

A Scientometric Review of E-School1993-2023: Exploration of Current and Future Dynamics in Digital Education

Tahani Aldosemani
ORCID <https://orcid.org/0000-0002-2347-1564>
Prince Sattam University, Saudi Arabia

Nahid Mirshekari
Islamic Azad University, Zahedan, Iran.

Amir Karimi
ORCID <https://orcid.org/0000-0002-0299-1771>
Farhangian University, Iran

Arman Laghaei
ORCID <https://orcid.org/0009-0008-3531-8891>
*Islamic Azad University, Tehran Science and Research
Branch, Iran*

Kourosh Fathi
Farhangian University, Iran

Latefah I Dosimany
King Salman Royal Reserve, Saudi Arabia

ABSTRACT

E-schools, marked by their digital and interactive settings, offer synchronous and asynchronous learning, transcending traditional educational confines. Highlighted during the COVID-19 pandemic, these schools emphasize flexibility and accessibility, crucial for education during crises. The expected post-pandemic growth of e-learning stresses digital literacy, and combines online and conventional learning techniques. Global access to e-learning hints at equitable educational opportunities, despite geographical barriers. This study employs bibliometric analysis to understand e-schools' academic influence, examining related literature, citation impact, and global reach. It explores thematic trends and emerging research areas in e-schools, identifying key publications and contributors. By mapping the global distribution and recognizing leading nations and institutions in e-school research, this study offers a comprehensive view of current and future dynamics in digital education, aiming to guide educators, policymakers, and researchers in this evolving domain.

KEYWORDS

Online Education, E-School, Bibliometric Analysis, Scientometric

A SCIENTOMETRIC REVIEW OF E-SCHOOLS FROM 1993-2023: EXPLORATION OF CURRENT AND FUTURE DYNAMICS IN DIGITAL EDUCATION

E-schools, characterized by their digital and interactive learning environments, have become a significant trend in modern education, breaking free from the constraints of traditional classroom settings. Utilizing a range of online technologies, e-schools, or virtual schools, offer both synchronous and asynchronous learning opportunities. Al Shekaili (2021) emphasizes e-learning as an effective and measurable alternative to traditional education. This flexibility and accessibility have been amplified by the COVID-19 pandemic, which accelerated the transition to online education. The pandemic years underscored the importance of digital, learner-centered educational approaches and showcased

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the potential of e-learning to offer flexible, accessible education during crises (Chikurteva et.al, 2020). Post-pandemic, the role of e-learning is expected to become even more prominent, with an increased emphasis on digital literacy and the integration of online and traditional learning methods. Additionally, the global reach of e-learning signifies an opportunity to create equitable education. With the potential to bridge educational divides, e-schools can offer quality education to diverse populations, irrespective of geographical limitations.

Technological advancements in personal computing and the internet have made e-learning interactive and engaging. E-schools are now crucial providers of innovative learning models and enhanced accessibility; they also present challenges requiring strategic solutions, especially regarding issues regarding effective and equitable education. The integration of advanced technologies, such as AI and IoT, will further enhance remote education, offering personalized and immersive learning experiences. Miroshnyk et al. (2023) discuss the impact of technologies like AI, VR, and AR on e-learning. With advancements in data analytics and machine learning, e-schools are likely to offer even more personalized, and immersive, learning experiences. Adaptive learning systems can tailor content and assessments to individual learners' needs, optimizing the pedagogical process and improving student outcomes. Future e-learning platforms are expected to place greater emphasis on social learning, where collaboration and interaction among students are key components. As e-schools continue to evolve, they are expected to play a vital role in transforming the educational landscape, making student learning more accessible, engaging, and tailored to individual needs. In the future, e-schools are expected to further diversify and personalize learning experiences, with a growing focus on microlearning and gamification. Addressing the digital divide and ensuring equitable access to e-learning resources for students in remote or underprivileged areas, however, will remain a crucial challenge. Furthermore, it is critical to develop e-learning solutions that respect user privacy, ensure the ethical use of educational data, and monitor any impacts on student mental health and wellbeing.

The following study employed bibliometric analysis, guided by two key research questions. The first was: How has the evolution of research in virtual and online schooling from 1993 to 2024, as reflected through performance, country contributions, thematic trends, influential authors, and institutional affiliations, shaped the current understanding and future directions of this field? The second question queried how global trends, technological advancements, and societal shifts have influenced the development and focus of research in virtual and online schooling from 1993 to 2024—and how these factors interact to affect, or even shape, the future of online education more broadly.

In seeking to understand how digital learning environments are reshaping education and the potential developments that could further influence the field, this study examines the body of scientific literature in the field of e-schools or virtual schools, deploying a detailed bibliometric analysis to dissect various facets of this growing research area. Using performance analysis, authors scrutinize the volume, citation impact, and influential reach of e-school research, providing a quantifiable measure of its academic footprint. Globally, e-schools have been influenced by regional cultural, economic, and technological contexts, leading to diverse approaches to their development. The country analysis, therefore, maps global distribution of this research, pinpointing geographical “hotspots” and identifying nations that are making major contributions. Delving deeper, the keywords co-occurrence analysis explores thematic structures within the e-school literature, uncovering dominant topics and trends shaping current research trajectories. This is complemented by the trend analysis that charts evolving priorities and emerging focus areas in e-school research, shedding light on the dynamic and forward-moving nature of this area of study.

Using data drawn from the exploration of current literature, the author analysis segment spotlights prominent researchers and their seminal contributions, recognizing individuals who have significantly influenced the e-school discourse (Derevtsova et al., 2021). This section is intricately linked with the source and citation analysis, which seeks to identify key publications that serve as foundational texts and influential studies in e-school research. Lastly, the affiliations analysis reviews the role played

by various academic and research institutions, pinpointing centers of excellence and innovation in e-school research.

Through this comprehensive approach, this study endeavors to chart the current landscape of e-schools and forecast future directions, highlighting the challenges, opportunities, and evolving dynamics within modern education. The overarching goal of this study is to deepen understanding regarding how e-schools are reshaping educational paradigms, and to provide valuable insights for educators, policymakers, and researchers navigating this rapidly evolving field.

LITERATURE REVIEW

The term “e-schools,” a significant trend in modern education, refers to educational institutions or platforms that operate primarily through digital means, offering a remote learning environment. E-schools utilize various online technologies and platforms to deliver education, transcending traditional physical classroom boundaries. Their digital nature allows for a blend of synchronous and asynchronous learning, providing flexibility and accessibility to learners regardless of their geographical location (Zaguaia et al., 2021). Additionally, e-schools are expected to play a significant role in enhancing student engagement and motivation. Studies have shown that the flexibility and accessibility of e-learning can increase students’ motivation to learn (Wong & Lim, 2023). By adopting e-learning methods, students have engaged more actively with the course materials and participated in various online activities, thus enriching their educational experience. The shift to e-learning has also impacted teachers’ perspectives on education. Studies indicate that teachers have generally had positive attitudes towards e-learning, recognizing its benefits in providing continuity of education during disruptions like the COVID-19 pandemic. This highlights the importance of focusing on digital literacy development and enhancement of adaptability in education systems (Kaur, Laxmi, & Shalini, 2021; Popescu, 2021).

The COVID-19 pandemic catalyzed a massive shift towards online education. This transition reflected a broader shift in educational paradigms towards more digital, flexible, and learner-centered approaches. Globally, the trend towards e-learning is expected to continue, with significant growth in the use and acceptance of e-schools. This shift is anticipated to make education more accessible and flexible, catering to a diverse global student population. The ongoing development of e-learning platforms and the integration of advanced technologies will drive this global trend, reshaping the educational landscape (Popescu, 2021; Manian, 2020; Alfaro et al., 2021).

The historical evolution of e-schools dates back to the 1960s, with the inception of computer-assisted learning (Ivanova, 2021). During these early stages, e-learning primarily served the educational, business, and military sectors, setting the stage for today’s diverse applications (Bezhovski & Poorani, 2016). As technological advancements progressed, notably the rise of personal computers, the World Wide Web, and later mobile technologies, e-schools underwent significant change. Technological strides made e-learning more accessible, interactive, and engaging (Bezhovski & Poorani, 2016). The continued impact of e-schools on education since 2020 highlights their crucial role in the current educational landscape. They offer innovative learning models and enhanced accessibility, but also present challenges that require strategic solutions to ensure effective and equitable education (Bai et al., 2020).

A deeper exploration of the COVID-19 pandemic’s long-term impact reveals both challenges and opportunities for e-schools, indicating a potential paradigm shift in education. During the COVID-19 pandemic as traditional schools closed, e-schools rapidly became a crucial part of the global response to the challenge of maintaining educational continuity (Qiao et al., 2021). This shift to virtual education was a major change, driven by the need for social distancing and the closure of physical campuses. The adoption of e-learning during this period was marked by challenges such as access to technology, internet connectivity, and adjusting to new teaching methods. It also demonstrated the potential of e-learning to offer flexible, accessible education during crises (Kaur et al., 2021; Popescu, 2021).

Even post-pandemic, the role of e-learning is expected to remain more prominent than before. The pandemic has highlighted the importance of digital literacy and the need for educational systems to be adaptable and resilient (Gurcan et al., 2022). The increased reliance on technology in education could lead to more blended learning environments and models where online and traditional methods are integrated. The pandemic has also spurred innovations in educational technology, potentially leading to more advanced and effective e-learning solutions in the future (Popescu, 2021).

The forced adoption of e-learning associated with technological advancements is anticipated to have lasting effects on how education is delivered globally. In Asian countries, technological advancements have led to diverse blended learning models and greater inclusivity. The Arab Gulf region has embraced e-learning to keep pace with global educational standards and technological evolution. In the United States, e-learning's growth has been significantly influenced by policy changes to enhance global competitiveness and educational reform. Each region's unique cultural, economic, and technological contexts have played pivotal roles in shaping the development of e-schools, underlining their importance in today's educational landscape (Lee et al., 2021).

The integration of advanced technologies like IoT, AI, and cognitive models has opened new venues for interactive learning experiences. These technologies can significantly enhance the quality of remote education, offering personalized learning paths and improved engagement. These innovations promise to transform e-learning into more interactive, immersive, and personalized experiences. For example, AI can tailor learning content to individual students' needs, while VR and AR can provide immersive learning environments that simulate real-world scenarios. This evolution is expected to enhance student engagement and improve learning outcomes. The development of intelligent e-learning systems and the use of new web technologies are key areas of focus, shaping how education is delivered and experienced in the digital age (Ivanova, 2021; Alfaro et al., 2021; Miroshnyk et al., 2023). The future of e-schools also includes exploring new dimensions in online education, such as gamification and microlearning, to keep learners engaged and motivated (Popescu, 2021; Idrisova et al., 2020).

There have been challenges, however, in adapting to online teaching methods and tools, highlighting the need for ongoing teacher training and support in e-learning environments. The pandemic highlighted various disparities in e-learning, such as unequal access to technology and internet connectivity (Juneja, 2021). Indeed, one of the most persistent challenges facing the development of e-schools is the "digital divide," which significantly affects access to online education. The lack of adequate digital devices and reliable internet connectivity exacerbates educational inequalities, as students without proper access are unable to participate full in e-learning activities (Faloye et al., 2020). Schools and policymakers must address these challenges to ensure equitable access to education. This involves considering factors, such as socio-economic background and geographical location, that may affect students' ability to participate fully in e-learning.

The research comparing e-learning and traditional education methods indicates mixed results regarding their impact on academic performance and student satisfaction. While some studies suggest that e-learning can lead to higher motivation and similar levels of academic achievement as traditional methods, others point to the challenges of reduced face-to-face interaction and the need for better online assessment strategies (Petruševich, 2020). The impact of e-schools on the social development of students is another area of concern (Zolocheskaya et al., 2021). The shift from a traditional classroom setting to a virtual one leads to decreased direct social interaction among students, potentially affecting their social skills and emotional development (Encarnacion et al., 2021). The lack of face-to-face communication and group activities in e-learning environments might hinder the development of essential social competencies and peer relationships (Eklund & Isotalus, 2024). Furthermore, e-learning may lack the depth and interaction of face-to-face education, potentially leading to lower levels of understanding and retention of knowledge. Additionally, the transition to online education has posed challenges for teachers who may not be adequately trained or equipped to deliver content effectively in a digital format.

As e-schools continue to grow and evolve, educational policies and regulations will need to adapt. This may include developing frameworks that support and regulate online learning platforms, ensuring quality and accessibility, as well as addressing issues such as data privacy and security (Al Shekaili, 2021). Policies need to address the digital divide by ensuring equitable access to technology and internet connectivity. The transformation induced by e-learning is likely to influence policy decisions at both national and global levels, with a focus on creating a more inclusive and effective educational ecosystems (Popescu, 2021). As e-schools continue to develop, significant changes in educational policies and regulations are expected; these changes will likely address the quality of online education, accessibility, and technology integration in learning (Varyani & Navaneeth, 2020). Emphasis will be placed on creating inclusive policies that cater to diverse learners and bridge the digital divide (Jacksi et al., 2021). Additionally, reforms may be focused on enhancing teachers' digital competencies, ensuring that online learning platforms meet educational standards (Varyani & Navaneeth, 2020; Lee et al., 2021).

The following study employs bibliometric analysis, a method that involves quantitative analysis of academic literature to map out trends, patterns, and impacts within a specific field; it aims to delve into the impact, challenges, and future prospects of e-schools. Through bibliometric analysis, researchers seek to understand how these digital learning environments are transforming the educational landscape, the challenges they face regarding technology adoption, quality assurance, and student engagement, and potential future developments (Gao et al., 2022). This bibliometric analysis helps provide insight into how e-schools can continue to evolve and respond to the changing needs of learners and educators in a rapidly digitalizing world.

This article aims to review the scientometrics of the articles published about e-schools by addressing the following research analysis domains: performance, country, keywords co-occurrence, trend, author, source and citation, and affiliations analysis.

METHODOLOGY

Bibliometric Analysis

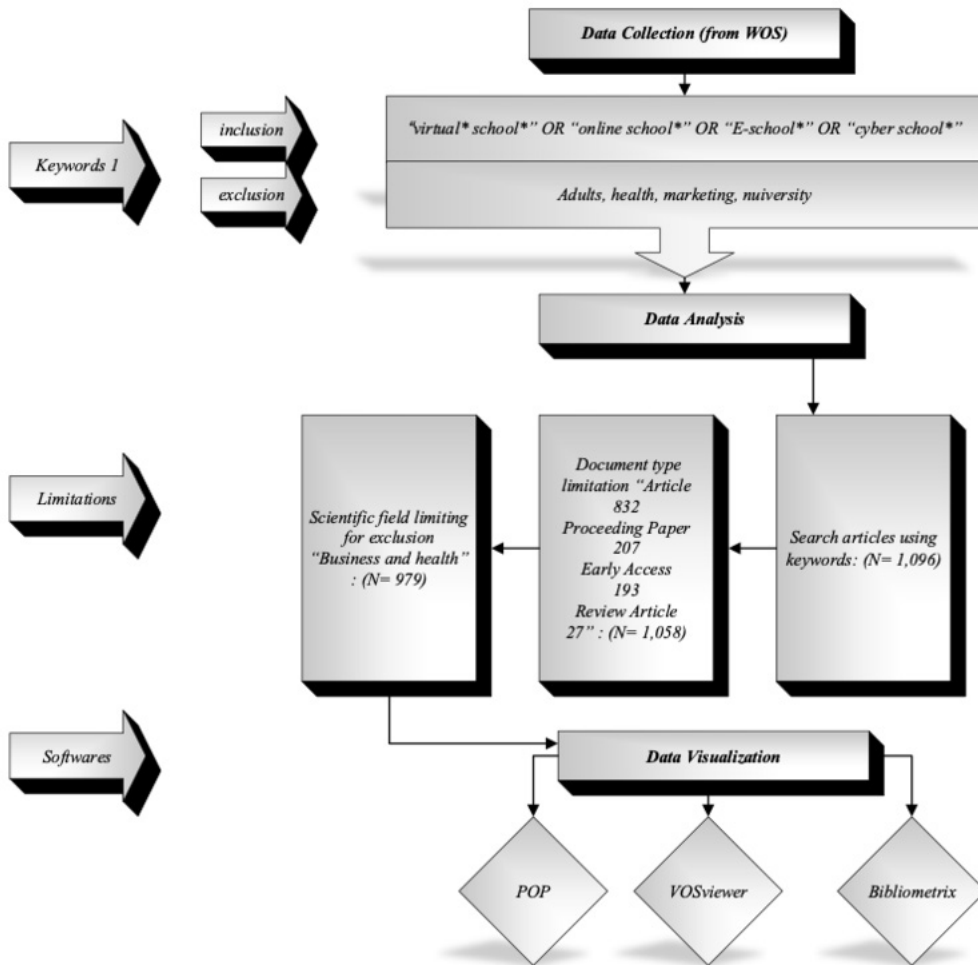
Bibliometric analysis is a quantitative approach to determining the academic value of scientific publications on a particular topic (Doulani, 2020). It comprises reviewing bibliographic information such as citations, publication dates, authors, journals, and keywords (Dehghanbanadaki et al., 2020; Donthu et al., 2021). The key aims are to understand the structure of scientific knowledge, identify trends, and evaluate research output. Citation analysis, publication analysis, journal analysis, co-authorship analysis, keyword analysis, H-index and impact factor, mapping, and visualization are all critical components (Borgohain et al., 2024b; Sikandar et al., 2021). Bibliographic analysis is widely used in academia, research institutions, and policymaking to assess the impact of research, identify influential academics, and aid in strategic decision-making.

Search Strategy and Data Collection

As presented in Figure 1, the methodology for collecting, analyzing, and visualizing data in the field of virtual or online schooling involved a series of steps (Rojas-Sánchez et al., 2022). The first step was data collection from the Web of Science database (4th March 2024), using specific search terms related to virtual, online, e-school, and cyber school. The search query for this study involved multiple variations of terms, and yielded 1,096 articles. The dataset was then refined by limiting document types to specific categories, focusing on primary research articles. The dataset was further reduced to 1,058 articles, after determining document types. The scientific field limitation for exclusion was set to "Business and Health," thus excluding articles from specific fields. The dataset was further reduced to 979 articles. Tools used for data visualization included Bibliometrix for comprehensive bibliometric analysis, VOSviewer for constructing and visualizing bibliometric networks, and Publish

or Perish (POP) for assessing citation metrics and understanding the academic impact of the retrieved articles. This systematic approach aimed to uncover patterns, trends, and critical insights within virtual or online schooling.

Figure 1. The search approach



Bibliographic Mapping Software

Bibliometrix is an R-based program for bibliometric analysis that includes functions for analyzing and displaying data (Linnenluecke et al., 2020; Rusydia, 2021). It calculates productivity, cooperation, and impact indicators, analyzes co-authorship, co-citation, and keyword data, and makes it possible to see bibliometric networks and trends (Fellnhöfer, 2018; Razzaq et al., 2022). In 2018, Nees Jan van Eck and Ludo Waltman of Leiden University’s Centre for Science and Technology Studies (CWTS) created VOSViewer, a software application that allows users to generate maps of scientific literature and show associations between documents, authors, or keywords (Cheng et al., 2021; Orduña-Malea & Costas, 2021). This application generates network visualizations based on co-authorship, co-citation, or co-occurrence links, offers clustering and density visualization, thereby allowing for customizing visualizations (Borgohain et al., 2024; Zyoud & Zyoud, 2021). The

third software that Anne-Wil Harzing created is Publish or Perish, a software application that helps researchers measure the effect of their publications by acquiring and analyzing citation data from sources such as Google Scholar (Alstete et al., 2018). It calculates citation metrics, lets researchers assess their academic influence in comparison to peers, and gives insights into citation trends and areas for growth. These tools help enhance comprehension of scholarly communication patterns and improve strategic decision-making in academic research.

RESULTS

Performance Analysis

The 666 articles from which the data was gathered and evaluated spanned the years 1993 to 2024, as shown in Table 1. With 979 papers, publications has grown at an average yearly rate of 4.57%. The average age of the documents was 7.79 years, and included both recent and past publications. The data contained 2839 author-provided keywords and 1,518 unique Keywords Plus IDs. The 979 papers had contributions from 2,914 writers, demonstrating cooperation and a range of viewpoints. One hundred ninety-one documents had a single author, 184 had a single author, and each document had 3.33 co-authors. There were co-authorships from other countries in approximately 14.5 percent of the papers. Numerous document kinds, including articles, proceedings papers, reviews, and rectification documents, were included in the data. This data offered a thorough overview of the bibliometric data, highlighting patterns in document kinds, growth, collaboration, and citation effect.

Table 1. Main information about the collected documents (Bibliometrix)

| Description | Results |
|------------------------------------|-----------|
| Main information about data | |
| Timespan | 1993:2024 |
| Sources (journals, books, etc) | 666 |
| Documents | 979 |
| Annual growth rate % | 4.57 |
| Document average age | 7.79 |
| Average citations per doc | 11.7 |
| References | 1 |
| Document contents | |
| Keywords plus (ID) | 1518 |
| Author's keywords (DE) | 2839 |
| AUTHORS | |
| Authors | 2914 |
| Authors of single-authored docs | 184 |
| Author collaboration | |
| Single-authored docs | 191 |
| Co-authors per doc | 3.33 |
| International co-authorships % | 14.5 |
| Document types | |

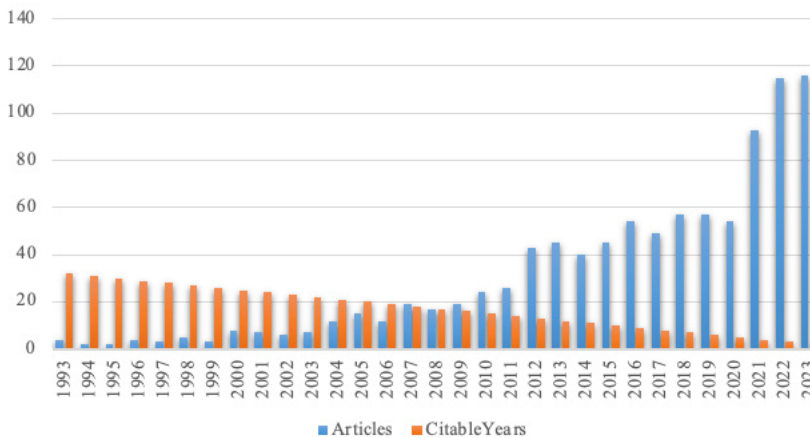
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Table 1. Continued

| Description | Results |
|--------------------------------|---------|
| Article | 578 |
| Article; early access | 168 |
| Article; proceedings paper | 11 |
| Correction; early access | 2 |
| Meeting abstract; early access | 1 |
| Proceedings paper | 193 |
| Review | 18 |
| Review; early access | 8 |

As shown in Figure 2, the year with the most citations was 1993, followed by 1994, 1995, 1996, 1997, to 2023. The citations ranged from 0 to 116. The total number of citations totalled 116.

Figure 2. The growth trend of scientific productions and citation



Country Analysis

The highest link strength was found in the United States (74), followed by England (58), Germany (49), Australia (36), Canada (32), the Netherlands (28), and Italy (26). The document lists countries with the highest number of documents, including the United States (391), People’s Republic of China (79), England (60), Australia (56), Germany (45), Canada (44), Italy (28), Brazil (22), South Korea (18), and India (17). The list of countries with the most citations includes the United States (7750), Canada (801), People’s Republic of China (637), England (597), Australia (357), Finland (329), Belgium (304), and Germany (258).

Due to its muscular link strength, document count, and citation count, the United States leads the world in research cooperation and impact. Nations like Australia, Germany, England, and others also demonstrate significant collaboration and effect in research. China has produced influential research, as evidenced by the large number of citations it has received, despite its smaller document count. New developments in scientific cooperation, especially with China, point to a changing dynamic in international alliances and information sharing. Knowing these trends can help in making

strategic decisions that will increase the worldwide effect of research projects, promote knowledge dissemination, and establish international research alliances.

Author Keywords Co-Occurrence Analysis

In the comprehensive analysis of virtual and online schooling research, a detailed examination of thematic clusters provided valuable insights into the diverse areas of focus within the field. Table 2 categorizes 36 distinct terms that emerged across various clusters, each representing a unique thematic area. This classification revealed eight key themes, reflecting the multifaceted nature of research in virtual and online education.

Table 2. Keywords co-occurrences cluster formation (Data source: WOS, software: VOS-viewer and MS-Excel)

| Label | Occurrences | Total Link Strength | Links |
|-----------------|-------------|---------------------|-------|
| Cluster 1 | | | |
| Adolescents | 76 | 345 | 104 |
| School | 37 | 151 | 81 |
| Youth | 35 | 139 | 69 |
| Mental health | 29 | 152 | 72 |
| Behavior | 28 | 115 | 58 |
| Cluster 2 | | | |
| Education | 91 | 225 | 106 |
| Students | 66 | 245 | 98 |
| COVID-19 | 67 | 189 | 73 |
| Virtual schools | 48 | 103 | 43 |
| Online learning | 41 | 130 | 61 |
| Cluster 3 | | | |
| Children | 84 | 304 | 102 |
| Achievement | 34 | 135 | 61 |
| Intervention | 20 | 74 | 45 |
| Health | 20 | 73 | 47 |
| Parents | 17 | 773 | 51 |
| Children | 84 | 304 | 102 |
| Cluster 4 | | | |
| Perceptions | 26 | 127 | 66 |
| Experience | 20 | 82 | 53 |
| Attitudes | 18 | 61 | 47 |
| Middle school | 14 | 65 | 43 |
| Engagement | 11 | 71 | 45 |
| Cluster 5 | | | |
| Motivation | 29 | 129 | 59 |
| Performance | 30 | 119 | 63 |

continued on following page

Table 2. Continued

| Label | Occurrences | Total Link Strength | Links |
|----------------|-------------|---------------------|-------|
| Predictors | 19 | 102 | 63 |
| Model | 31 | 101 | 65 |
| Social support | 12 | 51 | 42 |

Cluster 1 explored the intersection of teenagers' conduct and mental health within educational settings, highlighting the psychological and behavioral aspects affecting students. Cluster 2 focused on the broader field of education, with particular emphasis on COVID-19's impact on online learning environments and virtual schools, illustrating the pandemic's significant influence on educational practices.

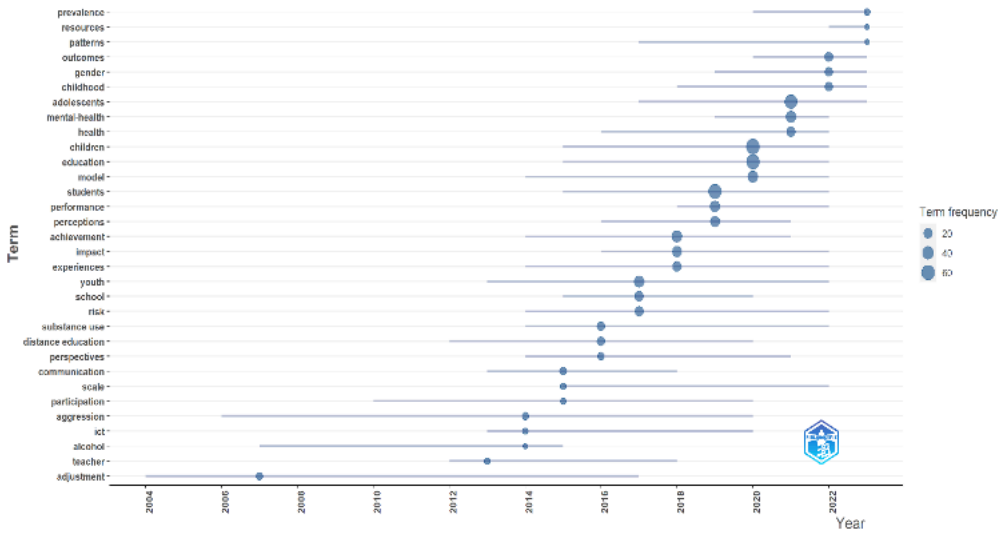
Cluster 3 addressed critical issues related to children's academic achievement, interventions, health, and the dynamics of parent-child relationships, emphasizing the importance of these factors in the context of virtual schooling. In Cluster 4, the research delved into perceptions, experiences, attitudes, and middle school participation, alongside the general school environment, shedding light on how these elements shape students' educational experiences.

Cluster 5 centered on performance, motivation, and predictive models, underlining the role of social support in enhancing student outcomes. This thematic analysis provided a comprehensive overview of the current research landscape, revealing the key areas of interest and ongoing developments in the field of virtual and online schooling.

Trend Analysis

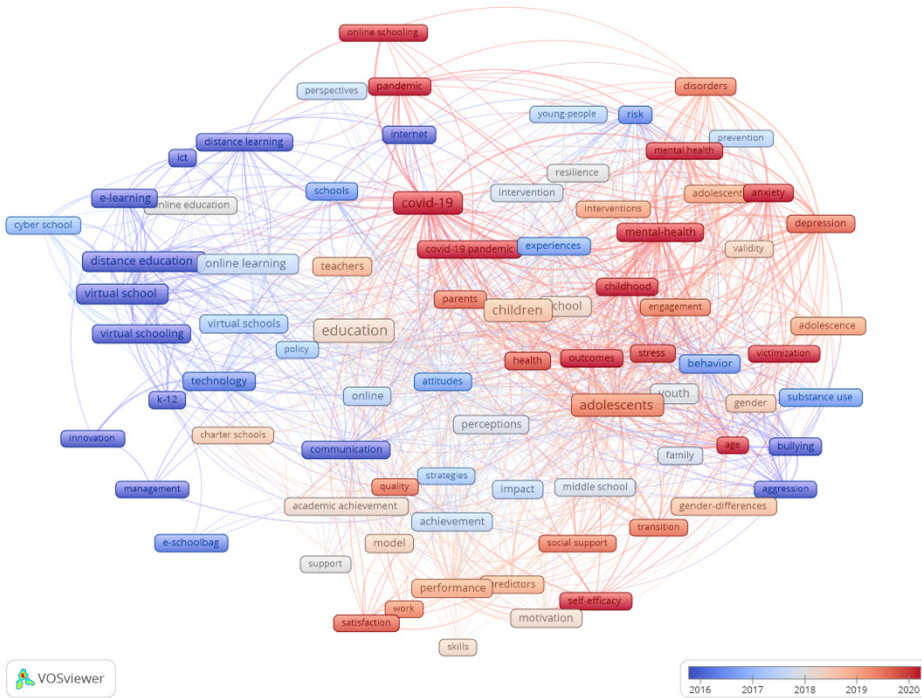
Trending keywords in online school included: item prevalence, resources, patterns, outcomes, gender, childhood, teenagers, mental health, education, children, model, performance, students' perceptions, impact, experiences, achievement, risk, youth, school, substance use, perspectives, distance education, scale, participation, communication, ICT, and aggression. These are shown in Figure 3.

Figure 3. Trend topics (Data source: WOS, software: Biblioshiny—R studio and MS Excel)



In Figure 4, keywords colored blue, such as e-learning, distance learning, management, internet, technology, innovation, and virtual school, are considered basic terms. The terms COVID-19, online schooling, anxiety, mental health, childhood, stress, and self efficacy, are new and considered “hotspots” in the e-schooling research field.

Figure 4. Overlay network of the keywords (Data source: WOS, software: VOS-viewer)



Author Analysis

Table 3 lists the most relevant authors in a specific field, sourced from Scopus and analyzed using Biblioshiny in R Studio and MS Excel. The table shows the authors’ contributions to the field, with Barbour being the most prolific.

Table 3. Most relevant authors

| Author | Affiliation | Documents |
|---------------------|--|-----------|
| Barbour, Michael K. | Touro University California | 20 |
| Beck, Dennis | University of Arkansas System | 13 |
| Borup, Jered | George Mason University | 11 |
| Rice, Mary F. | University of New Mexico | 7 |
| Graham, Charles R. | Brigham Young University | 6 |
| Lin, Chin-Hsi | University of Hong Kong | 6 |
| Maranto, Robert | University of Arkansas College of Education and Health Professions | 6 |

Source and Citation Analysis

Table 4 presents the most globally cited documents related to childhood obesity. These include studies by Brazendale et al. (2017), Anderson et al. (2001), Kuperminc et al (2001), Denham et al.(2012), and Dearing et al (2001).

These studies explore the differences between summer and school obesogenic behaviors in children, the impact of early childhood television viewing on adolescent behavior, the role of early

childhood teachers in fostering emotional competence, and the impact of family income-to-needs on children. These studies highlight the importance of understanding the structure of childhood behaviors and the role of early childhood teachers in shaping children’s emotional competence (Anderson et al., 2001; Brazendale et al., 2017; Dearing et al., 2001; Denham et al., 2012; Kuperminc et al., 2001).

Table 4. The most globally cited documents

| | Authors | Title | Year | Publication | DOI |
|-----|---------------------------|--|------|---|-------------------------------|
| 377 | Brazendale et al., (2017) | Understanding differences between summer vs. school obesogenic behaviors of children: the structured days hypothesis | 2017 | International Journal of Behavioral Nutrition and Physical Activity | 10.1186/s12966-017-0555-2 |
| 265 | Anderson et al., (2001) | Early childhood television viewing and adolescent behavior: The recontact study - Introduction | 2001 | Monographs of the Society for Research in Child Development | 10.1111/1540-5834.00121 |
| 254 | Kuperminc et al., (2001) | School social climate and individual differences in vulnerability to psychopathology among middle school students | 2001 | Journal of School Psychology | 10.1016/S0022-4405(01)00059-0 |
| 212 | Denham et al., (2012) | Early Childhood Teachers as Socializers of Young Children's Emotional Competence | 2012 | Early Childhood Education Journal | 10.1007/s10643-012-0504-2 |
| 196 | Dearing et al., (2001) | Change in family income-to-needs matters more for children with less | 2001 | Child Development | 10.1111/1467-8624.00378 |

Table 5 lists various sources, including the *International Review of Research in Open and Distributed Learning*, *American Journal of Distance Education*, *Online Learning*, *TechTrends*, *Frontiers in Psychology*, *Journal of School Psychology*, *Journal of Research on Technology in Education*, *Education and Information Technologies*, and *EDULEARN18*. These sources contribute significantly to the literature and research on open and distributed learning, distance education, online learning, and educational technology. *The International Review of Research in Open and Distributed Learning* is a significant source for scholarly articles. *The American Journal of Distance Education* is dedicated to distance education research and has published numerous articles on the subject. *Online Learning* is a source dedicated to online learning. *TechTrends* covers educational technology trends, focusing on the technological aspects of education. *Frontiers in Psychology* suggests a connection between psychological factors and online education, while the *Journal of School Psychology* focuses on psychological research on school settings, including aspects relevant to online education. These sources represent a diverse range of journals, conferences, and publications that contribute significantly to the literature and research in these fields.

Table 5. Most relevant sources

| Sources | Articles |
|---|----------|
| International Review of Research in Open and Distributed Learning | 13 |
| American Journal of Distance Education | 12 |
| Online Learning | 12 |
| TechTrends | 11 |
| Frontiers in Psychology | 10 |

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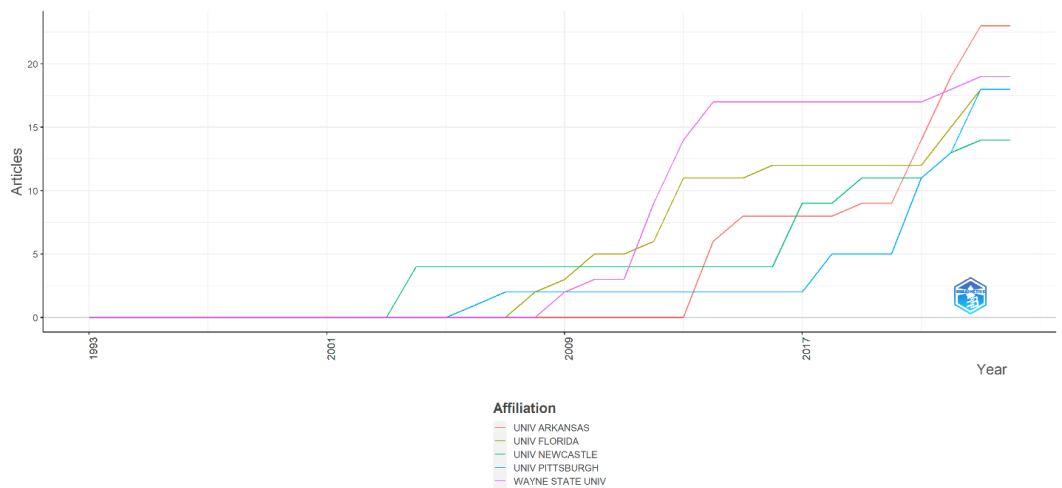
Table 5. Continued

| Sources | Articles |
|--|----------|
| Journal of School Psychology | 10 |
| Journal of Research on Technology in Education | 9 |
| Education and Information Technologies | 8 |
| EDULEARN18: 10th International Conference on Education and New Learning Technologies | 8 |
| Frontiers in Education | 8 |

Affiliations Analysis

Figure 5 shows the number of articles associated with different affiliations, with the top affiliations being the University of Arkansas (23), Wayne State University (19), University of Florida (18), University of Pittsburgh (18), University of Newcastle (14), Northwestern University (13), Arizona State University (12), Brigham Young University (12), University of North Carolina (12), and University of Zagreb (12). These affiliations contribute to the publication of various academic articles.

Figure 5. Affiliations' production over time



Significant advancements in online education have been made by the University of Arkansas and the University of Pittsburgh, particularly in the areas of cutting-edge research, efficient teaching strategies, and creative online learning systems. These developments can be attributed to potentially better technological infrastructure, effective online teaching strategies, excellent course offerings, or discoveries in research that have had a beneficial influence on the online education market.

The majority of the universities on the list were located in the United States, with the University of Arkansas having the most publications. The University of Florida, University of Pittsburgh, and Wayne State University each made further noteworthy contributions. The only universities on the list that are outside the United States are the International University of Zagreb and University of Australia.

DISCUSSION

The bibliometric analysis presented in this study addressed critical questions regarding the evolution of virtual and online schooling research, from 1993 to 2024. By analyzing performance metrics, international collaborations, thematic trends, influential authors, and institutional roles, the study shed light on how these elements have collectively shaped the field's current understanding and future trajectory. Furthermore, the study highlighted the significant impact of global trends, technological advancements, and societal shifts on research focus and development, illustrating how these factors might interplay to influence the future of online education.

The study revealed a diverse thematic focus, substantial international collaboration among authors, and major contributions from countries like the United States, England, Germany, Australia, Canada, and China. The study identified key trends, such as the impact of COVID-19 on online education, and pointed to influential authors and institutions driving this research area. This analysis underscored the dynamic and evolving nature of virtual schooling, reflecting its growing importance in modern education.

In this bibliometric study on virtual and online schooling, seven key areas were analyzed. First, performance analysis was used to assess the overall research output and impact. Second, country analysis was used to explore geographical contributions to the field. Third, keyword co-occurrence analysis helped identify major themes in the literature. Fourth, trend analysis was utilized to examine evolving research focuses. Fifth, the application of author analysis highlighted influential researchers. Sixth, source and citation analysis was used to evaluate key publications and their impact. Finally, using affiliations analysis helped examine the role of academic and research institutions in the field.

Performance Analysis

The bibliometric analysis of 979 papers in virtual or online schooling from 1993 to 2024 revealed a steady growth in these domains, with an average annual increase of 4.57%. This trend underscored the escalating importance and consistent interest in virtual schooling over the past three decades. The average age of the documents, 7.79 years, indicated a well-balanced mix of both historical and current research, providing a comprehensive view of the field's evolution. The vast array of keywords, encompassing 2839 author-provided terms and 1518 unique Keywords plus IDs, highlighted the diverse range of topics and themes under investigation, pointing to shifts in focus and emerging areas of interest within virtual schooling according to global trends. The involvement of 2,914 authors across these papers, with an average of 3.33 co-authors per document, underscored a significant degree of collaboration. The presence of international co-authorships in 14.5% of the papers further emphasized the global relevance and cross-border interest in virtual or online schooling. Interestingly, the data balanced single-author and multiauthor documents, with 191 single-authored and 184 multiauthored papers respectively.

The citation trends revealed that the most significant impact, as measured by citations, occurred in the early years (1993-1997), with a citation range from 0 to 116. This highlighted that the foundational work done during these years has had an ongoing influence on the field. Analysis of citation trends raises questions about the impact of citations on more recent studies, which could be attributed to the time it takes for newer research to be recognized, or a shift in research priorities. This highlights the critical need for adaptability in education to incorporate technological advancements and respond to societal shifts. Additionally, it highlights the necessity of addressing the digital divide and developing comprehensive policies for the effective integration of virtual schooling into broader educational systems and the need for continuous innovation and strategic planning.

Country Analysis

The country analysis, based on bibliographic coupling and citation data, revealed trends in international research collaboration and their impact on virtual or e-schools. These trends highlight

the evolving dynamics in international research collaborations and knowledge sharing. Understanding these global patterns is crucial for strategic decision-making in research collaborations and projects. Such insights also underscore the importance of fostering international alliances and knowledge dissemination to further the field of virtual or e-schools.

The country analysis of virtual and online schooling research offered several insights for a range of stakeholders. Educational policymakers and administrators can learn about the benefits of investing in research and development, as exemplified by leading countries. Researchers and academics are encouraged to pursue international collaborations, drawing from these nations' successful models and high-impact research. Educational institutions and universities can benefit from aligning their research agendas on e-schools with global trends and forging partnerships with institutions in leading countries. The analysis provides valuable direction for technology and e-learning developers to tailor services to meet the evolving educational needs identified in influential research. Lastly, global education policy organizations need to focus on the importance of advocating for equitable knowledge sharing and collaboration to ensure balanced and inclusive growth in virtual schooling.

Author Keywords Co-Occurrence Analysis

The visualization of highly applied terms in previous research provided a detailed thematic mapping of the research in virtual and online schooling. The use of color coding showed distinct research themes and their interconnections and emphasized the growing approach to understanding the multifaceted factors that drive student success in virtual school settings. The thematic analysis of research in virtual and online schooling amplified the importance of addressing psychological and social aspects of adolescent learning and the significant impact of the COVID-19 pandemic on students regarding the swift transition to virtual learning—along with the challenges and opportunities this shift has presented. Furthermore, the research explored qualitative aspects such as perceptions, experiences, and attitudes toward virtual schooling, indicating the importance of understanding how different stakeholders experience and interact with virtual education. Lastly, the emphasis on performance, motivation, predictors, and the role of social support systems underscored the need to identify factors that drive student success in virtual learning environments. These themes provided a comprehensive overview of the current state of research in virtual and online schooling, highlighting the diverse challenges and exploring innovative educational strategies within this evolving field of e-schools. These themes have painted a comprehensive picture of the current state of virtual and online schooling research, shedding light on the challenges and innovative strategies being explored in this increasingly important field of education.

Trend Analysis

The trend analysis presented a close snapshot of the evolving focus areas in e-schools and highlighted the focus on core elements of online schooling research centered around technology and instructional design. The trending keywords offered insights into this domain's current research priorities and emerging topics. The list of trending keywords indicated a broad spectrum of research interests. These terms suggest that the research in online schooling focuses on the educational content and outcomes, as well as the holistic experience of learners in terms of mental health, societal impacts, and their use of technology. The keywords with a blue color represented foundational themes in online schooling research, and appear to be essential topics—in that they appear consistent over time, focusing basic elements and issues within this field of research. On the other hand, terms like “COVID-19,” “online schooling,” “anxiety,” “mental health,” “childhood,” “stress,” and “self-efficacy” were highlighted as new and emerging “hotspots” in e-schooling research. This shift in focus has been a response to recent global events, particularly the COVID-19 pandemic, which has significantly impacted education systems worldwide. The prominence of terms related to mental health and stress reflected a growing awareness of the psychological impacts of online schooling on students. Understanding these trends is essential for researchers and policymakers to effectively address current

needs and challenges in online schooling. This shift indicated that educational strategies should encompass technological advancements and consider students' emotional and psychological needs. Educational researchers and policymakers need to stay attuned to these evolving trends to develop effective, relevant, and holistic online schooling systems that respond to both traditional educational goals and emerging student needs.

The Author Analysis

The author's analysis revealed key contributors in the field of virtual or online schooling, reflecting the importance of both individual expertise and collective efforts in driving understanding of virtual and online schooling. Michael Barbour emerged as the most prolific author, with substantial contributions to the field. Barbour's research covered a wide range of topics within virtual schooling, including seminal or foundational research that has helped shape current understanding and practices. Other notable authors added valuable perspectives and findings to the collective knowledge in this field and played significant roles in advancing research in virtual or online schooling.

Through their individual contributions, these works serve as important resources for understanding the historical and current trends in virtual schooling, offering insights into effective practices, challenges, and potential areas for future research. Moreover, examining the specific focus areas and methodologies employed by these authors provides inspiration and guidance for new research initiatives. It is also important to consider the collaborative networks these authors may be part of, as collaboration plays a crucial role in advancing research. Such collaborations are crucial for bringing diverse insights, fostering innovation, and identifying new research opportunities. Identifying these networks can reveal important connections and trends in the field, potentially leading to new avenues for research and collaboration.

Source and Citation Analysis

The comprehensive source and citation analysis shed light on the breadth of research contributions in childhood obesity and online learning. The globally cited studies by Brazendale et al. (2017), Anderson et al. (2001), Kuperminc et al (2001), Denham et al.(2012), and Dearing et al (2001).

each explore distinct, yet interrelated, aspects of childhood obesity—these studies demonstrate the multifaceted nature of this issue. These studies collectively emphasize the need to understand the behavioral structures in childhood, the influence of socio-economic factors, and the pivotal role of early childhood educators in shaping emotional and behavioral outcomes. Additionally, the variety of sources listed illustrates the interdisciplinary nature of research in these field—sources that play a crucial role in disseminating knowledge and research findings. They provide a rich and varied landscape of research, encompassing aspects of open and distributed learning, distance education, online learning, educational technology, and the psychological dimensions of learning. For researchers and practitioners in these fields, these sources are invaluable for staying abreast of the latest trends, challenges, and opportunities in the rapidly evolving domain of education. The breadth of these studies offers a rich landscape of knowledge, showcasing different approaches and methodologies that can inform and enhance current educational practices and policies.

Affiliations Analysis

The affiliations analysis based on the number of articles published offered valuable insights into the institutions at the forefront of research in online education. This prominence could be attributed to a range of factors, such as strong technological infrastructure, innovative teaching methods, and impactful research contributions that have shaped the online education landscape. The presence of other prominent international universities underscored the global interest and investment in researching and improving online education, emphasizing the importance of cross-border research collaborations and knowledge exchange. The dominance in this list of universities in the United States suggests a potentially higher emphasis or resource allocation for online education research in these institutions.

The larger international representation, however, although limited, pointed towards a growing global interest in the field of virtual and e-schooling. Their high publication count suggested a strong focus on technological infrastructure, innovative teaching methods, and impactful research, indicating that resource allocation and institutional support are key drivers of research productivity and quality.

Understanding the contributions and efforts of these institutions can provide valuable insights into current trends and future directions of online education research, highlighting the importance of these institutions as key players in shaping the global landscape of online and virtual education. Their contributions help in grasping current trends and shaping future research directions, reaffirming the role of these institutions in molding the global landscape of online and virtual education.

Practical Applications of the Findings

Educators

The thematic analysis revealed a broad spectrum of topics, indicating that educators should focus on designing instruction that meets diverse student needs. This can be achieved by incorporating personalized learning pathways and adaptive technologies to enhance student engagement and academic outcomes. Additionally, the emphasis on terms like “anxiety” and “mental health” underscored the importance of integrating social-emotional learning components into the curriculum. By doing so, educators can ensure that virtual learning environments support not only academic success, but also the emotional well-being of students. To effectively implement these emerging trends in virtual education, educators may require ongoing professional development, particularly in utilizing digital tools to monitor and support student well-being. Furthermore, the diverse thematic focus highlighted in the research suggests the need for inclusive practices in virtual schooling, ensuring that learning materials and methods are accessible to students with varying abilities and backgrounds.

Policymakers

The research underscored the critical importance of investing in robust technological infrastructure, which policymakers can use to prioritize equitable access to online schooling, especially in underprivileged regions. By leveraging the insights from the trend analysis, policymakers can engage in data-driven policymaking that addresses current needs in digital education, while anticipating future challenges. Understanding and adopting the successful strategies employed by leading countries can further enhance national e-schooling systems, improving both the quality and accessibility of education. Moreover, the study highlighted the necessity of addressing digital equity through targeted policies, ensuring that all students, regardless of their socio-economic status, have access to the necessary resources for effective virtual learning.

Stakeholders

E-learning developers and other stakeholders can leverage the findings to create innovative educational tools that not only facilitate learning but also address students’ emotional and psychological needs, as highlighted by the focus on self-efficacy and mental health. Additionally, educational institutions and private sector stakeholders can use these insights to forge strategic partnerships that align with emerging research trends, driving innovation in digital learning environments. Incorporating these trends into curriculum development will ensure that educational programs remain relevant and effective, preparing students for success in an increasingly digital world. The identified trends also highlighted new market opportunities within virtual schooling, allowing stakeholders to capitalize on the demand for specialized online programs that cater to evolving educational needs.

Limitations of the Study

While the findings of this bibliometric analysis offered valuable insights into the field of virtual and online schooling, several potential limitations and biases must be acknowledged. Data collection

bias could have influenced the results, as the selection of databases and inclusion criteria might have inadvertently excluded relevant studies, especially those published in non-English languages or in less accessible journals. This exclusion could limit the generalizability of the findings, potentially overlooking important contributions from diverse linguistic and regional contexts. Additionally, temporal bias is a concern, as the higher citation impact observed in earlier years might have reflected the historical evolution of the field, rather than the actual significance of more recent research. This could have led to an overemphasis on older studies in the analysis, skewing the understanding of current trends and emerging areas of interest.

Geographical bias also posed a challenge, with the dominance of research from certain countries, such as the United States, potentially overshadowing contributions from less-represented regions. This imbalance might have resulted in a skewed perspective on global research trends, underestimating the diversity of insights and approaches from other parts of the world. The uneven geographical representation could also have impacted the development of globally relevant strategies for virtual schooling.

Finally, the study's reliance on bibliometric methods, while providing a robust quantitative analysis, introduced the risk of methodological bias. Bibliometric approaches may not fully capture the qualitative impact of specific studies or the nuanced developments within the field of virtual schooling. These methods might have overlooked the depth of certain research contributions, or the contextual factors influencing educational practices, thus limiting the scope of the analysis. Recognizing these potential limitations and biases going forward is essential for interpreting the findings with a balanced and critical perspective, ensuring that future research continues to build a more comprehensive and inclusive understanding of virtual schooling.

CONCLUSION

In conclusion, this exploratory study has provided a comprehensive bibliometric analysis of the burgeoning field of e-schools, encapsulating various facets from performance and country analyses, to thematic explorations through keywords, trends, influential authors and publications. The performance analysis revealed the growing academic interest and impactful contributions within the e-school sector, highlighting the expanding volume of research and its widespread influence. The country analysis offered a global perspective, showcasing the geographical spread of e-school research and identifying leading nations driving this educational innovation. This global distribution underlined the universal relevance and application of e-school methodologies across diverse educational landscapes.

The exploration of keywords and thematic clusters through co-occurrence analysis uncovered the central themes dominating e-school research. These ranged from technological advancements and pedagogical strategies to the psychological and social aspects of virtual learning, reflecting a comprehensive approach to understanding the complexities of digital education. Trend analysis further emphasized the dynamic nature of e-school research, capturing the evolving priorities and emergent focus areas, particularly under the influence of recent global events such as the COVID-19 pandemic. This shift highlighted the adaptability and resilience of the e-school system in response to global challenges and changing educational needs.

The author's analysis recognized the key contributors in the field, shedding light on the thought leaders and their pivotal research that has shaped discourse around e-schools. This was complemented by a detailed source and citation analysis, highlighting the most influential publications and seminal works, reflecting the foundational theories and practices in e-school education. Affiliations analysis provided insight into the leading academic and research institutions championing e-school research, indicating the hubs of innovation and excellence in this domain. The involvement of these institutions underscored the collaborative nature of e-school research and its role in driving educational advancements.

This bibliometric study highlighted the multifaceted nature of e-school research, its global impact, and the potential future trajectories in this field. E-schools, as evidenced by the findings, play a crucial role in the modern educational paradigm, offering flexible, accessible, and diverse learning opportunities. The study underscored the importance of continuous innovation, adaptation, and strategic policymaking to harness the full potential of e-schools in addressing contemporary educational challenges. As the field continues to evolve, it is imperative for stakeholders in education, technology, and policy to collaborate in optimizing digital learning environments, ensuring they meet the evolving needs of learners and educators globally. This research lays the groundwork for future studies and discussions, aiming to contribute to the ongoing transformation of education in the digital age.

The future role of e-schools in education appears to be integral and dynamic. E-schools will be gateways to innovative, inclusive, and effective learning. The integration of cutting-edge technologies is set to redefine educational experiences, making learning more accessible, engaging, and tailored to individual needs. As these systems continue to evolve, they hold the promise of transforming the educational landscape, making learning a more flexible, interactive, and efficient process. Globally, e-schools are expected to maintain their growing relevance in the education sector. The shift towards online education, accelerated by the COVID-19 pandemic, has highlighted the necessity for adaptable and resilient educational systems. Blended and hybrid learning models are likely to become more prevalent, offering a combination of online and traditional methods. This approach is expected to cater to a wider audience and provide more flexible learning opportunities. The ongoing transformation of e-schools presents a promising area for further discussion and research. Exploring the intersection of technology, policy, and education will provide valuable insights into optimizing these digital learning environments. Stakeholders in education, technology, and policy should collaborate to harness the full potential of e-schools, ensuring they meet the evolving needs of learners and educators alike. Continued research and discussion in this field are essential for shaping a future where education is more accessible, equitable, and adaptable to global challenges.

The bibliometric analysis presented in this study addresses critical questions regarding the evolution of virtual and online schooling research, from 1993 to 2024. By analyzing performance metrics, international collaborations, thematic trends, influential authors, and institutional roles, the study sheds light on how these elements have collectively shaped the field's current understanding and future trajectory. Furthermore, the study highlights the significant impact of global trends, technological advancements, and societal shifts on research focus and development, illustrating how these factors interplay to influence the future of online education.

COMPETING INTEREST

The authors of this publication declare there are no competing interests.

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CORRESPONDING AUTHOR

Correspondence should be addressed to Tahani Aldosemani; tahaniaaldosemani1@gmail.com

REFERENCES

- Alfaro, L., Rivera, C., Luna-Urquizo, J., Castañeda, E., Zúñiga-Cueva, J., & Rivera-Chavez, M. (2021). New trends in e-technologies and e-learning. *Proceedings of the 2021 IEEE World Conference on Engineering Education (EDUNINE)*, 1-6. DOI: 10.1109/EDUNINE51952.2021.9429120
- Alstete, J. W., Beutell, N. J., & Meyer, J. P. (2018). History and evolution of scholarly metrics and impact factors. *Evaluating Scholarship and Research Impact*, 10(1), 21–65. DOI: 10.1108/978-1-78756-387-220181003
- Anderson, D. R., Huston, A. C., Schmitt, K. L., Linebarger, D. L., Wright, J. C., & Larson, R. (2001). Early childhood television viewing and adolescent behavior: The recontact study. *Monographs of the Society for Research in Child Development*, 66(1), 154. <https://www.jstor.org/stable/3181552> PMID: 11326591
- Bai, Y., Li, H., & Liu, Y. (2020). Visualizing research trends and research theme evolution in e-learning field: 1999–2018. *Scientometrics*, 126(2), 1389–1414. DOI: 10.1007/s11192-020-03760-7
- Bezhovski, Z., & Poorani, S. (2016). The evolution of e-learning and new trends. *Information and Knowledge Management*, 6, 50–57.
- Borgohain, D. J., Bhardwaj, R. K., & Verma, M. K. (2024b). Mapping the literature on the application of artificial intelligence in libraries (AAIL): A scientometric analysis. *Library Hi Tech*, 42(1), 149–179. DOI: 10.1108/LHT-07-2022-0331
- Brazendale, K., Beets, M. W., Weaver, R. G., Pate, R. R., Turner-McGrievy, G. M., Kaczynski, A. T., Chandler, J. L., Bohnert, A., & von Hippel, P. T. (2017). Understanding differences between summer vs. school obesogenic behaviors of children: The structured days hypothesis. *The International Journal of Behavioral Nutrition and Physical Activity*, 14(1), 1–14. DOI: 10.1186/s12966-017-0555-2 PMID: 28747186
- Cheng, P., Tang, H., Dong, Y., Liu, K., Jiang, P., & Liu, Y. (2021). Knowledge mapping of research on land use change and food security: A visual analysis using CiteSpace and VOSviewer. *International Journal of Environmental Research and Public Health*, 18(24), 13065. DOI: 10.3390/ijerph182413065 PMID: 34948674
- Chikurteva, A., Spasova, N., & Chikurtev, D. (2020). E-learning: technologies, application and challenges. *Proceedings of the 2020 XXIX International Scientific Conference Electronics (ET)*, 1–4. DOI: 10.1109/ET50336.2020.9238176
- Dearing, E., McCartney, K., & Taylor, B. A. (2001). Change in family income-to-needs matters more for children with less. *Child Development*, 72(6), 1779–1793. DOI: 10.1111/1467-8624.00378 PMID: 11768145
- Dehghanbanadaki, H., Seif, F., Vahidi, Y., Razi, F., Hashemi, E., Khoshmirsafa, M., & Aazami, H. (2020). Bibliometric analysis of global scientific research on Coronavirus (COVID-19). *Medical Journal of the Islamic Republic of Iran*, 34(1), 51. DOI: 10.47176/mjiri.34.51 PMID: 32934940
- Denham, S. A., Bassett, H. H., & Zinsser, K. (2012). Early childhood teachers as socializers of young children's emotional competence. *Early Childhood Education Journal*, 40(3), 137–143. DOI: 10.1007/s10643-012-0504-2
- Derevtsova, I., Kartapoltseva, M., Snitsareva, P., & Sych, S. (2021). E-learning system development: Challenges and threats in the digital economy. *Baikal Research Journal*, 12(3), 150–160. DOI: 10.17150/2411-6262.2021.12(3).10
- Donthu, N., Kumar, S., Pandey, N., & Gupta, P. (2021). Forty years of the International Journal of Information Management: A bibliometric analysis. *International Journal of Information Management*, 57, 102307. DOI: 10.1016/j.ijinfomgt.2020.102307
- Doulani, A. (2020). A bibliometric analysis and science mapping of scientific publications of Alzahra University during 1986–2019. *Library Hi Tech*, 39(4), 915–935. DOI: 10.1108/LHT-06-2020-0131
- Eklund, M., & Isotalus, P. (2024). Having it both ways: Learning communication skills in face-to-face and online environments. *Frontiers in Education*, 9, 1270164. DOI: 10.3389/feduc.2024.1270164
- Encarnacion, R., Galang, A., & Hallar, B. (2021). The impact and effectiveness of e-learning on teaching and learning. *International Journal of Computing*, 5(1), 383–397. DOI: 10.25147/ijcsr.2017.001.1.47
- Faloye, S., Ajayi, N., & Raghavjee, R. (2020). Managing the challenges of the digital divide among first year students: A case of UKZN. *Proceedings of 2020 IST-Africa Conference (IST-Africa)*, 1–11. <https://researchspace.ukzn.ac.za/handle/10413/16823>

- Fellnhofer, K. (2018). Visualised bibliometric mapping on smart specialisation: A co-citation analysis. *International Journal of Knowledge-Based Development*, 9(1), 76–99. DOI: 10.1504/IJKBD.2018.090502
- Gao, Y., Wong, S., Khambari, M., & Noordin, N. (2022). A bibliometric analysis of the scientific production of e-learning in higher education (1998-2020). *International Journal of Information and Education Technology (IJJET)*, 12(5), 390–399. DOI: 10.18178/ijjet.2022.12.5.1632
- Gurcan, F., Dalveren, G., & Derawi, M. (2022). Covid-19 and e-learning: An exploratory analysis of research topics and interests in e-learning during the pandemic. *IEEE Access : Practical Innovations, Open Solutions*, 10, 123349–123357. DOI: 10.1109/ACCESS.2022.3224034
- Idrisova, J., Idigova, L., & Alikhadzhiev, S. (2020). Online education: Steps into the future. *Journal of Physics: Conference Series*, 1691(1), 012179. Advance online publication. DOI: 10.1088/1742-6596/1691/1/012179
- Ivanova, T. (2021). Modern technologies and e-learning—present and future. *Proceedings of the 22nd International Conference on Computer Systems and Technologies*. DOI: 10.1145/3472410.3472423
- Jacksi, K., Sulaiman, M., & Saeed, R. (2021). The importance of e-learning in the teaching processor secondary schools. *Review Article*, 10(1), 53–62. DOI: 10.25007/ajnu.v10n1a800
- Juneja, K. (2021). Challenges and benefits of online teaching in higher education. *Journal of Global Resources.*, 08(01). Advance online publication. DOI: 10.46587/JGR.2022.v08i01.014
- Kaur, M., Laxmi, V., & Shalini, . (2021, December 30). Perception of Parents Regarding E-Learning of School Students During COVID-19 Pandemic. *Abhigyan*, 39(3), 33–41. Advance online publication. DOI: 10.56401/Abhigyan/39.3.2021.33-41
- Kuperminc, G. P., Leadbeater, B. J., & Blatt, S. J. (2001). School social climate and individual differences in vulnerability to psychopathology among middle school students. *Journal of School Psychology*, 39(2), 141–159. DOI: 10.1016/S0022-4405(01)00059-0
- Lee, H., Guo, R., & Chen, C. (2021). E-learning in the postpandemic era: A case study in Taiwan. *IEEE Transactions on Engineering Management*, 1(99), 1–13. DOI: 10.1109/TEM.2021.3098605
- Linnenluecke, M. K., Marrone, M., & Singh, A. K. (2020). Conducting systematic literature reviews and bibliometric analyses. *Australian Journal of Management*, 45(2), 175–194. DOI: 10.1177/0312896219877678
- Manian, C. (2020). Designing e-learning environments in higher education to match technological trends, 152–166. DOI: 10.4018/978-1-7998-2547-0.ch008
- Miroshnyk, R., Matviy, I., Bahlai, I., & Halaz, L. (2023). Peculiarities of e-learning in modern conditions and prospects for its development. *Proceedings of the 2023 IEEE 18th International Conference on Computer Science and Information Technologies (CSIT)*, 1–4. DOI: 10.1109/CSIT61576.2023.10324039
- Orduña-Malea, E., & Costas, R. (2021). Link-based approach to study scientific software usage: The case of VOSviewer. *Scientometrics*, 126(9), 8153–8186. DOI: 10.1007/s11192-021-04082-y
- Petrusevich, D. (2020). The impact of e-learning and social parameters on students' academic performance. *Science for Education Today.*, 10(6), 143–161. Advance online publication. DOI: 10.15293/2658-6762.2006.08
- Popescu, A. (2021). E-learning in the post-pandemic future. *eLearning and Software for Education1*. DOI: 10.15293/2658-6762.2006.08
- Qiao, P., Zhu, X., Guo, Y., Sun, Y., & Qin, C. (2021). The development and adoption of online learning in pre- and post-COVID-19: Combination of technological system evolution theory and unified theory of acceptance and use of technology. *Journal of Risk and Financial Management*, 14(4), 162. DOI: 10.3390/jrfm14040162
- Razzaq, S., Kamran Malik, A., Raza, B., Khattak, H. A., Moscoso Zegarra, G., & Díaz Zelada, Y. F. (2022). Research collaboration influence analysis using dynamic co-authorship and citation networks. *International Journal of Interactive Multimedia and Artificial Intelligence*, 7(3), 103–116. DOI: 10.9781/ijimai.2022.03.001
- Rojas-Sánchez, M. A., Palos-Sánchez, P. R., & Folgado-Fernández, J. A. (2022). Systematic literature review and bibliometric analysis on virtual reality and education. *Education and Information Technologies*, 28(1), 155–192. DOI: 10.1007/s10639-022-11167-5 PMID: 35789766

- Rusydiana, A. S. (2021). Bibliometric analysis of journals, authors, and topics related to COVID-19 and Islamic finance listed in the Dimensions database by Biblioshiny. *Science Editing*, 8(1), 72–78. DOI: 10.6087/kcse.232
- Shekaili, N. (2021). E-learning: The future of next generation education. *PARIPEX Indian Journal of Research*, 10(7), 17–18. Advance online publication. DOI: 10.36106/paripex/3807623
- Sikandar, H., Vaicondam, Y., Khan, N., Qureshi, M. I., & Ullah, A. (2021). Scientific mapping of industry 4.0 research: A bibliometric analysis. *International Journal of Interactive Mobile Technologies*, 15(18), 129–147. DOI: 10.3991/ijim.v15i18.25535
- Van Eck, N. J., & Waltman, L. (2018). Analyzing the activities of visitors of the Leiden Ranking website. *Journal of Data and Information Science*, 3(3), 81–98. DOI: 10.2478/jdis-2018-0015
- Varyani, H., & M.S., Navaneeth (2020). The past, present and future of e-learning: In India. *EduRN: Other Technology & Resources in Education 1*(1). DOI: 10.2139/ssrn.3696122
- Web of Science. (2024). *Web of Science (version 6.0)* [Database]. Retrieved March 4th, 2024, from <https://www.webofscience.com>
- Wong, P., & Lim, K. (2023). Impact of e-learning on the academic performance of university students. *International Journal of Medical Education*, 5(18), 57–74. Advance online publication. DOI: 10.35631/IJMOE.518005
- Zaguaia, A., Ameyed, D., Haddar, M., Cheikhrouhou, O., & Hamam, H. (2021). Cognitive IoT-based e-learning system: Enabling context-aware remote schooling during the pandemic. *Journal of Healthcare Engineering*, 2021(1), 1–12. DOI: 10.1155/2021/7358874 PMID: 34512940
- Zolochesvskaya, E., Zubanova, S., Fedorova, N., & Sivakova, Y. (2021). Education policy: the impact of e-learning on academic performance. *Proceedings of the E3S Web of Conferences*. DOI: 10.1051/e3sconf/202124411024
- Zyoud, S. H., & Zyoud, A. H. (2021). Visualization and mapping of knowledge and science landscapes in expert systems with applications journal: A 30 years' bibliometric analysis. *SAGE Open*, 11(2), 21582440211027574. Advance online publication. DOI: 10.1177/21582440211027574