

Digital Media Reshaping Art Education: A Literature Review in the Age of COVID-19

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Abstract

This study aims to conduct a bibliometric analysis in the field of digital media in arts education. The study's primary objectives were identifying the main topics, authors, sources, and most cited articles. In addition, the study aims to develop a knowledge base on the use of digital media in arts education. We analyzed articles indexed in major scientific databases such as Web of Science and Scopus to achieve these goals. The study results include quantitative analysis supported by tables, graphs, and maps, focusing on digital media in the arts and key performance indicators of scientific production and citations. The total number of articles reviewed was 239, of which 149 were analyzed in detail. The study was an inductive analysis resulting in significant categories of papers cited. These categories include art learning and the use of digital media in art education, the use of digital media in various areas of art education, learning processes using digital media, and current topics related to the COVID-19 pandemic. The study makes an important contribution to understanding the dynamics of the digital media field in education, particularly in the arts context. It can be a starting point for future research and development.

Key words: Distance Learning, Coronavirus Pandemic, Digital Education, Art Education, Educational Technologies

Introduction

Contemporary art education is experiencing significant change and innovation in integrating technology into the educational process. Numerous studies and practical applications confirm that technology solutions significantly impact student learning and development in the arts.

Over time, many art education teachers and educators have realized modern technology's potential. Working with digital tools and multimedia resources allows students to develop creative thinking, self-expression, problem-solving, and visual thinking skills (Surya et al., 2013; Sholihah & Maryono, 2020).

However, despite the apparent benefits, many arts educators remain cautious about integrating digital technologies into their curricula. According to research (Rohotchenko et al., 2021), this is due to the perception that using technology can be difficult and ineffective in achieving educational goals.

A particularly pressing issue is how art teachers can integrate digital technologies into their teaching. The lack of clear recommendations and guidelines leaves teachers alone facing the digital age's challenges.

The scientific community increasingly emphasizes training art educators in modern technology skills. Such competencies can be acquired, among other things, through specialized courses and programs offered by universities (Nurtaev, 2021).

In conclusion, contemporary art educators need to actively embrace technology and integrate it into the teaching process, taking into account the rapid development of digital resources and focusing on the needs and expectations of modern students. Only then will cultural education remain relevant and effective in the 21st century.

Therefore, modern art actively integrates digital technologies into education, making them more interactive and modern. These research and educational programs offer students unique opportunities to develop digital media skills and prepare for today's challenges in the arts.

The study aims to analyze the scientific literature and identify the most significant topics, authors, sources, articles, and

countries using a bibliometric review. This study is based on determining the connection between digital media in art education and identifying how widely they are used and involved in the educational process.

To achieve these goals, scientific articles indexed on the Internet were analyzed. From Science and the main Scopus collection, with analysis of articles and the most pressing topics in articles published up to September 2023. This study addresses the following research questions based on early research (RQ):

Question 1: Which authors and journals significantly influence digital media in art education, and which articles are most frequently cited?

Question 2: What are the main bibliographic graphs and data tables reflecting the knowledge bases for digital media use in art education? This question is intended to provide an opportunity for deeper analysis and presentation of the data structure in a generalized form, contributing to a deeper understanding of current digital media and arts education research.

This article comprehensively analyzes the research questions using bibliometric methods that contribute to a deeper understanding of current digital media and arts education research.

This article is structured as follows: The first part provides an introduction to the study and discusses the study's purpose and the main research questions. The second section includes information about previously conducted studies: a literature review. The third section presents the research methodology and describes the step-by-step structure of searching and identifying literature on digital media in education. The fourth section presents the results. Finally, the fifth section summarizes the findings and suggests directions for future research.

2. Review Literature on Bibliometric Analysis

This study uses the bibliometric analysis method proposed by Pritchard (1969). This method quantifies science communication processes in different contexts (Kirtania, 2023). Bibliometric analysis is a method of researching scientific publications using quantitative indicators to evaluate and analyze the scientific productivity and impact of researchers, journals, and scientific fields (Nandiyanto, 2023). It allows you to identify authors, identify important scientific journals, and analyze methods used and conclusions (Anderson & Lemken, 2023). By analyzing metadata, an overview of a broad research area can be obtained (Zhao et al., 2023).

Bibliometric methods can be used to analyze various aspects such as subject areas (Díaz-Millón & Olvera-Lobo, 2023), scientific journals (Yu et al., 2023), geographical distribution (Wijewickrema, 2023), and other aspects of scientific research.

3. Methodology

This study uses quantitative analysis with bibliometric methods to analyze a selected data set focusing on digital media research in arts education. Pritchard (1969) contributed to the coining of the term bibliometric analysis, a methodological tool for quantifying the process of scientific communication (Yeung et al., 2019). The main purpose of this study is to identify and analyze existing literature on digital media in arts education, followed by creating a knowledge structure map (Arafat et al., 2021).

The first part of the study includes performance analysis and scientific mapping. Bibliometric mapping provides information about connections between disciplines, subject areas, subject areas, specific articles, and authors (Small, 1999). To achieve this goal, we used the recommendations of Cobo et al. (2011) to create a map and identify key thematic areas and structural features in the data set. The methodology was adapted from Rojas-Sánchez et al. (2023).

3.1 Data set

Scientific articles representing a representative cross-section of international research activity were analyzed. These articles were published in professional journals (Levay, 2016). It should be emphasized that documents such as minutes of meetings, editorials, books, chapters, minutes, news reports, and other documents found in databases were excluded from the analysis.

3.2 Sources

A web bibliographic database was used to collect data. From the main Web collection of Science, including journal articles. When choosing this database, we were guided by basic criteria such as quality indices such as JCR, extensive coverage time, and the ability to download many stored references simultaneously (Levay, 2016).

Use the interdisciplinary bibliographic database Scopus to search for information in scientific journal articles organized by topic and subfield. The main advantages of this database are reflected in the following: more excellent coverage compared to Internet Science and the ability to download a significant number of links simultaneously (Bartol et al., 2015).

3.3 Study Selection Criteria

The search was conducted in English to obtain the most comprehensive data on digital media in arts education. Table 1 shows the search results obtained at the very beginning using the search terms. We have established the following criteria for including articles in the main list: document type - articles only, language - English. Exclusion criteria applied to medical fields. This study does not include health professions areas to provide an overview of the broadest possible range of possible applications in training. This is especially valuable for researchers as it guides current and future directions for research exploring the value of virtual reality in times of crisis and isolation, such as the one we have just experienced. A sharp increase in the use of technology characterizes this period.

Table 1. Documents obtained as a result of database search

Base data	Search
VOS	T.I. =(("digital media" and "art lessons*")) or (((("digital media" and "art learning*")) or (((("digital media" and "art lessons*")) or ((("digital media" and "art class*")) or ("digital media" and "art student*"))) or ("digital media" and art)) or ("digital media" and Covid*)) Exclude source: Document type: (other types than Articles), language: (not English) and publication year: 2023 and 2024. Delete (medicine) 99
Scopus	(TITLE ("digital media") AND TITLE ("art*" OR "study art*" OR "teach art*" OR "art class*" OR "art teacher" OR "art student*" OR covid *)) AND (LIMIT - TO (DOCTYPE, " ar")) AND (LIMIT - TO (LANGUAGE, " English ")) Exclude source: Document type: (other types than Articles), Language: (not English). AND (EXCLUDE(SUBYARON, " MEDI ") 140

3.4 Data Analysis Process

Documents for which bibliographic information was available were included in this analysis. This information was obtained by manually reviewing 99 relevant papers in the Science web database (WoS) and 140 documents found in Scopus. During the analysis, 90 duplicate documents were identified and removed. As a result of these actions, 149 documents were combined into one. xlsx. This entire process was represented as a three-step search strategy, shown in Figure 2.

The most commonly used tool for data analysis was the “Biblioshiny” program. Biblioshiny allows you to interactively build various graphs and perform scientometric data analysis (Taqi et al., 2021). The application provides a web interface for easy access to the functionality of the R package “Bibliometrix” (Moral-Muñoz, 2020). It can also provide data in a graphical format for statistical visualization. This study uses graphical elements to present information about digital media in the arts education sector over the selected period. Figure 1 provides an overview of the search strategy used.

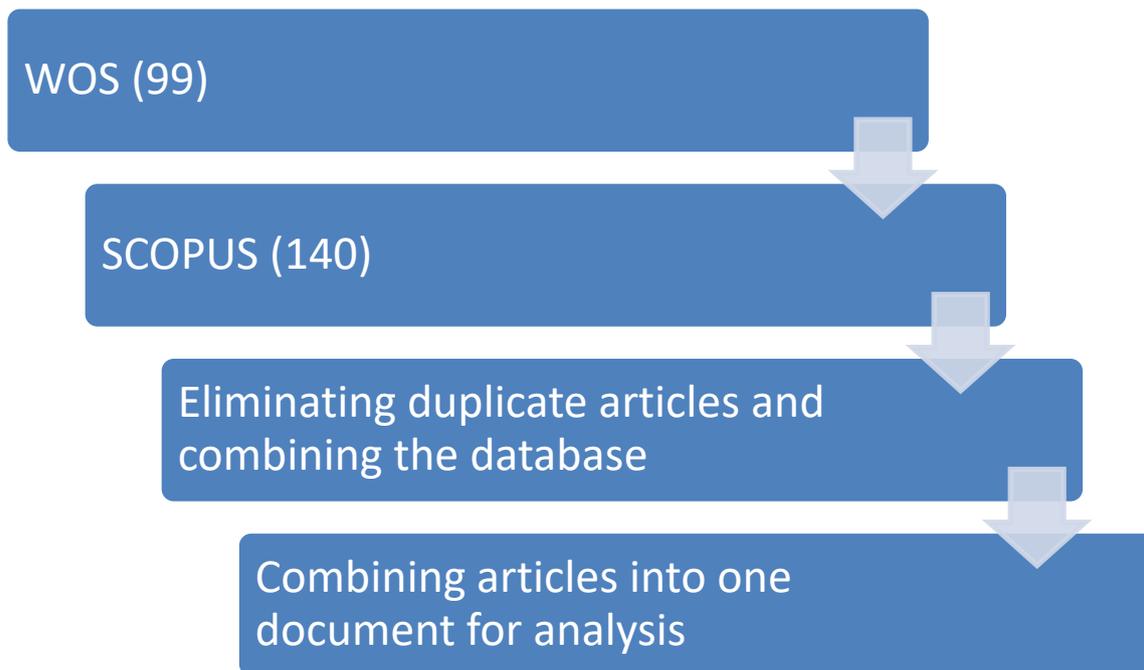


Figure 1. Brief description of the search strategy

4. Results

4.1 SLR Article on Digital Media in Arts Education

Table 2 summarizes systematic literature reviews (SLRs) on digital media and arts education. The number of relevant documents has increased significantly recently, possibly due to current events such as the COVID-19 pandemic and the shift to remote working. This shows that technological innovation in education systems is more important than ever. Digital media in education has become commonplace, and digital media is no exception and is often included in the educational process.

Table 2. Basic information

Description	Results
BASIC DATA INFORMATION	
Period	1986:2024
Sources (magazines, books, etc.)	102
Documentation	139
Annual growth Rate %	0
Document Medium Old	3.11
Middle Quotes Per Doc	5,612
Recommendations	1
CONTENTS OF THE DOCUMENT	
Keywords Plus (ID)	901
author Keywords (German)	416
AUTHORS	
Authors	350
Authors of individual copyright documents	51
COOPERATION WITH AUTHORS	
Lone author Documents	54
Co-authors Per Doc	2.68
International Co-authorship %	15.11.
TYPES OF DOCUMENTS	
Article	149
Article Article	1

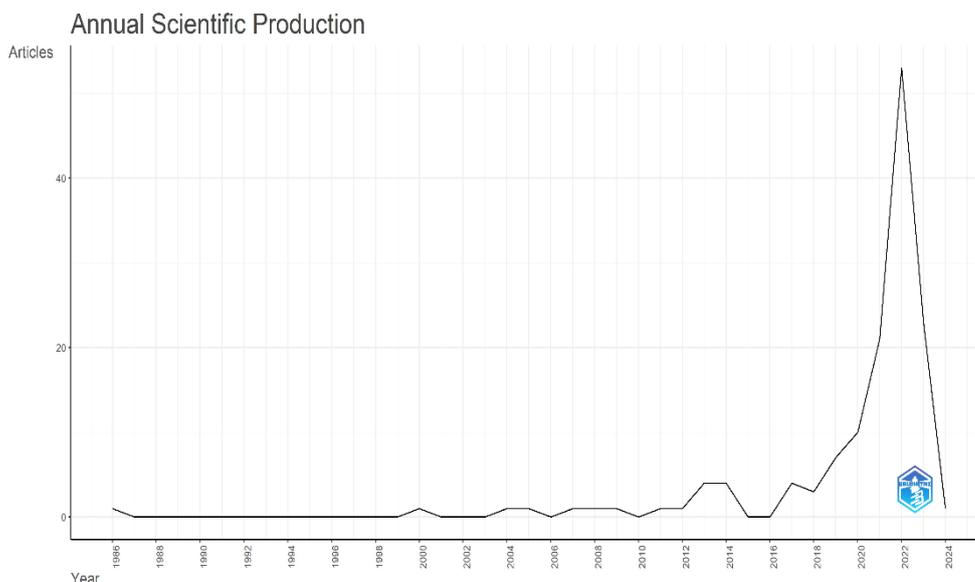


Figure 2. Annual production of publications

An analysis of publication performance over the sample period from 1986 to 2023 shows rapid growth, as shown in Figure 2. This growth is attributed to expanding content in the digital arts space, covering more and more sectors, including real estate, transportation, and security. And even education.

4.2 Analysis of Publications

This performance study involves a primary evaluation method through quote analysis. This method assumes that the

number of citations an article receives correlates with its influence in the field. The index is a widely used measure that reflects the quantity and impact of a researcher's scientific output.

4.2.1 Overview of the Analyzed Data Set

As a result of the data obtained, using the descriptive statistics presented in Table 4, it can be concluded that the relationship between media and arts education tends to increase interest from the academic community, as evidenced by the growth in the number of publications (149) with more than five average citations per article.

The indicator reflected in Figure 3, the average number of annual citations, allows us to assess the topic's significance by year. It should be noted that the highest average number of citations per year was achieved in 2020, amounting to 4.9 citations per year, and in 2022, this figure was 0.8 citations per year. Despite the authors' expectations of significant shifts and changes in the digital media market, the number of recorded citations in 2015 was zero, after which it began to increase slightly until 2018 and then increased sharply, primarily until 2023.

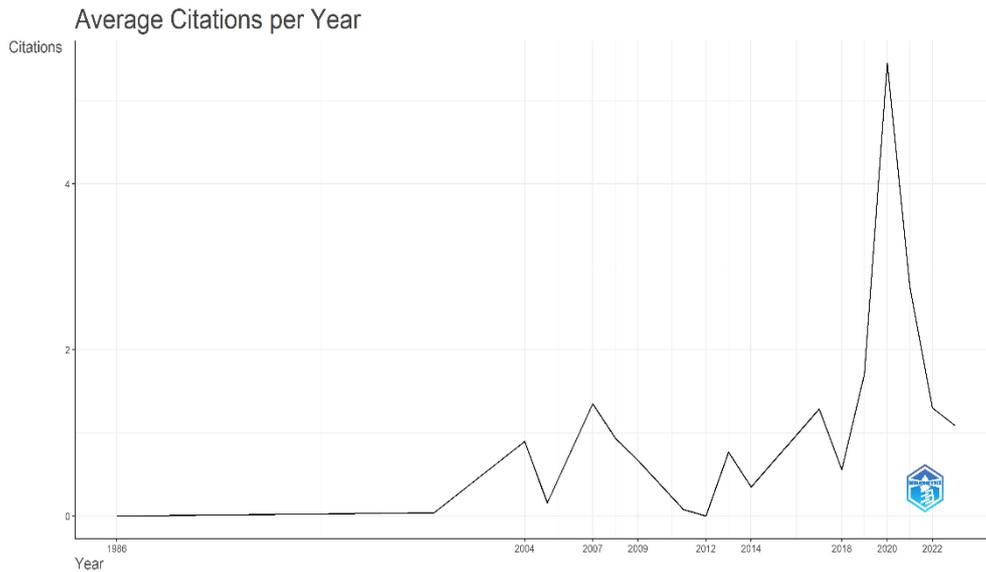


Figure 3. Average annual citations per year

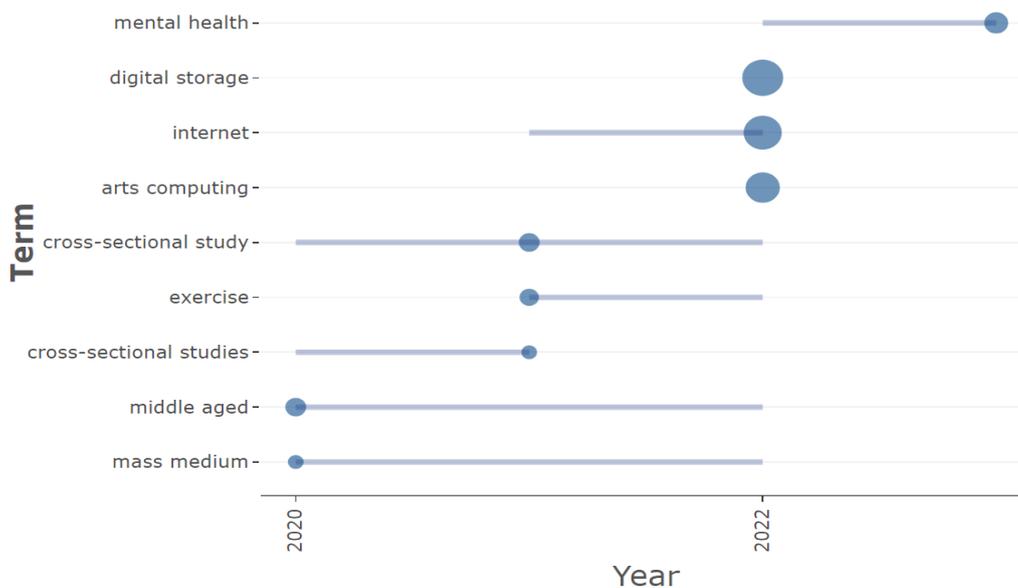


Figure. 4. The most influential publications according to the H- index

Figure 4 reflects information regarding trends in changes in the main current topics from 2020 to 2022: the use of simulation as a teaching tool for accessing education to students during the COVID-19 pandemic. 2019 is different in that preparing for online education has begun. In 2020, there was increased interest in the literature on e-learning using digital tools, allowing students to become interested in e-education. This is likely due to changes in teaching methods

brought about by the COVID-19 pandemic and the abrupt, sometimes unexpected shift from in-person to distance learning. It should be noted that by mid-2023, there will be a trend towards creating platforms that can be used for teaching or participating in lessons. This shows the growing importance of information technology, its user acceptance, and interest in artificial intelligence, deep learning, and digital media.

The journal that published the most articles in this study was Mobile Information Systems (7), with an H-index of 1. This means that the number of journal publications was cited once. Table 3 contains a list of journals sorted by number of articles published and by impact as measured by the H-index.

Table 3. Journals with the greatest productivity and impact

Element	h_inde x	g_inde x	m_inde x	T C	N P	PY_star t
Mobile Information Systems	1	1	0,5	6	7	2022
Frontiers in Psychology	2	3	0,5	13	4	2020
International Journal of Environmental Research and Public Health	2	4	0,66	44	4	2021
Journal of Sensors	1	1	0,33	5	4	2021
Wireless Communications and Mobile Computing	1	4	0,33	17	4	2021
Education Inquiry	2	3	0,18	18	3	2013
Advances in Multimedia	1	1	0,5	1	3	2022
Computational Intelligence and Neuroscience	1	1	0,5	1	3	2022
Computers in Human Behavior	2	2	2	6	2	2023
Creative Nursing	2	2	0,18	8	2	2013
Journal of Medical Internet Research	2	2	0,5	28	2	2020
Leonardo	2	2	0,1	41	2	2004
Theory Into Practice	2	2	0,4	12	2	2019
Frontiers in Psychiatry	1	1	0,5	1	2	2022
Journal of Environmental Media	1	2	0,25	6	2	2020

4.2.2 Authors with the Most Significant Influence according to the H- index

Figure 5 shows the most prolific authors, including Y. Li, Y. Liu, and G. Wang. Figure 5 and Figure 6 rank these authors by level of influence. Notably, Li Yu has the most significant publications - 5 articles. If we evaluate the degree of influence, we will see that Jamerson L. and Liu P. have the highest H- index equal to 2. Each has 2 articles with at least 2 citations (Fig. 7).

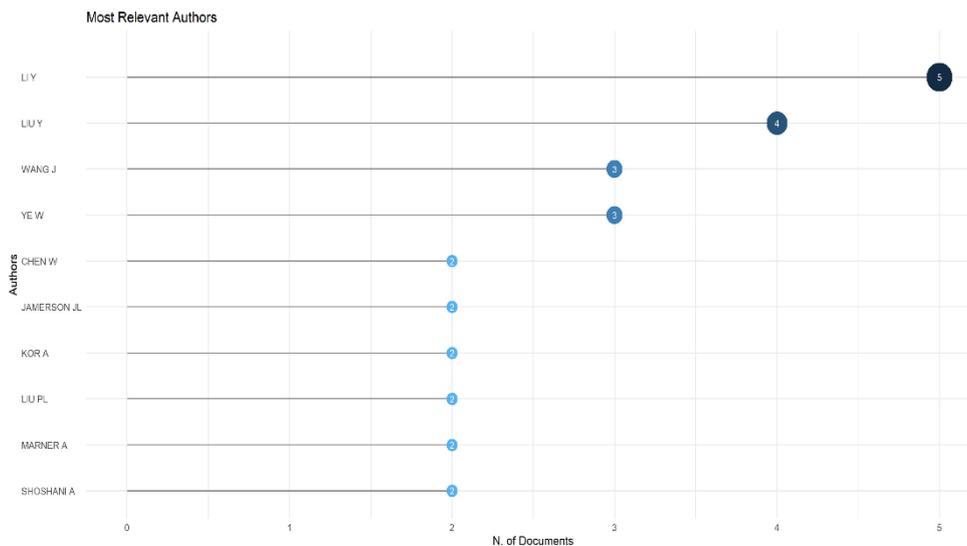


Figure. 5. The most significant authors by number of publications

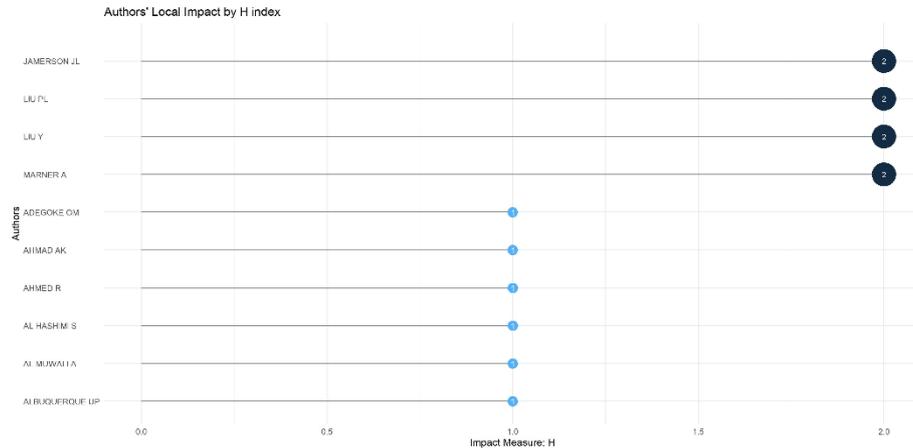


Figure 6. The most significant authors, according to the H-index

The most active authors over the past four years have been Jamerson L, Liu Y, and Liu P, as shown in Figure 7. Jamerson L researches digital, social, and mobile conversational engagement with low-income populations. Liu P studied preventive measures against COVID-19 infection and tested mediation pathways that link four types of digital media consumption (social media, mobile social media apps, online media, and real-time streaming services). Finally, Y. Liu's research touches on various aspects of digital media, information visualization, and artificial intelligence in education. The work notes the importance of student involvement in the educational process, which is enhanced by digital media.

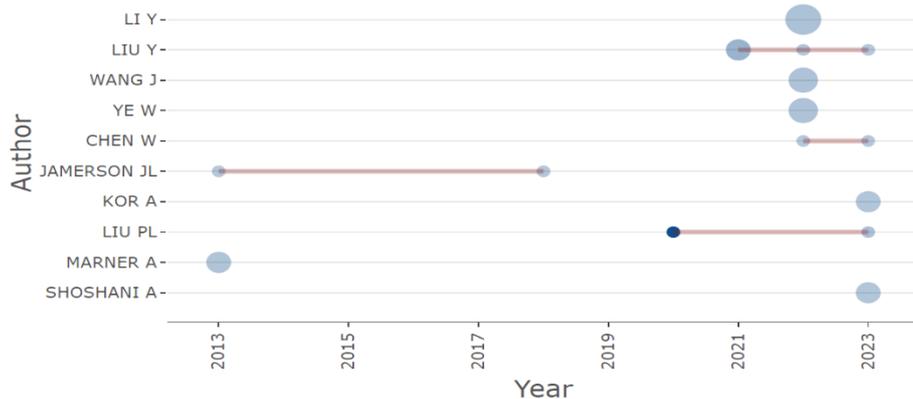


Figure 7. Productivity of the principal authors

The leading educational institutions represented in the analyzed dataset can be seen in Figure 8. It shows that the University of Ningbotech and the University of Padova are the most productive, with 5 articles each. The second one is that of the University of California, with 4 articles.

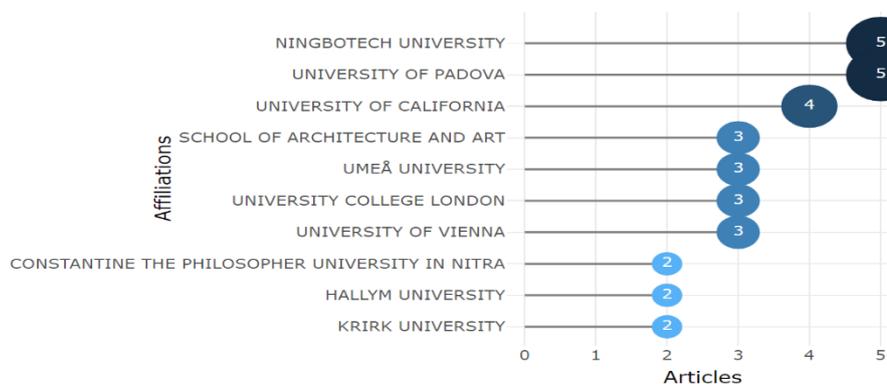


Figure 8. Most influential organizations

4.2.3 Most popular Documents and Most Frequently Used Words in the Dataset

Table 4 shows the papers with the most citations in this study. The author of the most cited article is Liu P. (2020), with 171 citations. In second place is Fleerackers A. (2022), with 37 citations. Both articles were published in *Cyberpsychology, Behavior, Social Networking, and Health Come On*.

Table 4. Most frequently cited documents in the dataset worldwide.

Paper	DOI	Total Citations	TC per Year	Normalized TC
LIU PL, 2020, CYBERPSYCHOL BEHAV NETWORKING	2020, COVID-19 Information Seeking on Digital Media and Preventive Behaviors: The Mediation Role of Worry	171	42,75	7,84
FLEERACKERS A, 2022, HEALTH COMMUN	2022, Communicating Scientific Uncertainty in an Age of COVID-19: An Investigation into the Use of Preprints by Digital Media Outlets	37	18,50	14,21
MUTZ M, 2021, INT J ENVIRON RES PUBLIC HEALTH	2021, Use of Digital Media for Home-Based Sports Activities during the COVID-19 Pandemic: Results from the German SPOVID Survey	35	11,67	4,22
SHUAI L, 2021, GLOBALIZATION HEALTH	2021, Influences of digital media use on children and adolescents with ADHD during COVID-19 pandemic	34	11,33	4,10
AL HASHIMI S, 2019, INT J EMERG TECHNOL LEARN	2019, The Effectiveness of Social Media and Multimedia-Based Pedagogy in Enhancing Creativity among Art, Design, and Digital Media Students	29	5,80	3,38
GONG Y, 2021, ECOL INFORMATICS	2021, Application of virtual reality teaching method and artificial intelligence technology in digital media art creation	26	8,67	3,14
RINEHART R, 2007, LEONARDO	2007, The Media Art Notation System: Documenting and Preserving Digital/Media Art	23	1,35	1,00
STEINHEIDER B, 2004, LEONARDO	2004, Interdisciplinary Collaboration in Digital Media Art: A Psychological Perspective on the Production Process	18	0,90	1,00
LIU Y, 2021, WIRELESS COMMUN MOBILE COMPUT	2021, Holographic Projection Technology in the Field of Digital Media Art	16	5,33	1,93
TSAI JY, 2020, J MED INTERNET RES	2020, Intergroup Contact, COVID-19 News Consumption, and the Moderating Role of Digital Media Trust on Prejudice Toward Asians in the United States: Cross-Sectional Study	16	4,00	0,73

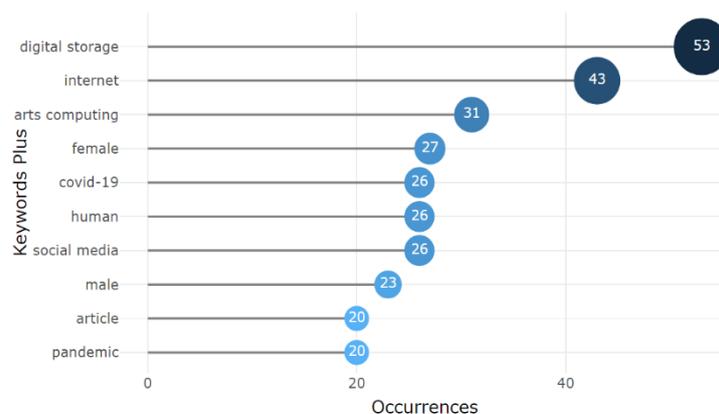


Figure 9. Common current keywords

Figure 9 shows the words that appear most frequently in the data set. The first four words refer to the key terms used in the search strings, but the frequency hierarchy shows the frequency of words such as " Art Computing, "Digital Storage," and "Social Networks."

4.3 Scientific Cartographic Analysis

According to Cobo research et al. (2011), bibliometric maps can reflect the development of a research field, and the conceptual structure of that field can be revealed based on co-citations. By analyzing co-citations and bibliographic context, we can examine the intellectual structure of an academic field. Analyzing co-authorship and affiliations of authors to organizations such as universities or countries also allows us to examine the social structure of a particular field.

4.3.1 Main Themes by Keywords Plus Factor Analysis

Figure 10 shows a two-dimensional plot based on keywords from cited articles. Multiple correspondence analysis summarizes large amounts of data with many variables in a low-dimensional space. This analysis creates a two-dimensional map in which the keywords in the group's center represent topics that have received more attention in recent years, and the keywords on the edges represent topics that are either less studied or included in other topics.

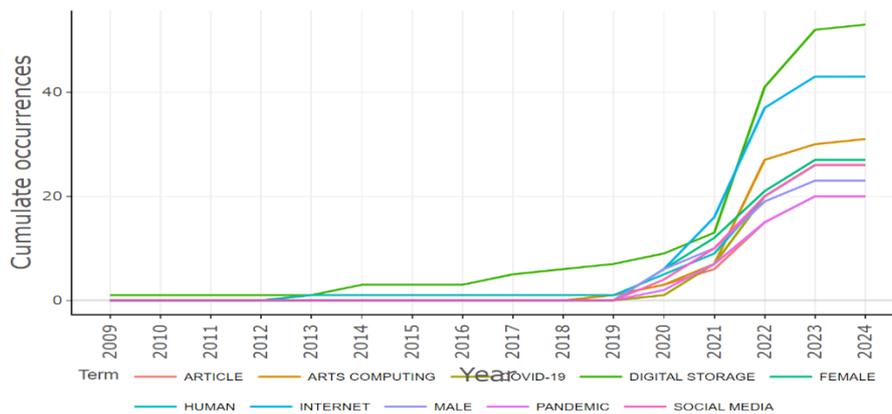


Figure 10. Keywords plus match network

4.3.3 Distribution of Product Productivity by Country

An analysis of the countries with the most significant productivity shows leaders in this field, such as the Republic of China, represented by 75 documents; United States of America - 40 documents; Germany – 12 documents in Figure 11. The high activity of these countries is associated with the technological development of these countries.

China is a global leader in digital technology in media and arts education. Chinese universities are actively developing research in this area to solve problems associated with digital media. This is because Chinese culture is characterized by a high willingness to introduce new technologies. In this regard, China is one of the most important markets in the digital world.

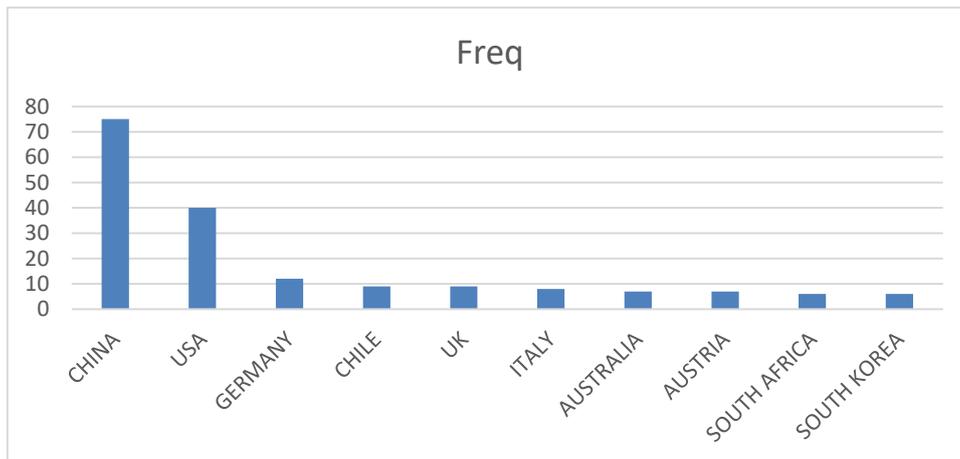


Figure 11. Country of publications

Digital media in education opens up space for e-learning in the arts. A global media space has been formed, and media tools have firmly entered all spheres of human life, becoming practical, multifunctional, convenient tools for daily human activity. The scale and depth of the ongoing changes determined the inevitability of reflecting this situation in art; moreover, they influenced the establishment of new forms of artistic creativity in modern art, a change in creative consciousness, and a change in the language of many types of art.

5. Discussion

The research conducted in this article highlights the importance of integrating technology into the educational process in arts education. The presented material demonstrates that technology in art education is explored and applied in practice, bringing significant benefits to students through developing their creativity, self-expression, problem-solving, and visual thinking skills.

The results showed that the production of digital media documents in art education has increased since 2020, possibly due to increased interest in digital technologies during the COVID-19 pandemic. The 2014 National Core Art Standards place greater emphasis on technology. Adapting to these new standards can help art educators integrate technology into their curricula. Patton and Buffington (2016) believe that media arts should be considered part of the broader fine arts division and that art educators should demonstrate mastery of media arts and media arts standards. Beckett and Brennan (2008) advocate that art teacher preparation programs review required technology courses and expand technology course offerings to include several courses considering media arts as part of acceptable arts standards. Technologies are constantly changing and developing.

The study results showed that China is the leader in the number of publications. However, interestingly, Mobile is the journal with the most publications, and the information system is also located in China.

The paper's authors with the most citations were (Liu P., 2020), with 171 citations, and in second place (Fleerakers, 2022), with 37 citations, both published in the journals *Cyberpsychology, Behavior and Social Networking* as *Health Come On*.

Co-occurrence was used to determine the conceptual structure by analyzing words in the cited articles with Keyword Plus. The most common words are "Art," Computing, "Digital Storage," and "Social Networks." Words covering Keyword Documents Plus topics were analyzed using factor map and cluster analysis.

Despite the widespread adoption of digital media over recent decades, educational institutions have slowly adapted. It is perceived as destructive and is often used for entertainment by students. According to the results of this study, it can be concluded that the use of digital media in art education has very little practical application. However, the shift to online learning caused by the COVID-19 pandemic has seen teachers quickly resort to using technology platforms for learning.

Digital media during the COVID-19 pandemic contributed to the active development of new services and platforms of digital education; on the other hand, it showed the low technical equipment of modern education and the unpreparedness of the majority of teachers, students, and parents for a complete transformation of education and refusal from traditional teaching formats. Students and teachers received good practice in serious work with modern digital technologies and saw shortcomings in their digital competencies. Nevertheless, we all have serious work to solve shortcomings and master new future educational technologies that meet the digital economy's needs. This can be a topic for future contributions.

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Authors contributions

Ileshan Smanov and Olga Stycheva were responsible for study design and revising. Gaziza Smanova was responsible for the methodology. Bibigul Zholdasbekova and Gulzhan Isatayeva handled conceptualization. Ileshan Smanov and Olga Stycheva were responsible for data analysis. Gaziza Smanova was responsible for data collection. Bibigul Zholdasbekova and Gulzhan Isatayeva drafted the manuscript, and Ileshan Smanov revised it. All authors read and approved the final manuscript. All authors contributed equally to the study.

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Data sharing statement

No additional data are available.

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