking to integrate AI and avatars into inclusive and productive learning settings.

This is accomplished by addressing five major research questions: (1) How is research on avatars and AI in education distributed across countries? (2) What are the most commonly used keywords? (3) Who are the most cited authors? (4) What are the most common words in abstracts? (5) Which SDGs are most referenced? By addressing these questions, fresh perspectives on the development of this field of study will be offered to point out knowledge gaps and suggest future research directions.

By providing a methodical and data-driven viewpoint this current study bridges the gap between artificial intelligence immersive learning and educational policy making it especially pertinent. The research will help academics, educators and policymakers make more informed decisions about incorporating AI and avatars into educational frameworks by providing a better understanding of the direction of this fields research. By demonstrating the originality and value of the work considerable contribution will be made to the understanding of how emerging technologies function in education.

2. Method

2.1 Article selection process

In this study, bibliometric mapping analysis was used. In order to carry out the bibliometric mapping analysis, the literature source was selected as Web of Science. Using the advanced search function, the keywords entered were “Avatar” AND Education” AND “Artificial Intelligence” in the all-field section. A total of 191 published articles relating to the use of Avatar in education were accessed (Access date: February 2025). When English was selected as language, and the document type was limited to articles, book chapter, proceeding papers, and review articles, the number obtained was 189. Then, full records and cited references were downloaded in plain text file format. The file was uploaded to the VOSViewer software.

2.2 Data analysis

Bibliometric analysis illustrates the most recent research patterns within a specific research framework (Kacprzak & Hensel, 2023). Bibliometric research can demonstrate the visualization of intellectual structures using network mapping specific to a research field with important themes which can then help to clarify and discover future research related to a particular research field (Wen et al., 2021).

3. Findings

3.1 Distribution of articles across countries

In order to create a map based on text data for the distribution of the number of articles across countries, the Web of Science bibliographic database file was uploaded into the programme. Then, the field for the minimum number of citations was set as 20. Of the 57 countries, the largest set of connected items that met the criteria were found to be 13. The map created from this is shown in Figure 1. It shows 13 items, 3 clusters, and 56 links and total link strength 116.

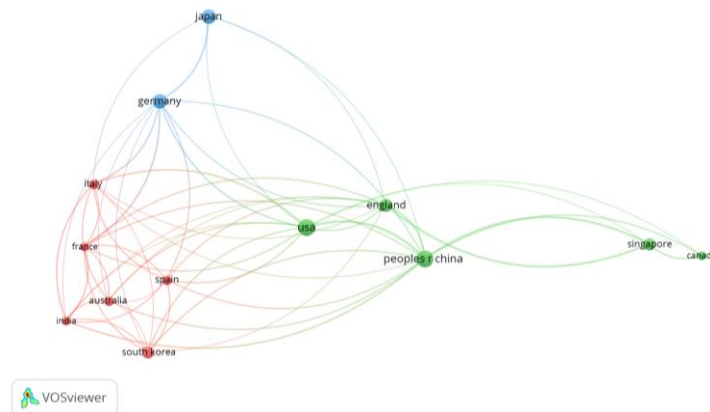


Figure 1. Distribution of articles across countries

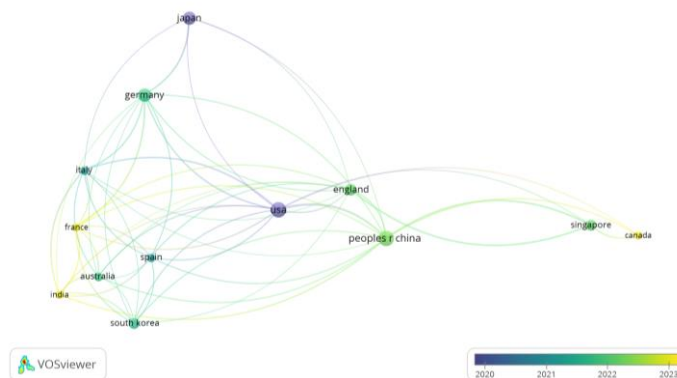


Figure 2. Distribution of the number of articles across countries by year

Table 1. Countries

Country	Documents	Citations	Total link strength
China	37	1568	31
Usa	35	1055	26
Germany	25	941	23
Japan	25	55	8
England	18	961	21
Singapore	16	561	14
South Korea	15	1155	14
Australia	10	967	14
Italy	10	907	19
Spain	10	1068	17
India	8	1104	18
Canada	7	265	6
France	7	1063	21

3.2 Most used keywords in the articles

In order to create a map based on text data for the most used keywords, co-occurrence analysis was used and author keywords were selected. The minimum number of occurrences of a keyword was set as 5 and the number of keywords to be selected was automatically given as 11. The map created is illustrated in Figure 3. It shows there are two clusters and the most used keyword is ‘artificial intelligence’ ($f = 38$). In addition, it is revealed that ‘metaverse’ ($f = 30$), ‘virtual reality’ and ‘avatar’ ($f = 28$) each, ‘avatars’ ($f = 16$) and ‘augmented reality’ ($f = 14$) are the most used keywords. These results indicate that the articles mostly focus on artificial intelligence and metaverse. It can be seen that AR studies in science education began to grow in number in 2013, though the first study was published in Web of Science much earlier, in 1999. When the distribution of the number of articles using the keywords by year is shown, it can be seen that recent articles focus mainly on mobile learning. The distribution of the number of the articles by years is presented in Figure 3.

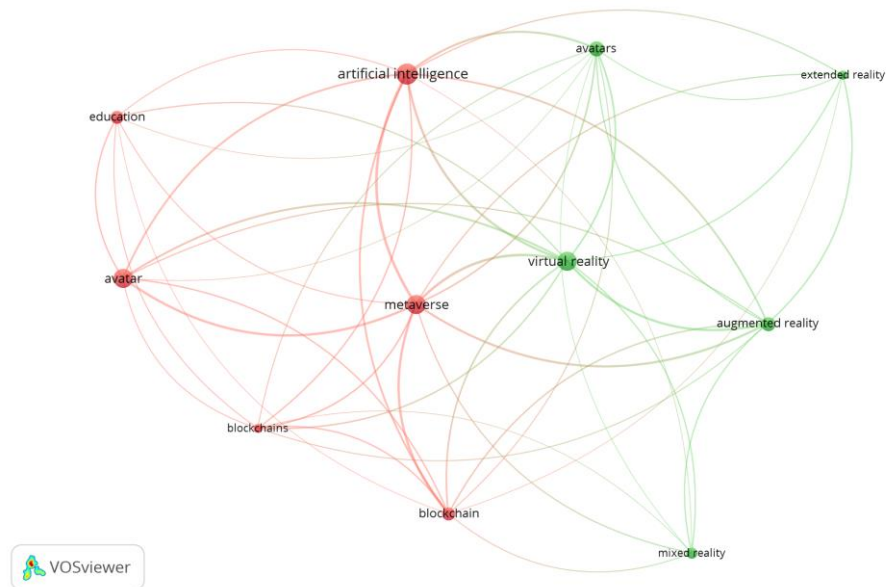


Figure 3. Most used keywords in the articles

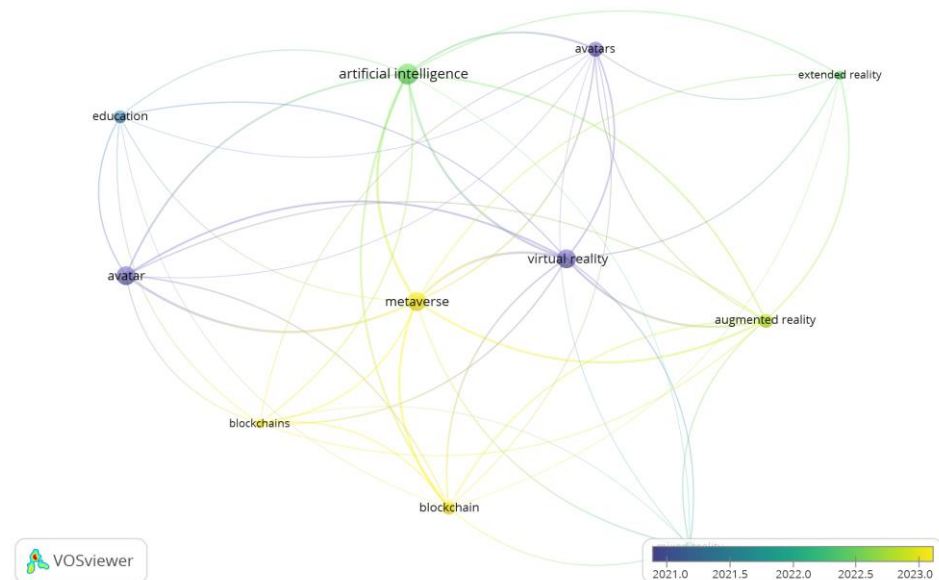


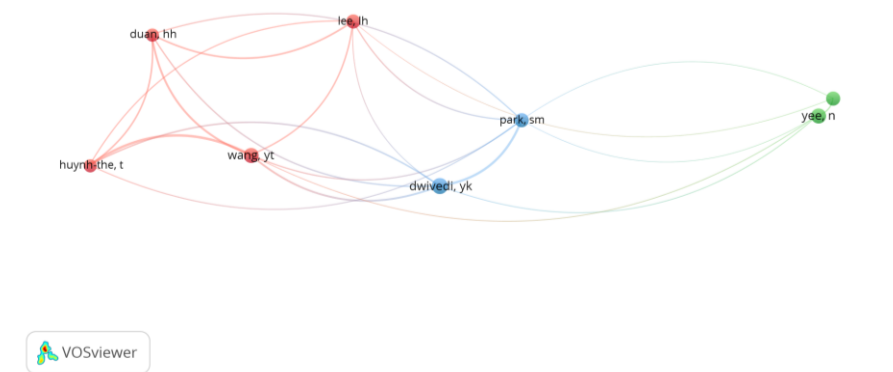
Figure 4. Author keywords by year

Table 2. Co-occurrence of author keywords

Keyword	Occurrences	Total link strength
Artificial intelligence	37	62
Metaverse	30	75
Avatar	29	39
Virtual reality	28	62
Avatars	16	30
Augmented reality	14	44
Blockchain	11	41
Education	11	15
Mixed reality	7	14
Blockchains	5	26
Extended reality	5	16

3.3 Most cited authors

In order to create a map for most cited authors, citation analysis and cited authors were selected. The minimum number of citations of an author was set as 10. The map created is shown in Figure 5. This indicates that Graesser, Ac (18 citation) Dwivedi, Yk (16 citation), Wang, Yt (14 citation), and Yee, N (13 citation).

**Figure 5.** Most cited authors**Table 3.** Most cited authors

Author	Citations	Total link strength
Graesser, Ac	18	0
Dwivedi, Yk	16	38
Wang, Yt	14	48

Yee, N	13	9
Park, Sm	12	31
Bailenson, Jn	11	6
Lee, Lh	11	25
Duan, Hh	10	35
Github	10	0
Huynh-The, T	10	36

3.4 Most used words in the abstract sections

In order to create a map based on text data for the most used words in the abstracts of articles, the Web of Science bibliographic database file was uploaded into the programme. Then, abstract and binary counting method was selected as field. The minimum number of occurrences of a term was set as 10 and the number of terms to be selected was automatically stated to be 45. The map created from this is given in Fig. 4. It shows three clusters and the word ‘technology’ (f=63) is the most used word found in the abstracts, ‘reality’ (f = 51), ‘student’ (f = 44), agent (f = 37), challenge (f = 36), effect (f = 35), metaverse (f = 35), time (f = 30), information (f = 30). These results indicate that the articles mostly focus on technology, agent, challenge, effect, metaverse, time, and information. When the distribution of these words is shown on a year-by-year basis, it is evident that more recent articles tend to focus on student and metaverse. The distribution of the most used words in article abstract is presented in Table 4 and Figure 6 while the distribution of most used words in articles abstract by year is presented in Figure 7.

Table 4. Most used words in the abstracts

Term	Occurrences	Relevance score
Technology	63	0.5558
Reality	51	0.3406
Student	44	0.6845
Agent	37	0.9082
Challenge	36	0.6718
Effect	35	0.7102
Metaverse	35	1.7587
Information	30	0.4073
Time	30	0.5277
Participant	28	1.6567
Experiment	27	1.5136
Tool	26	0.5242
Issue	24	0.7984

Concept	23	0.7455
Human	22	1.2653
Task	22	0.5464
Video	21	0.6889
Patient	20	1.298
Need	19	0.4783
virtual environment	19	0.388
virtual world	19	1.4142
Year	18	1.0019
Group	17	1.1799
implementation	17	0.3411
Opportunity	17	0.8077
Teacher	17	1.1541
Text	17	0.341
Type	17	0.4166
Interest	16	0.6153
Term	16	0.5698
Training	16	1.7694
Addition	15	0.3902
Advancement	15	0.5685
Limitation	15	0.4929
Problem	15	0.7018
Simulation	15	0.5849
Chatbot	14	2.4894
Effectiveness	14	0.6381
Implication	14	1.8385
Order	14	1.6326
Blockchain	12	2.7882
Internet	12	1.7772
Number	12	2.8032
Individual	10	0.4767
Total	10	1.7385

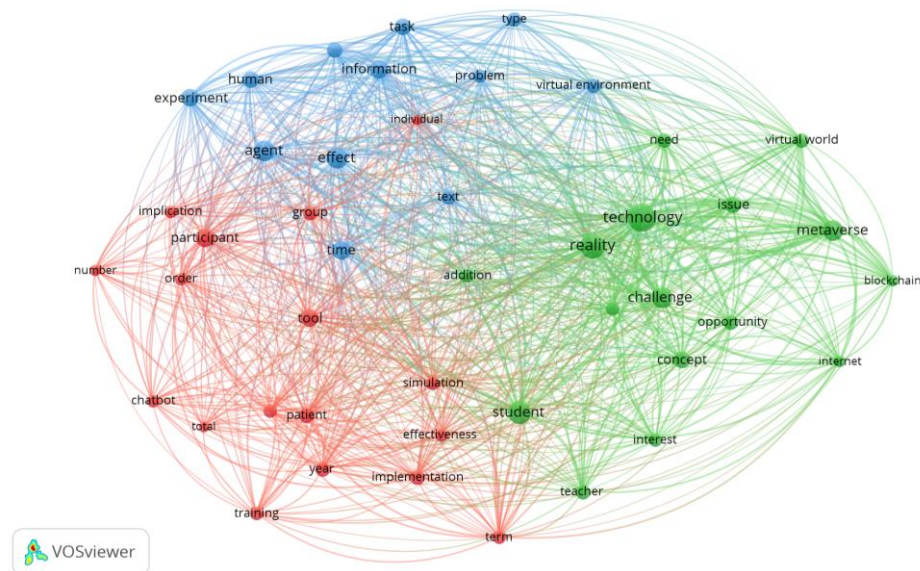


Figure 6. Most used words found in article abstracts

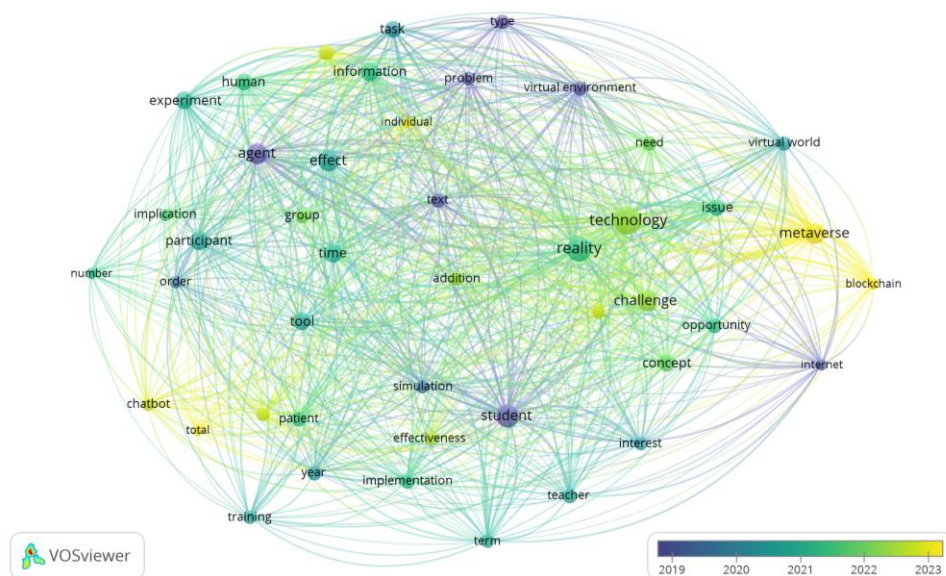


Figure 7. Distribution of most used words in article abstract by year

3.5 Sustainable Development Goal usage in the studies

The data extracted from the web of science shows that SDG 3 ‘good health and well-being’ was found to be used the most in the studies ($f = 38$), SDG 04 ‘quality education’, and SDG 11 ‘sustainable cities and communities’. It is evident

that most of the articles focused on only 6 SDGs out of 17 SDGs as shown below in Table 5.

Table 5. Most Sustainable Development Goal use in the articles

Sustainable Development Goals	Count
SDG: 03 Good Health and Well Being	38
SDG: 04 Quality Education	27
SDG: 11 Sustainable Cities and Communities	8
SDG: 16 Peace and Justice Strong Institutions	3
SDG: 05 Gender Equality	1
SDG: 10 Reduced Inequality	1

4. Discussion

This study was designed with the bibliometric mapping analysis method which aims to analyze literature on the use of artificial intelligence and avatars in education. The studies on the Web of Science database has been examined. According to the findings obtained from VosViewer, Arthur C. Graesser is the most cited author (18 citations).

The results indicate that the most used words in abstracts are technology, reality and student. This finding shows that the studies included in the scope of the research focus on technological aspects on the subject. Moreover, the fact that the word reality is among the most used words indicates that immersive technologies are emphasized in the studies and that technologies such as augmented reality, virtual reality, extended reality are used together with avatars in educational environments. The results of Liarokapis, Milata and Skola's (2024) study indicated that the use of avatars and artificial intelligence technologies with extended reality provides dynamic and engaging learning environments for learners. In parallel with these, the most used words in studies are artificial intelligence, metaverse and avatars.

The finding obtained regarding the usage of Sustainable Development Goals in the studies is also one of the striking findings of the research. Good Health and Well Being SDG has become the most preferred Sustainable Development Goal. The reason for this can be shown as the prevalence of avatars and artificial intelligence applications in health education applications and the fact that research on the well-being and mental health of students can also be carried out using the same technology. Hamilton (2024) argues that the use of these technologies in medical education will make formative simulation more accessible, customizable, realistic, and widespread. The other preferred STG is Quality Education. This finding was not a surprise since the studies within the scope of the research were related to education.

5. Conclusions

In this study, articles in the Web of Science database were scanned with the title “Avatars and Artificial Intelligence in Education” in the scope of bibliometric analysis. The VosViewer software was used in order to obtain data regarding the authors with the highest number of studies, countries where the highest number of studies were conducted regarding the research keywords, the most used words in abstract sections of studies as well as the studies where the most used Sustainable Development Goals are mentioned.

The findings show that based on the research keywords the Professor Arthur C. Graesser at the University of Memphis is the most influential author in the literature. The countries with the highest number of documents in the field of study are the China, USA, Germany and Japan and this finding is also parallel to the number of citations of documents based on the country. As a result, the keywords technology, reality and are the most used in studies. This study aimed to present current research on avatars and artificial intelligence in education and to guide future studies.

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