Educational Technology Quarterly, Vol. **2025**, Iss. 1, pp. 101–120 https://doi.org/10.55056/etq.868

A bibliometric analysis on the effects of digital media among children in the time of COVID-19 pandemic

Placidius Ndibalema

The University of Dodoma, 1 Benjamin Mkapa Rd., 41218 Iyumbu, Dodoma, Tanzania

Abstract. Although technology was considered the fundamental tool in enhancing learning during COVID-19, there have been several concerns about the excessive use of digital media among children, which in turn impacted their well-being. A lack of adequate evidence on the impact of excessive use of digital media during COVID-19 among children prompted the need for a bibliometric analysis. The study aimed to examine the effects of digital media on children through a bibliometric analysis. A total of 1738 empirical articles published between 2019 and 2022 from the Dimensions scientific database were analysed using the VOSviewer 1.6.16 software. The analysis aimed at establishing visualisation networks on the most influential authors, countries, universities and co-authorships. The occurrence of keywords was also analysed to identify the effects of digital media among children during COVID-19. The results indicate increased burnout, bullying and frustration among children as a result of excessive use of digital media and screen time. Children lacked parental control since parents had inadequate digital skills to control children's online learning at home. Although technology was used to enhance learning during the pandemic, it was necessary to highlight the need for digital safety guidelines to ensure children's mental, psychological and physical health are maintained. Enhancing digital literacy among educators and parents can significantly reduce the risks associated with children spending excessive time on screens. Having digital inclusion guidelines would also increase awareness among educational stakeholders on effective ways of protecting children from digital risks and improving their well-being.

Keywords: digital inclusion, digital culture, digital media, digital divide, digital revolution

1. Introduction

An estimated 1.58 billion learners were out of school during the outbreak of the COVID-19 pandemic, which represents 91.3% of the total enrolled learners in the world and an unprecedented situation in the history of education. In this situation, continuity in learning among children became a challenge as children at home could not access the learning resources. In alignment with the Sustainable Development Goals (SDGs), many countries have already developed policies and technological solutions that support virtual learning. One of the strategies in addressing SDG goal number four is to promote the use of ICT, particularly mobile technology, for learning [55]. There has been an increased prevalence of technology usage in adolescents and children during lockdown, thus leaving its impact on their lives either in a positive or negative aspect. The overall documented percentage increase of technology usage in children was about 15%, of which smartphone usage has 61.7% of prevalence [32].

As a consequence of the pandemic, digital media is becoming the platform of choice for public opinions, perceptions, and attitudes towards various events or public health

0000-0002-9119-4255 (P. Ndibalema)
ndibaplac@yahoo.com (P. Ndibalema)
https://www.udom.ac.tz/staff/staff_profile?id=VDBSalBRPT0= (P. Ndibalema)

policies regarding COVID-19. Social media has become a pivotal communication tool for governments, organisations, and universities to disseminate crucial information to the public [69]. According to Pandya and Lodha [50], the excessive use of screens has resulted in many health challenges, which include sleep problems and increased risk of myopia. Most of the technological challenges are emerging due to increased unsupervised online internet use, which has magnified issues around sexual exploitation and cyberbullying [47]. Sad to mention, several studies indicate an increased abusive content and children were susceptible to access them due to lockdown and increased several mental risks such as depression and anxiety due to compromised sleep time [5, 32, 64].

1.1. The growth of digital divide

Although there were remarkable indicators of the digital revolution in many countries due to the outbreak of COVID-19, the transition to online learning increased the digital divide among children. Studies indicate that children at home, during the lockdown, lacked access to digital devices and internet connections due to poverty and rural context [62]. In this context, the term digital divide is considered as an increased inequality due to the presence or absence of technology [17]. In some cases, online learning among children at home was not possible because of the inadequate technological environment. In some countries, particularly low- and middle-income countries, online learning among children was not taking place because of insufficient technological preparedness and readiness, lack of digital resources and lack of support at home [4].

The global statistics indicate that in 2020, about two-thirds of school-aged children and young people aged 25 years or less do not have an internet connection at home [73]. Further statistics indicate that while about 80% and 89% of the school-aged children at home can access computers and the Internet respectively in high-income countries, the situation is worse in low-income countries where only 7% and 15% can access computers and the Internet respectively (figure 1).

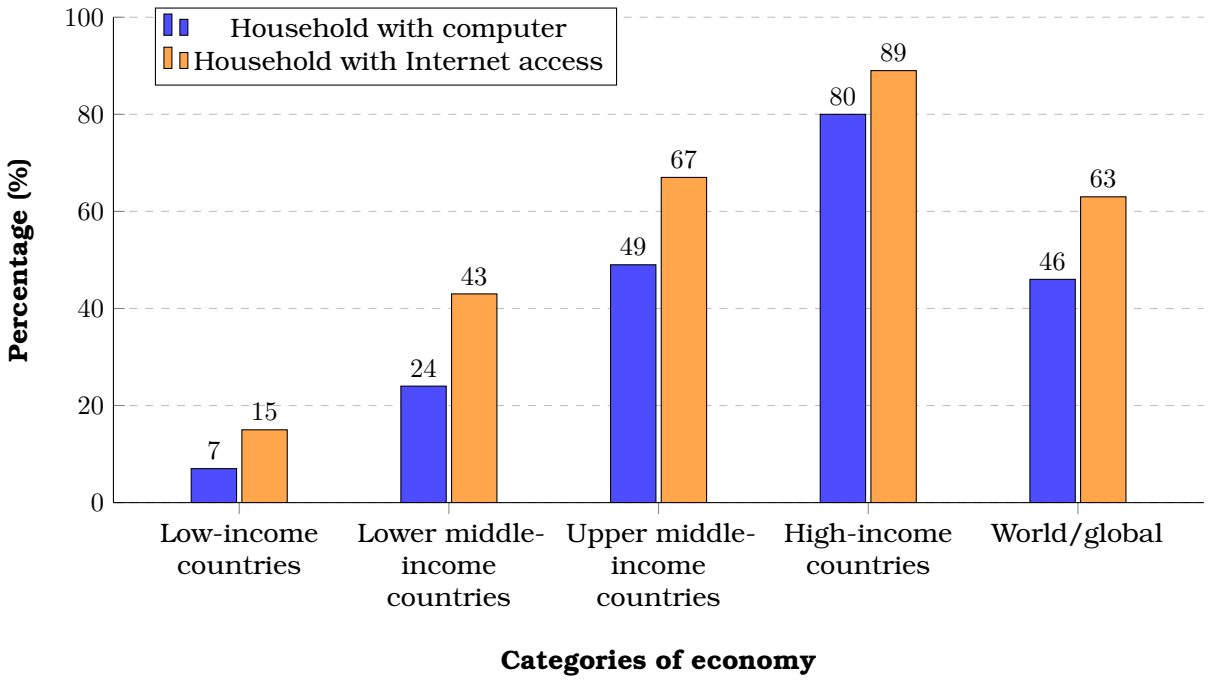

Figure 1: Percentage of households with a computer and internet access by 2020 [66, p. 12].

Even though we witnessed the transition to online distance learning, children in low- and middle-income countries were most vulnerable as access to computers and the Internet was very limited. While most schools migrated to online delivery in high-income countries, the availability and accessibility of digital platforms in low and middle-income countries was a critical barrier [36, 52]. Although SDG 4 explicitly outlines indicators necessary for the digital learning environment, during the outbreak of the COVID-19 pandemic, many children in low and middle-income countries such as Tanzania experienced a deep digital divide due to limited access to ICT infrastructure [37]. In other countries such as Ethiopia, Kenya and Malawi, the engagement of learners in online learning was limited due to lack of electricity, poor internet connectivity and limited broadband, absence of digital infrastructure at schools and home, as well as funding shortfalls for digitisation [54]. This implies that before the outbreak of the COVID-19 pandemic, the digitisation of learning was not a priority in many low- and middle-income countries.

Most schools migrated to online learning, but there were no clear policies and guidelines to guide the practice at home. Parents lacked adequate time, educational qualifications and skills to assist their children in learning at home, which contributed to frustrations and burnout among caregivers [36, 40]. Availability of digital infrastructure and family factors such as divorce were other concerns that limited children's online learning in some countries [19]. Although some children were unable to access digital learning opportunities, those who managed were reported to spend additional time on virtual platforms, which subjected them to more risks of harmful and violent content, including cyberbullying [52]. The increased use of technological devices for learning enhanced technological addiction due to lack of psychological and social support, which resulted in many health disorders such as refractive errors, accommodation disturbances and visual symptoms such as dry eye and asthenopia [11, 60]. There is no doubt that children who were exposed to uncontrolled digital content and those who spent extra time in front of the screen increased health challenges. The magnitude and extent to which these children were affected by increased reliance on digital devices is under-researched despite its critical implications for learning among children. Thus, the current bibliometric analysis aimed at establishing network patterns on the effects of excessive reliance on digital media among children during COVID-19. A thorough examination of the impact of digital media on children would aid scholars and researchers in identifying and evaluating the existing research gaps, understanding the research landscape, and forecasting emerging trends and future developments.

1.2. Research questions

The study employed bibliometric analysis methods to address the following research questions:

1. Who are the major contributors to the research body on the effects of digital media among children during the COVID-19 pandemic?
2. What are the most popular journals, institutions and countries publishing about the effects of digital media among children during the COVID-19 pandemic?
3. What are the key areas of focus in publications related to the effects of digital media among children during the COVID-19 pandemic?

2. Methodological procedures

The review included an extensive search to locate research evidence from empirical studies. A bibliometric analysis was conducted following the PRISMA model by

detailing the criteria for document selection, the search strategy employed and the methods used for data extraction and analysis [49].

2.1. Search strategy

The reviewed articles were extracted from the Dimensions database. This is a scientific, scholarly database that was launched in 2018 which clearly lists the sources of its data, and most publications come from Crossref, PubMed, Europe PMC (PubMed Central) and RePEc (Research Papers in Economics), just to mention a few [6, 21]. The Dimensions database stands out for conducting bibliometric analysis using VOSviewer due to its comprehensive coverage and rich metadata. It offers access to a vast array of scholarly empirical articles published in peer-reviewed journals and provides a diverse dataset for analysis. The detailed metadata includes crucial information such as citations, authorship, and funding sources, which facilitates an in-depth exploration of the impact of research and its trends. During the search, two Boolean operators, 'AND' and 'OR', were utilised. The search query was 'Effects' OR 'Impacts' AND 'Digital media' OR 'Technology' OR 'Multimedia' OR 'Digital content' AND 'early grade learners' OR 'children' AND 'COVID-19 pandemic' OR 'Coronavirus pandemic'.

2.2. Inclusion and exclusion criteria

The selection of empirical articles included in the study was based on the author's established inclusion and exclusion criteria. The criteria were established to ensure that relevant studies to the main topic were located [33]. A set of inclusion and exclusion criteria is defined and used to evaluate relevant documents, aligning with the research objectives and questions [48]. On this basis, the study employed several criteria, which included publication years, type, research fields, language, accessibility, participants, and scope of articles. The inclusion and exclusion criteria that were considered during the review are summarised in table 1.

2.3. Selection process

The search was limited to English articles using the search period of 2019 to 2022, of which a total of 41,783 documents were retrieved from the Dimensions database, and 1,571 documents were excluded as they were published before the outbreak of the COVID-19 pandemic. A total of 23,671 documents were also excluded as they were not journal articles. Documents such as book chapters, edited books, monographs, proceedings, book reviews, early access and pre-prints were excluded just to maintain the credibility of the empirical studies included in the review. Likewise, about 10,793 journal articles were excluded as they were not relevant to education, curriculum, pedagogy, psychology, education system and ICT and were not addressing the effects of digital media among children. Further exclusion involved a total of 4,010 that were not open access. Figure 2 presents the procedures for selecting empirical articles included in the review process based on the PRISMA model.

2.4. Data analysis

The analysis was carried out using VOSviewer 1.6.16 software. The VOSviewer was chosen for its capacity in visualising and analysing bibliometric networks. It is a free open-access software which has a user-friendly interface which supports the generation of various data relationships between authors, journals, and keywords in different formats [26]. VOSviewer uses inputs from Dimensions, and its outputs are maps which represent network visualisations of keywords, scientific publications and journals, researchers and research organisations and their countries of origin, co-authorship analysis and citations metrics [26, 70]. The network visualisation analysis involved the most productive authors, countries, journals and institutions.

Table 1
Selection criteria.

Criteria	Inclusion	Exclusion
Accessibility	Articles which were open access and retrievable	Articles which were not open access and retrievable
Publication date	Empirical articles published from 2019-2022	Articles published before 2019 and after 2022
Scope of the article	Articles focusing on digital media effects among children during COVID-19	Articles that are not related to digital media effects among children and not addressing issues of COVID-19
Participants	Young children, teachers and parents	Other participants out of young children, teachers and parents
Language	Articles written in English language	Articles written in other languages
Research fields	Articles that were relevant to education, psychology, education system, pedagogy, curriculum and ICT	Articles that were not related to education, psychology, education system, pedagogy, curriculum and ICT
Publication type	Empirical articles from peer-reviewed journals	Books, book chapters, newspaper articles, thesis, dissertations, review articles, early access, proceedings and monographs, book reviews
Indexes	Empirical articles published in journals indexed in Dimensions	Empirical articles indexed by other scientific database

Further analysis involved establishing the relational patterns of keywords with the aim of generating insights for the future direction of research about the topic.

3. Results

3.1. Authors with the highest citations

The analysis was based on authors with the highest number of citations. The consideration was that the document had a minimum of 5 citations, and only 1566 articles were included in the analysis. Out of the 1566 documents, only 286 documents met the threshold. The analysis identified the top ten authors with the highest citations about the topic as presented in table 2.

The results in table 2 indicate that Mishra (2020) was the leading author, followed by Adedoyin (2020), with the highest citations about the topic. Further results indicate that the same authors had the higher links as indicated in figure 3.

The results in figure 3 indicate that Mishra (2020), Adedoyin (2020) and Konig (2020) were the authors with the highest citations on the topic under review.

3.2. Sources with highest citations and links

The analysis considered the source with a minimum of 5 documents and 5 citations, of which out of 618 sources analysed, only 56 documents met the threshold. The total strengths of the citation links with other sources were calculated, and 48 items met the threshold. The top ten sources with the highest citations are presented in table 3.

The results in table 3 indicate that the Education Sciences journal was the leading source in all aspects. Although the Frontiers in Education had a minimal number of citations (127), it had stronger links compared to journals like Social Sciences &

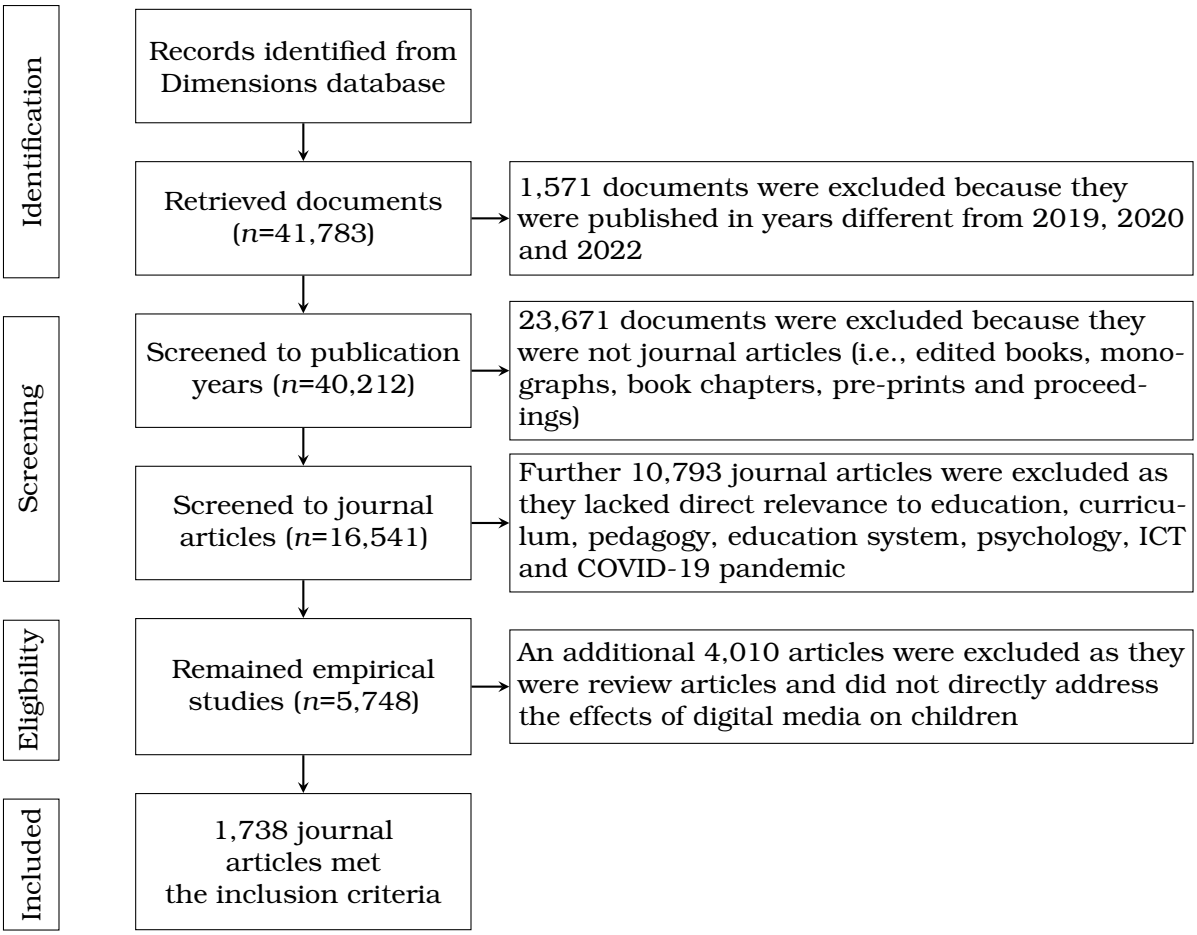

Figure 2: Process flow of the systematic review.

Table 2
Authors with the highest citations.

№	Author	Number of citations
1	Mishra (2020)	477
2	Adedoyin (2020)	461
3	Konig (2020)	316
4	Kuhfeld (2020)	270
5	Engzell (2021)	222
6	Longhurst (2020)	183
7	Muthuprasad (2021)	163
8	Lassoued (2020)	101
9	Gillis (2020)	84
10	Osman (2020)	56

Humanities Open (179) but with very low links with other journals. The network patterns indicating the connection with other sources are presented in figure 4.

The results indicate that Frontiers in Education, International Journal of Environmental Research and Public Health, and Education and Information Technologies were the leading journals, with articles with the highest citations and strong links to digital media among children during COVID-19.

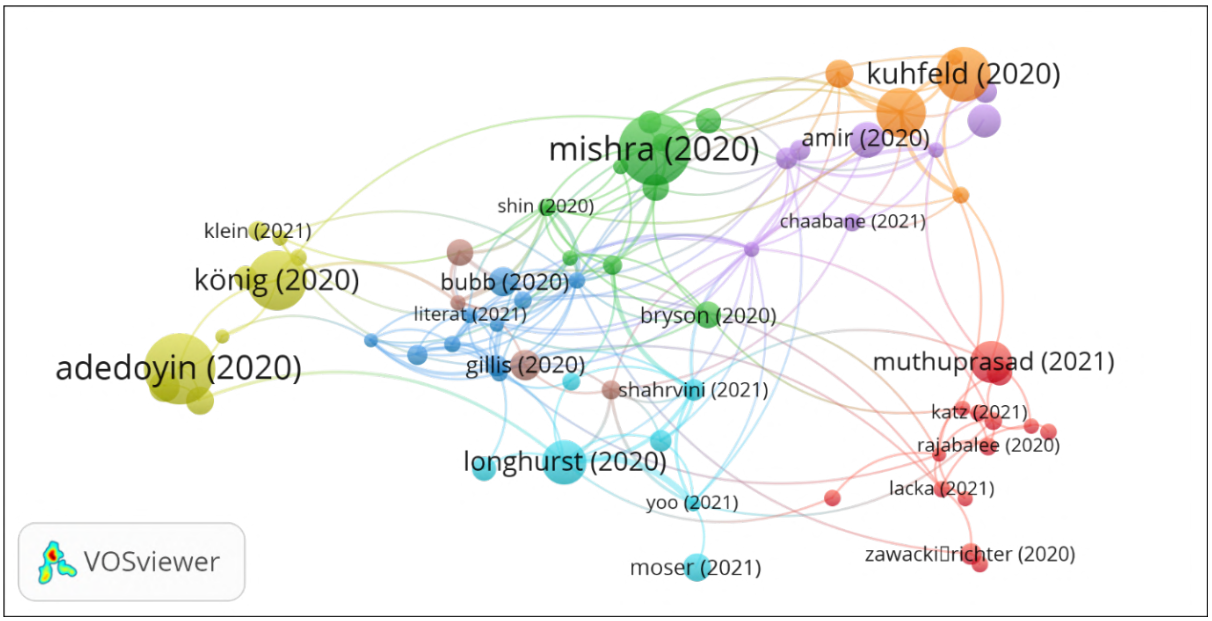

Figure 3: Authors with the highest citation links.

Table 3
Sources with highest citations.

№	Source	Number of articles	Number of citations	Total link strengths
1.	Education Sciences	45	493	22
2.	International Journal of Educational Research Open	7	483	16
3.	BMC Medical Education	14	253	15
4.	Education and Information Technologies	69	237	16
5.	International journal of Environmental Research and Public Health	52	228	21
6.	Anatomical Sciences Education	8	194	8
7.	Social Sciences & Humanities Open	6	178	5
8.	Frontiers in Education	51	129	20
9.	International Review of Education	7	127	10
10.	Plos One	18	111	14

3.3. Institutions with articles with high citations and co-authorship links

The analysis ignored documents co-authored by a large number of organisations, of which a maximum of 25 organisations were considered per document. Further consideration was put on the minimum of 3 documents of an organisation and 10 citations of the article in the organisation. Out of the 1366 organisations, 98 met the threshold, and only 57 organisations were revealed to have articles with co-authorship. The top ten organisations with co-authored citations are presented in table 4.

The results in table 4 indicate that some organisations had a good number of co-authored articles and citations while having very weak links. Organisations such as the University of Indonesia and the University of Lund had no link to co-authored articles.

Figure 5 provides further visualisation of co-authorship links and density based on the number of citations.

The results in figure 5 indicate that the State University of London and the University

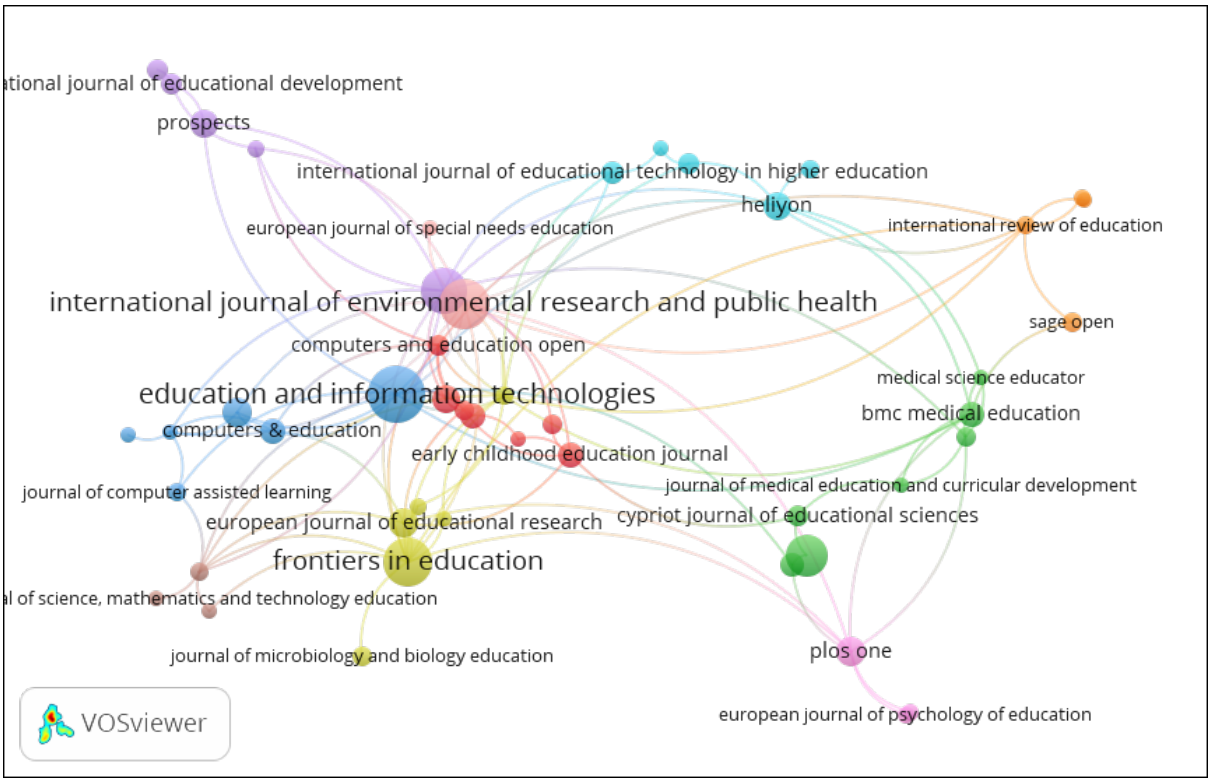

Figure 4: Journals with the highest frequency publications and strong links.

Table 4
Top 10 organisations with articles with high citations and co-authorship links.

№	Organisation	Number of articles	Number of citations	Total link strengths
1.	University College of London	10	301	6
2.	University of Maryland, College Park	3	289	1
3.	Stockholm University	3	281	1
4.	Trinity College Dublin	5	204	3
5.	University of Sheffield	5	141	2
6.	University of Indonesia	3	114	0
7.	University of Lund	4	110	0
8.	Beijing Normal University	7	108	4
9.	University of Hong Kong	8	107	4
10.	University of Glasgow	3	106	2

of Hong Kong had the highest co-authorship links with other universities.

3.4. Countries with the highest production of articles with the highest citations

The analysis was based on a minimum of 3 documents per country and 5 citations. Of the 173 countries, 60 met the thresholds. For each of the 60 countries, the total strengths of the citation links with other countries were calculated. The top 20 countries are presented in table 5.

Countries with the greatest total link strengths were selected, and the largest set of the connected countries is indicated in Figure 6.

The results indicate that the United States and Indonesia were the leading countries with the highest production of research on the effects of digital media. Most publications were from high-income countries and few from middle-income countries like

Malaysia and Kazakhstan, while none of the countries from low-income countries had publications on the topic.

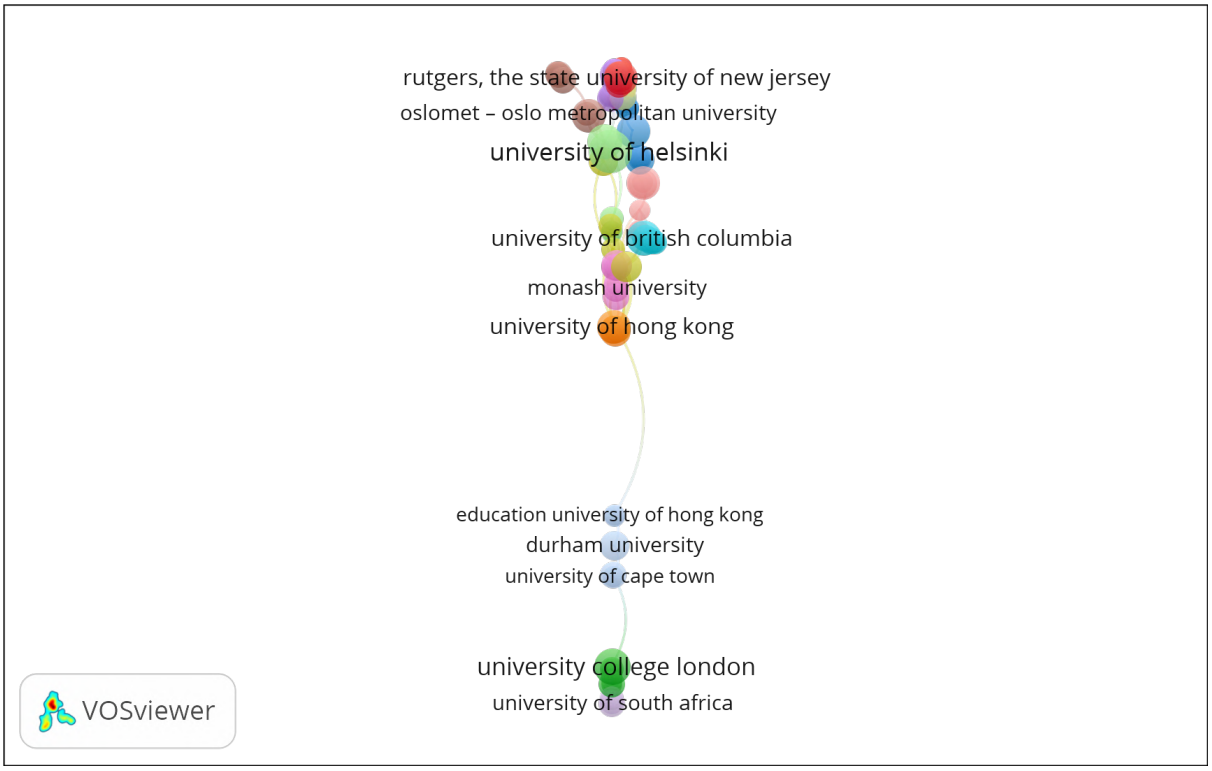

Figure 5: Visualisation network of institutional links on co-authorship and citations.

Table 5
Top 20 countries that have published widely about the topic.

№	Country	Number of articles	Number of citations	Total link strengths
1.	United States	280	1486	166
2.	United Kingdom	100	1191	123
3.	Germany	36	524	99
4.	Sweden	21	461	65
5.	Spain	74	333	61
6.	Indonesia	162	372	54
7.	India	19	704	49
8.	Canada	59	173	47
9.	Australia	57	203	40
10.	China	65	355	38
11.	Turkey	33	100	28
12.	Norway	22	175	26
13.	Saudi Arabia	27	169	24
14.	Cyprus	7	469	23
15.	South Africa	26	38	20
16.	Italy	25	70	19
17.	Belgium	6	57	18
18.	Malaysia	22	33	18
19.	France	16	60	17
20.	Ireland	9	205	17

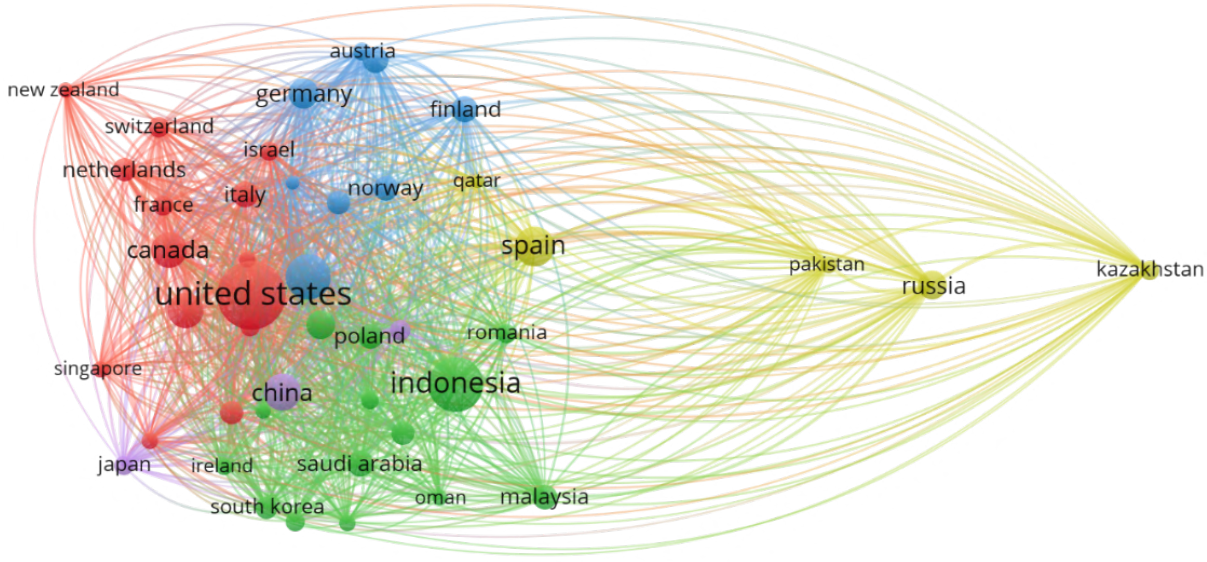

Figure 6: Countries with higher production of articles on the topic and strong links.

3.5. Keywords analysis

The analysis of keywords from 1,738 articles was based on titles and abstracts fields, which had a total of 27,482 terms, and a minimum of occurrences of 5 key terms was considered, of which only 1639 terms met the threshold. The relevance score was calculated based on 1639 terms, of which the most relevant terms were selected based on the VOSviewer default choice of 60%. The results are presented in figure 7.

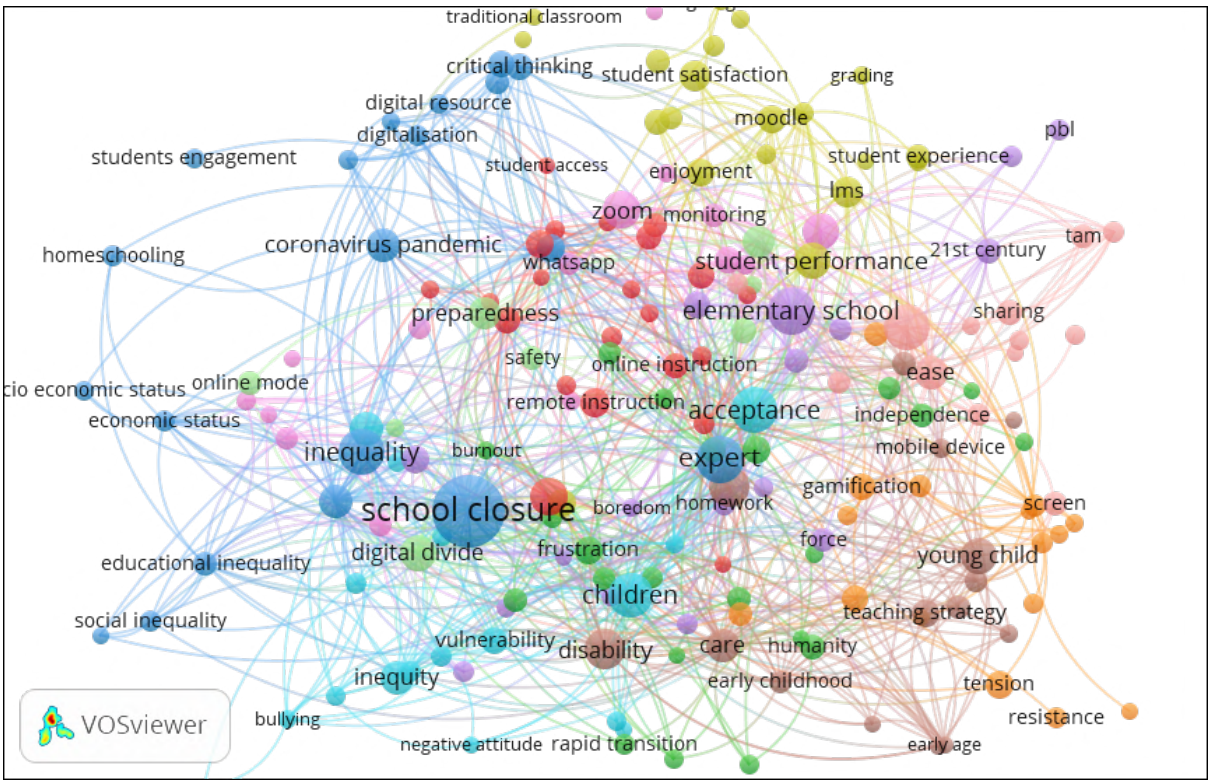

Figure 7: Key terms analysis.

The results can be grouped into several aspects, such as learning opportunities

from digital media, causes of the digital divide, delivery mode and effects of digital media. Figure 7 indicates that there were several opportunities for children to learn through digital media, which included students' engagement in learning, digitalisation, gamification, access to digital resources, problem-based learning and critical thinking. The school closure appears to have strong links with several factors related to the digital divide, which include socioeconomic status, homeschooling, boredom and social inequality. Further results indicate several delivery platforms, such as Moodle learning management system, zoom and WhatsApp, which were most useful during the outbreak of COVID-19. Some effects of digital media among children indicate increased burnout, bullying and frustration among children as a result of excessive use of digital media and screen time. The results in figure 7 also indicate safety concerns, negative attitudes, vulnerability, disability and preparedness as some of the issues that compromised the effective use of digital media for learning among children during the COVID-19 pandemic. Children lacked parental control due to parents' inadequate digital skills to control children's online learning at home.

4. Discussion

There is no doubt that the school closure due to the outbreak of the COVID-19 pandemic has accelerated the digital transformation in learning among children as one could witness increased innovations and solutions for online learning [22, 24]. The transition to online delivery has changed teachers' roles, which include digital content development, e-mentoring and communication [76]. Evidence indicates that the shift to online distance learning also increased opportunities for teachers to integrate technology in their teaching and increased use of virtual platforms [7, 37]. Learning at home during the lockdown also strengthened parents' role in shaping their children's digital experiences and engagement in their children's learning [31]. Although the transition to online distance learning programs during the COVID-19 brought the digital revolution in teaching, most schools had no adequate capacity to manage them. Most teachers were unable to develop interactive digital materials, conduct online assessments, and lacked adequate skills in collaborating with parents and capacity to run online programs as well as handling children's diversity [7, 30, 44].

Likewise, parents faced difficulties in helping their children with online learning due to a lack of technological competence, pedagogical competence, lack of access to technological devices and the Internet for their children and lack of adequate time to participate in their children's learning [34, 51]. The lack of clear guidelines on homeschooling and the unpreparedness of parents to participate in remote teaching in their children increased worries and stress among them [57]. Schools' unpreparedness to run online programs was also attributed to several factors, such as difficulties in internet access, lack of infrastructure to support e-learning, limited skills to manage virtual classrooms, teachers' and students' attitudes towards technology, lack of specific guidelines for e-learning [12, 16, 20, 59]. It makes sense to argue that the outbreak of COVID-19 increased educational inequalities among children, particularly in high-poverty countries.

In some cases, teachers were forced to adapt to online learning and adopt alternative arrangements to ensure continuity of learning and prevent school dropouts [34]. While the SDGs emphasise equal access to education, many researchers report an increased digital divide due to the rapid transition to online learning without proper guidelines and preparations. The research by Khlaif, Salha and Kouraichi [25] indicates that online learning has broadened digital inequality and threatened students' digital privacy, which negatively influenced student engagement. Although the teachers' role has changed due to the outbreak of COVID-19, there was a lack of proper interaction

in online distance learning, which contributed to negative experiences among teachers and children in online teaching and learning [13, 58]. In the context where there were limited technological facilities in schools and homes, as is the case in Tanzania, children were not able to access lessons during school closures due to the outbreak of COVID-19 [37]. Further evidence indicates that the development of digital content for learning among children in Tanzania is still in the infancy stage [72]. Even the available digital content for children is not culturally relevant to the Tanzanian context [8]. This could be an indication that critical investments in digital content development are crucial to supporting online distance learning during the school closure when there is an outbreak of such a pandemic.

Apart from the digital divide, the reviewed research articles revealed several effects of excessive use of digital devices during COVID-19 due to the rapid transition to online learning. Lack of outdoor physical activities due to lockdown increased the screen time among children who thus lacked parental control, which increased the risks of addiction [10, 61]. Among the effects reported were related to physical and mental health-related challenges that included predisposing them to myopia, ocular ill health, irregular sleeping patterns, dry eye and visual fatigue symptoms, depression, anxiety and irritability [11, 14, 15, 35, 42, 43, 68, 71, 74]. The review proved that the rapid transition to online learning increased frustration and burnout not only for children but also for teachers, parents and school administrators. Online sessions were occasionally interrupted due to unstable internet connectivity and network latency [23]. Most teachers lacked adequate skills in blended or online distance learning, and thus, they had to struggle to ensure learners were engaged fully in online learning, but some did not manage, which resulted in frustrations [3, 39]. Some teachers reported that they had never taught online, which, to them, online teaching was seen as a frustrating process [53]. There were no specific and universal guidelines for parents at home to guide their children towards digital learning, which resulted in every parent guiding the child based on personal discretion [27, 46].

While several global digital learning strategies emphasise the need to empower both educators and students on significant digital safety and cybersecurity issues [1, 2, 29, 67], still, children's safety was compromised by privacy concerns and risks associated with longer screen time which attracted harassment and cyberbullying, access to harmful online content and misinformation [38, 56]. Evidence indicates that during the outbreak of the COVID-19 pandemic, there was a sudden shift to online learning due to school closure, and many parents had limited digital skills and were unprepared to support learning [9, 18, 57]. Parents, too, often found themselves struggling with unfamiliar software, digital content and learning management systems, thus leaving them unsure of how to support their children's safe learning needs in a required manner. This situation led to increased stress and anxiety [14, 68, 71, 74]. It is possible to note that in this situation, parents needed urgent support and training to enhance their digital literacy and foster a safer digital learning environment at home. Ensuring digital safety awareness among parents is crucial to empowering them to support their children at home in navigating digital learning responsibly and safely while harnessing the opportunities provided by technologies for learning. Based on the digital learning pillars, parents are responsible for teaching and reinforcing positive behaviours with digital technologies, which means that their understanding of digital safety and literacies impacts their children's well-being [45]. For effective learning in a safe learning environment for children, schools and educational authorities should recognise the need to strengthen both teachers' and parents' digital literacy to develop the necessary skills to support their children's education during a challenging time like the COVID-19 pandemic.

Other literature indicates that the largest barrier to online distance learning was

the inability of both parents and educators to balance work, home life, and online teaching, teachers' limited experience in virtual learning and other technology-related constraints such as connectivity and lack of digital resources [28, 63, 65]. In South Africa, for example, students and teachers were thrust into virtual teaching and learning situations in which the majority had no preparation for the shift [41]. It can be observed that for effective e-learning programs, schools need to strengthen their e-learning systems and strategies to ensure teachers are motivated to meet learners' learning needs [75]. Before the outbreak of COVID-19, digitisation of education was given little attention in most low and middle-income countries such as Tanzania, Ethiopia and Kenya [37, 54]. On this basis, the transition to online distance learning in schools was too challenging as there were no already established formal technological systems that could support the same.

5. Conclusion and recommendations

Although the outbreak of the COVID-19 pandemic resulted in digital transformation in many educational institutions, one could notice several barriers that limit the effective implementation of e-learning strategies. Several authors outline institutional, policy, and personal challenges that contribute to the prevalence of the digital divide, which accelerates inequity in learning. Also, the review indicates that most of the effects among children on excessive use of screens were due to lack of parental control in the sense that some parents lacked appropriate knowledge and skills. Digital literacy among parents would certainly minimise the risks of children spending excess time on screen. The reviewed studies also highlight a growing concern regarding children's mental health, educational engagement, and social interactions due to increased screen time. Researchers have documented both positive and negative outcomes, emphasising the dual role of digital media as a potential tool for learning and networking while, at the same time, it contributes to stress and isolation among children. The findings also indicate that there are limited collaborative efforts among educators, policymakers and parents to create a responsive digital learning environment for children.

The review indicated that the knowledge on the topic is produced in high-income countries while none is produced in low-income countries, hence suggesting that there is a need for more research to explore the effects of digital media globally. Likewise, the review results indicate limited collaboration in co-authorship between the institutions in low-income and high-income countries. Therefore, strengthening the institutional collaboration between low-income and high-income countries in scientific writing would bring more holistic solutions to the grand challenges that emanate from the misuse of digital media. Although technology was used to enhance learning during the pandemic, it was necessary to highlight the need for digital safety guidelines to ensure children's mental, psychological and physical health are maintained. This would minimise the negative implications of excessive use of digital media. Digital literacy among educators and parents would certainly minimise the risks of children spending excess time on screen. Having digital inclusion guidelines would also increase awareness among educational stakeholders on the effective ways of protecting children from digital risks and improving their well-being. It makes sense to note that there is a need for further exploration into effective strategies for managing digital media use among children in all learning contexts, including homes. As the outbreak of the COVID-19 pandemic has transformed digital learning at different levels of education, it remains crucial to implement guidelines that promote mental well-being through digital media practices and mitigate adverse effects. This creates the need to understand the long-term implications of digital media use among children. Ultimately,

this bibliometric analysis serves as a foundational step in informing stakeholders about the complexities of digital media's role in children's lives, particularly in times of crisis.

5.1. Limitations and future research directions

Despite the strengths of this study in addressing several effects of digital media among children during the COVID-19 pandemic, some limitations must be acknowledged. First, the scope of literature included in the analysis was limited to the Dimensions database, thus potentially overlooking some relevant studies that could be accessed through other scientific databases. There may be other studies that capture the effects of digital media among children that can be accessed in other scientific databases. Such restriction can lead to a limited representation of the field and its context, hence making it difficult to generalise the findings. In that regard, future research should consider multiple scientific databases to explore more studies that address the effects of digital media on children. Second, the bibliometric analysis was restricted to empirical studies on digital media effects among children. Therefore, the effects of digital media on sections of the population other than children may be overlooked. To better understand how other population sections, like the youth, were widely affected by excessive use of digital media during the COVID-19 pandemic, further bibliometric analysis and systematic review should focus on such populations. Third, the analysis was restricted to a shorter period (i.e., 2019 to 2022) focusing on the COVID-19 pandemic, of which the effects of digital media could be temporal, thus limiting the understanding of the effects in the long term and trends. With this in mind, future research should focus on longitudinal studies to understand the long-term implications of digital media use during this critical period. Fourth, the present study focuses only on obtaining secondary data on the effects of digital media among children during COVID-19; thus, the study did not explore the primary data from stakeholders about the topic. Therefore, future studies are needed to further explore stakeholders' perspectives (parents, children, teachers and policymakers) about the effects of digital media among children in other periods apart from the COVID-19 pandemic. Lastly, the rapid growth of digital media during the COVID-19 pandemic may have resulted in varied perspectives towards the definition of digital media across different contexts, which may lead to variations in understanding or making some findings outdated. This suggests that conclusions and interpretations should be made considering various insights from diverse disciplines to gain a comprehensive understanding of the effects of digital media on children.

Data availability statement: The data supporting the findings of this study are available upon request from the corresponding author.

Declaration on generative AI: The author declares that he has not used AI tools in the writing of this article.

References

[1] African Union, 2020. The Digital Transformation Strategy for Africa (2020-2030). Available from: https://au.int/en/documents/20200518/digital-transformation-strategy-africa-2020-2030.

[2] African Union, 2022. Digital Education Strategy and Implementation Plan. Available from: https://au.int/en/documents/20221125/digital-education-strategyand-implementation-plan.

[3] Al Mazrooei, A.K., Hatem Almaki, S., Gunda, M., Alnoor, A. and Manji Sulaiman, S., 2022. A systematic review of K–12 education responses to emergency remote

teaching during the COVID-19 pandemic. *International Review of Education*, 68(6), pp.811–841. Available from: https://doi.org/10.1007/s11159-023-09986-w.

[4] Asadullah, M.N. and Bhattacharjee, A., 2022. Digital Divide or Digital Provide? Technology, Time Use, and Learning Loss during COVID-19. *The Journal of Development Studies*, 58(10), pp.1934–1957. Available from: https://doi.org/10.1080/00220388.2022.2094253.

[5] Babvey, P., Capela, F., Cappa, C., Lipizzi, C., Petrowski, N. and Ramirez-Marquez, J., 2021. Using social media data for assessing children's exposure to violence during the COVID-19 pandemic. *Child Abuse & Neglect*, 116, p.104747. Protecting children from maltreatment during COVID-19: Second volume. Available from: https://doi.org/10.1016/j.chiabu.2020.104747.

[6] Badke, W.E., 2018. The Dimensions Database: A Revolution in Academic Information Tools? *Online Searcher*, 42(4), pp.52–54. https://www.researchgate.net/publication/334399065, Available from: https://www.infotoday.com/OnlineSearcher/Issue/8174-July-August-2018.shtml.

[7] Barasa, P.L., 2021. *Digitalization in teaching and education in the context of COVID-19: Kenya*. (Digitalization, the future of work and the teaching profession project background report). International Labour Organization, Geneva: International Labour Office. Available from: https://www.ilo.org/publications/digitalization-teaching-and-education-context-covid-19-kenya.

[8] Borzekowski, D.L.G., 2018. A quasi-experiment examining the impact of educational cartoons on Tanzanian children. *Journal of Applied Developmental Psychology*, 54, pp.53–59. Available from: https://doi.org/10.1016/j.appdev.2017.11.007.

[9] Carrell Moore, H., 2022. "The whole experience is still very high touch for parents": Parent moves to support young children's remote learning during the COVID-19 pandemic. *Journal of Early Childhood Research*, 20(4), pp.624–636. Available from: https://doi.org/10.1177/1476718X221098671.

[10] Chen, Q., Dai, W., Li, G. and Ma, N., 2022. The impact of screen time changes on anxiety during the COVID-19 pandemic: sleep and physical activity as mediators. *Sleep and Biological Rhythms*, 20(4), pp.521–531. Available from: https://doi.org/10.1007/s41105-022-00398-1.

[11] Cortés-Albornoz, M.C., Ramírez-Guerrero, S., Rojas-Carabali, W., Torre, A. de-la and Talero-Gutiérrez, C., 2022. Effects of remote learning during the COVID-19 lockdown on children's visual health: a systematic review. *BMJ Open*, 12(8), p.e062388. Available from: https://doi.org/10.1136/bmjopen-2022-062388.

[12] DeCoito, I. and Estaiteyeh, M., 2022. Transitioning to Online Teaching During the COVID-19 Pandemic: an Exploration of STEM Teachers' Views, Successes, and Challenges. *Journal of Science Education and Technology*, 31(3), pp.340–356. Available from: https://doi.org/10.1007/s10956-022-09958-z.

[13] Doz, E., Cuder, A., Caputi, M., Pellizzoni, S. and Passolunghi, M.C., 2023. Distance learning environment: perspective of Italian primary and secondary teachers during COVID-19 pandemic. *Learning Environments Research*, 26(2), pp.555–571. Available from: https://doi.org/10.1007/s10984-022-09451-9.

[14] El Refay, A.S., Hashem, S.A., Mostafa, H.H., Kamel, I.H. and Sherif, L.S., 2021. Sleep quality and anxiety symptoms in Egyptian children and adolescents during COVID-19 pandemic lockdown. *Bulletin of the National Research Centre*, 45(1), p.134. Available from: https://doi.org/10.1186/s42269-021-00590-2.

[15] Elsayed, W., 2021. Covid-19 pandemic and its impact on increasing the risks of children's addiction to electronic games from a social work perspective. *Heliyon*, 7(12), p.e08503. Available from: https://doi.org/10.1016/j.heliyon.2021.e08503.

[16] Francom, G.M., Lee, S.J. and Pinkney, H., 2021. Technologies, Challenges

and Needs of K-12 Teachers in the Transition to Distance Learning during the COVID-19 Pandemic. *TechTrends*, 65(4), pp.589–601. Available from: https://doi.org/10.1007/s11528-021-00625-5.

[17] Gandolfi, E., Ferdig, R.E. and Kratcoski, A., 2021. A new educational normal an intersectionality-led exploration of education, learning technologies, and diversity during COVID-19. *Technology in Society*, 66, p.101637. Available from: https://doi.org/10.1016/j.techsoc.2021.101637.

[18] Garbe, A., Ogurlu, U., Logan, N. and Cook, P., 2020. COVID-19 and Remote Learning: Experiences of Parents with Children during the Pandemic. *American Journal of Qualitative Research*, 4(3), pp.45–65. Available from: https://doi.org/10.29333/ajqr/8471.

[19] Greenhow, C., Lewin, C. and Staudt Willet, K.B., 2021. The educational response to Covid-19 across two countries: a critical examination of initial digital pedagogy adoption. *Technology, Pedagogy and Education*, 30(1), pp.7–25. Available from: https://doi.org/10.1080/1475939X.2020.1866654.

[20] Haidi, H. and Hamdan, M., 2023. Analysis of the home-based online teaching and learning policy during the COVID-19 second wave in Brunei: a joint parent/teacher perception. *Asia Pacific Education Review*, 24(3), pp.487–502. Available from: https://doi.org/10.1007/s12564-022-09798-x.

[21] Hook, D.W., Porter, S.J. and Herzog, C., 2018. Dimensions: Building Context for Search and Evaluation. *Frontiers in Research Metrics and Analytics*, 3. Available from: https://doi.org/10.3389/frma.2018.00023.

[22] Iivari, N., Sharma, S. and Ventä-Olkkonen, L., 2020. Digital transformation of everyday life – How COVID-19 pandemic transformed the basic education of the young generation and why information management research should care? *International Journal of Information Management*, 55, p.102183. Impact of COVID-19 Pandemic on Information Management Research and Practice: Editorial Perspectives. Available from: https://doi.org/10.1016/j.ijinfomgt.2020.102183.

[23] Jiang, B., Li, X., Liu, S., Hao, C., Zhang, G. and Lin, Q., 2022. Experience of Online Learning from COVID-19: Preparing for the Future of Digital Transformation in Education. *International Journal of Environmental Research and Public Health*, 19(24), p.16787. Available from: https://doi.org/10.3390/ijerph192416787.

[24] Kan, L., Degotardi, S. and Li, H., 2022. The impact of COVID-19 on the delivery of preservice teacher education: a scoping review. *Asia Pacific Education Review*. Available from: https://doi.org/10.1007/s12564-022-09816-y.

[25] Khlaif, Z.N., Salha, S. and Kouraichi, B., 2021. Emergency remote learning during COVID-19 crisis: Students' engagement. *Education and Information Technologies*, 26(6), pp.7033–7055. Available from: https://doi.org/10.1007/s10639-021-10566-4.

[26] Kirby, A., 2023. Exploratory Bibliometrics: Using VOSviewer as a Preliminary Research Tool. *Publications*, 11(1), p.10. Available from: https://doi.org/10.3390/publications11010010.

[27] Knopik, T., Błaszczak, A., Maksymiuk, R. and Oszwa, U., 2021. Parental involvement in remote learning during the COVID-19 pandemic—Dominant approaches and their diverse implications. *European Journal of Education*, 56(4), pp.623–640. https://onlinelibrary.wiley.com/doi/pdf/10.1111/ejed.12474, Available from: https://doi.org/10.1111/ejed.12474.

[28] Lase, D., Zega, T.G.C., Daeli, D.O. and Zaluchu, S.E., 2022. Parents' perceptions of distance learning during COVID-19 in rural Indonesia. *Journal of Education and Learning (EduLearn)*, 16(1), pp.103–113. Available from: https://doi.org/10.11591/edulearn.v16i1.20122.

[29] Law, N., Woo, D., de la Torre, J. and Wong, G., 2018. *A Global*

Framework of Reference on Digital Literacy Skills for Indicator 4.4.2. (Information Paper 51). Montreal, Quebec: UNESCO Institute for Statistics. Available from: http://uis.unesco.org/sites/default/files/documents/ip51-global-framework-reference-digital-literacy-skills-2018-en.pdf.

[30] Lestiyanawati, R., 2020. The Strategies and Problems Faced by Indonesian Teachers in Conducting e-learning during COVID-19 Outbreak. *CLLiENT (Culture, Literature, Linguistics, and English Teaching)*, 2(1), pp.71–82. Available from: https://doi.org/10.32699/cllient.v2i1.1271.

[31] Lewis, K.L., Howard, S.J., Verenikina, I. and Kervin, L.K., 2023. Parent perspectives on young children's changing digital practices: Insights from Covid-19. *Journal of Early Childhood Research*, 21(1), pp.76–90. Available from: https://doi.org/10.1177/1476718X221145486.

[32] Limone, P. and Toto, G.A., 2021. Psychological and Emotional Effects of Digital Technology on Children in COVID-19 Pandemic. *Brain Sciences*, 11(9), p.1126. Available from: https://doi.org/10.3390/brainsci11091126.

[33] Linnenluecke, M.K., Marrone, M. and Singh, A.K., 2020. Conducting systematic literature reviews and bibliometric analyses. *Australian Journal of Management*, 45(2), pp.175–194. Available from: https://doi.org/10.1177/0312896219877678.

[34] Loganathan, T., Chan, Z.X., Hassan, F., Kunpeuk, W., Suphanchaimat, R., Yi, H. and Majid, H.A., 2021. Education for non-citizen children in Malaysia during the COVID-19 pandemic: A qualitative study. *PLOS ONE*, 16(12), pp.1–19. Available from: https://doi.org/10.1371/journal.pone.0259546.

[35] Ma, M., Xiong, S., Zhao, S., Zheng, Z., Sun, T. and Li, C., 2021. COVID-19 Home Quarantine Accelerated the Progression of Myopia in Children Aged 7 to 12 Years in China. *Investigative Ophthalmology & Visual Science*, 62(10), pp.37–37. Available from: https://doi.org/10.1167/iovs.62.10.37.

[36] Mahapatra, A. and Sharma, P., 2021. Education in times of COVID-19 pandemic: Academic stress and its psychosocial impact on children and adolescents in India. *International Journal of Social Psychiatry*, 67(4), pp.397–399. Available from: https://doi.org/10.1177/0020764020961801.

[37] Manyengo, P.R., 2021. *Digitalization in teaching and education in the context of COVID-19: United Republic of Tanzania*. (Digitalization, the future of work and the teaching profession project background report). International Labour Organization, Geneva: International Labour Office. Available from: https://www.ilo.org/publications/digitalization-teaching-and-education-context-covid-19-united-republic.

[38] Marques de Miranda, D., da Silva Athanasio, B., Sena Oliveira, A.C. and Simoes-e-Silva, A.C., 2020. How is COVID-19 pandemic impacting mental health of children and adolescents? *International Journal of Disaster Risk Reduction*, 51, p.101845. Available from: https://doi.org/10.1016/j.ijdrr.2020.101845.

[39] Martin, F., Xie, K. and Bolliger, D.U., 2022. Engaging learners in the emergency transition to online learning during the COVID-19 pandemic. *Journal of Research on Technology in Education*, 54(sup1), pp.S1–S13. Available from: https://doi.org/10.1080/15391523.2021.1991703.

[40] Mathrani, A., Sarvesh, T. and Umer, R., 2022. Digital divide framework: online learning in developing countries during the COVID-19 lockdown. *Globalisation, Societies and Education*, 20(5), pp.625–640. Available from: https://doi.org/10.1080/14767724.2021.1981253.

[41] Mbhiza, H., 2021. Shifting Paradigms: Rethinking Education During and Post-COVID-19 Pandemic. *Research in Social Sciences and Technology*, 6(2), pp.279–289. Available from: https://doi.org/10.46303/ressat.2021.31.

[42] Mesce, M., Ragona, A., Cimino, S. and Cerniglia, L., 2022. The impact of media on children during the COVID-19 pandemic: A narrative review. *Heliyon*, 8(12), p.e12489. Available from: https://doi.org/10.1016/j.heliyon.2022.e12489.

[43] Mohan, A., Sen, P., Shah, C., Jain, E. and Jain, S., 2021. Prevalence and risk factor assessment of digital eye strain among children using online e-learning during the COVID-19 pandemic: Digital eye strain among kids (DESK study-1). *Indian Journal of Ophthalmology*, 69(1), p.140–144. Available from: https://doi.org/10.4103/ijo.ijo_2535_20.

[44] Munastiwi, E. and Puryono, S., 2021. Unprepared management decreases education performance in kindergartens during Covid-19 pandemic. *Heliyon*, 7(5), p.e07138. Available from: https://doi.org/10.1016/j.heliyon.2021.e07138.

[45] Normén-Smith, J., van Cappelle, F., Atis, E. and Ghobashy, D., eds, 2024. *Six pillars for the digital transformation of education: A common framework*. Paris: UNESCO. Available from: https://profuturo.education/wp-content/uploads/2024/10/Six-pillars-for-the-digital-transformation-of-education_compressed-1.pdf.

[46] Nottingham, E., Stockman, C. and Burke, M., 2022. Education in a datafied world: Balancing children's rights and school's responsibilities in the age of Covid 19. *Computer Law & Security Review*, 45, p.105664. Available from: https://doi.org/10.1016/j.clsr.2022.105664.

[47] OECD, 2020. *Combatting COVID-19's effect on children*. (OECD Policy Responses to Coronavirus (COVID-19)). Organisation for Economic Co-operation and Development, Paris: OECD Publishing. Available from: https://www.oecd.org/en/publications/2020/08/combatting-covid-19-s-effect-on-children_1a3fb8a9.html.

[48] Öztürk, O., Kocaman, R. and Kanbach, D.K., 2024. How to design bibliometric research: an overview and a framework proposal. *Review of Managerial Science*, 18(11), pp.3333–3361. Available from: https://doi.org/10.1007/s11846-024-00738-0.

[49] Page, M.J., McKenzie, J.E., Bossuyt, P.M., Boutron, I., Hoffmann, T.C., Mulrow, C.D., Shamseer, L., Tetzlaff, J.M., Akl, E.A., Brennan, S.E., Chou, R., Glanville, J., Grimshaw, J.M., Hróbjartsson, A., Lalu, M.M., Li, T., Loder, E.W., Mayo-Wilson, E., McDonald, S., McGuinness, L.A., Stewart, L.A., Thomas, J., Tricco, A.C., Welch, V.A., Whiting, P. and Moher, D., 2021. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ*, 372, p.n71. Available from: https://doi.org/10.1136/bmj.n71.

[50] Pandya, A. and Lodha, P., 2021. Social Connectedness, Excessive Screen Time During COVID-19 and Mental Health: A Review of Current Evidence. *Frontiers in Human Dynamics*, 3. Available from: https://doi.org/10.3389/fhumd.2021.684137.

[51] Pattnaik, J., Nath, N. and Nath, S., 2023. Challenges to Remote Instruction During the Pandemic: A Qualitative Study with Primary Grade Teachers in India. *Early Childhood Education Journal*, 51(4), pp.675–684. Available from: https://doi.org/10.1007/s10643-022-01331-4.

[52] Pokhrel, S. and Chhetri, R., 2021. A Literature Review on Impact of COVID-19 Pandemic on Teaching and Learning. *Higher Education for the Future*, 8(1), pp.133–141. Available from: https://doi.org/10.1177/2347631120983481.

[53] Polydoros, G.V. and Alasona, N., 2021. Teaching and Learning During The Covid-19 Pandemic. *Journal of Research and Opinion*, 8(6), pp.2954–2963. Available from: https://researchopinion.in/index.php/jro/article/view/107/189.

[54] Postic, N., 2021. *Digitalization in teaching and education in Ethiopia, Kenya, Malawi, Rwanda and the United Republic of Tanzania*. (Digitalization, the future of work and the teaching profession project synthesis re-

port). International Labour Organization, Geneva: International Labour Office. Available from: https://researchrepository.ilo.org/esploro/outputs/report/Digitalization-in-teaching-and-education-in/995219198202676.

[55] Purba, S.W.D., Chao, H.C., Hwang, W.Y. and Tang, Y.Q., 2024. Empowering vocational students: Exploring mobile learning for sustainable high-level cognition in authentic contexts. *Eurasia Journal of Mathematics, Science and Technology Education*, 20(8), p.em2491. Available from: https://doi.org/10.29333/ejmste/14917.

[56] Resende, M.A.A., Da Fonseca, M.L., De Freitas, J.T., Gesteira, E.C.R. and Rossato, L.M., 2024. Impacts caused by the use of screens during the COVID-19 pandemic in children and adolescents: an integrative review. *Revista Paulista de Pediatria*, 42. Available from: https://doi.org/10.1590/1984-0462/2024/42/2022181.

[57] Rousoulioti, T., Tsagari, D. and Giannikas, C.N., 2022. Parents' New Role and Needs During the COVID-19 Educational Emergency. *Interchange*, 53(3), pp.429–455. Available from: https://doi.org/10.1007/s10780-022-09464-6.

[58] Sandhu, D. and Barn, R., 2023. "The Internet Is Keeping Me from Dying from Boredom": Understanding the Management and Social Construction of the Self Through Middle-Class Indian Children's Engagement with Digital Technologies During the COVID-19 Lockdown. *International Journal on Child Maltreatment: Research, Policy and Practice*, 6(3), pp.489–504. Available from: https://doi.org/10.1007/s42448-022-00135-8.

[59] Sari, T. and Nayır, F., 2020. Challenges in Distance Education During the (Covid-19) Pandemic Period. *Qualitative Research in Education*, 9(3), p.328–360. Available from: https://doi.org/10.17583/qre.2020.5872.

[60] Serra, G., Lo Scalzo, L., Giuffrè, M., Ferrara, P. and Corsello, G., 2021. Smartphone use and addiction during the coronavirus disease 2019 (COVID-19) pandemic: cohort study on 184 Italian children and adolescents. *Italian Journal of Pediatrics*, 47(1), p.150. Available from: https://doi.org/10.1186/s13052-021-01102-8.

[61] Shutzman, B. and Gershy, N., 2023. Children's excessive digital media use, mental health problems and the protective role of parenting during COVID-19. *Computers in Human Behavior*, 139, p.107559. Available from: https://doi.org/10.1016/j.chb.2022.107559.

[62] Sosa Díaz, M.J., 2021. Emergency Remote Education, Family Support and the Digital Divide in the Context of the COVID-19 Lockdown. *International Journal of Environmental Research and Public Health*, 18(15), p.7956. Available from: https://doi.org/10.3390/ijerph18157956.

[63] Spadafora, N., Reid-Westoby, C., Pottruff, M., Wang, J. and Janus, M., 2023. From Full Day Learning to 30 Minutes a Day: A Descriptive Study of Early Learning During the First COVID-19 Pandemic School Shutdown in Ontario. *Early Childhood Education Journal*, 51(2), pp.287–299. Available from: https://doi.org/10.1007/s10643-021-01304-z.

[64] Susilowati, I.H., Nugraha, S., Alimoeso, S. and Hasiholan, B.P., 2021. Screen Time for Preschool Children: Learning from Home during the COVID-19 Pandemic. *Global Pediatric Health*, 8, p.2333794X211017836. Available from: https://doi.org/10.1177/2333794X211017836.

[65] Tang, K.H.D., 2023. Impacts of COVID-19 on primary, secondary and tertiary education: a comprehensive review and recommendations for educational practices. *Educational Research for Policy and Practice*, 22(1), pp.23–61. Available from: https://doi.org/10.1007/s10671-022-09319-y.

[66] *The State of Broadband: Accelerating broadband for new realities. September 2022*, 2022. ITU/UNESCO Broadband Commission for Sustainable Development,

Geneva: International Telecommunication Union. Available from: https://www.broadbandcommission.org/publication/state-of-broadband-2022/.

[67] The United Republic of Tanzania. Ministry of Education, Science and Technology, 2024. Draft national digital education strategy 2024/25 – 2029/30. Available from: https://www.moe.go.tz/sites/default/files/Draft_National_Digital_Education_Strategy2024-2030-2.pdf.

[68] Thiab, S., Barakat, M., Qudah, R., Basheti, I. and Daoud, S., 2022. Assessing health-related behaviors among Jordanian children during COVID-19 pandemic: A cross-sectional study. *Pharmacy Practice*, 20(2), p.2670. Available from: https://doi.org/10.18549/PharmPract.2022.2.2670.

[69] Tsao, S.F., Chen, H., Tisseverasinghe, T., Yang, Y., Li, L. and Butt, Z.A., 2021. What social media told us in the time of COVID-19: a scoping review. *The Lancet Digital Health*, 3(3), p.e175–e194. Available from: https://doi.org/10.1016/s2589-7500(20)30315-0.

[70] Tsilika, K., 2023. Exploring the Contributions to Mathematical Economics: A Bibliometric Analysis Using Bibliometrix and VOSviewer. *Mathematics*, 11(22), p.4703. Available from: https://doi.org/10.3390/math11224703.

[71] Ueno, C. and Yamamoto, S., 2022. The relationship between behavioral problems and screen time in children during COVID-19 school closures in Japan. *Scandinavian Journal of Child and Adolescent Psychiatry and Psychology*, 10(1), pp.1–8. Available from: https://doi.org/10.21307/sjcapp-2022-001.

[72] UNESCO Office in Dar-es-Salaam and Tanzania UR. Ministry of Education and Vocational Training, 2015. *ICT competency standards for teachers in Tanzania*. Available from: https://unesdoc.unesco.org/ark:/48223/pf0000234822.

[73] UNICEF and ITU, 2020. *How many children and young people have internet access at home? Estimating digital connectivity during the COVID-19 pandemic*. UNICEF Data and Analytis Section. Available from: https://www.itu.int/en/ITU-D/Statistics/Pages/youth_home_internet_access.aspx.

[74] Wadhwani, M., Manika, M., Jajoo, M. and Upadhyay, A.D., 2022. Online survey to assess computer vision syndrome in children due to excessive screen exposure during the COVID 19 pandemic lockdown. *Journal of Family Medicine and Primary Care*, 11(9), pp.5387–5392. Available from: https://doi.org/10.4103/jfmpc.jfmpc_1771_21.

[75] Wang, X.Y., Li, G., Malik, S. and Anwar, A., 2022. Impact of COVID-19 on achieving the goal of sustainable development: E-learning and educational productivity. *Economic Research-Ekonomska Istraživanja*, 35(1), pp.1950–1966. Available from: https://doi.org/10.1080/1331677X.2021.1927789.

[76] Yildiz, S., Kilic, G.N. and Acar, I.H., 2023. Early Childhood Education During the COVID-19 Outbreak: The Perceived Changing Roles of Preschool Administrators, Teachers, and Parents. *Early Childhood Education Journal*, 51(4), pp.743–753. Available from: https://doi.org/10.1007/s10643-022-01339-w.