

# Unveiling the Post-Pandemic Pedagogical Shift: A Bibliometric Odyssey into Educational Technology Research on the Scopus Database (2020-2023)

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## Abstrak

The aim of this research is to map and analyze the development of research on educational technology in publications indexed in Scopus. The method used is bibliometric analysis, which focuses on the study of publications on the topic of “Technology Education” in the Scopus database after the Covid-19 pandemic from 2020 to 2023. The analysis process involves the use of tools such as Excel and R/R Studio. Visual analysis uses VOSviewer to visualize the co-occurrence of keywords and document citations. This study identified 2289 publications relevant to the established criteria. The results show annual growth of -0.18%, peaking in 2021. The United States was the largest contributor to the number of publications, with Universidad De Granada being the most productive affiliate. The most prolific author on technology education is Yunus, M.M. This research provides a comprehensive review of the education literature with recommendations for future research directions. It is hoped that this research will make a valuable contribution to the understanding of educational strategies

Keywords: Technology, Education, Covid-19

## Introduction

In 2019, the world experienced a pandemic that we know as the Covid-19 virus pandemic (Drane et al., 2021; haucke et al., 2020). Where the Covid-19 pandemic prevents us from socializing with other people in any form, any activities we undertake must be carried out without physical contact with other people as the Covid-19 virus spreads through physical contact, we call this sort of thing social distancing (Zia et al., 2020; Schlemmer et al., 2022). Fortunately, we are currently witnessing the progress from the Industrial Revolution 4.0 era to the Industrial Revolution 5.0 era (Ivanova et al., 2020; Rodriguez et al., 2022; Hashim et al., 2022), This is technological change and digitalization (Herrmann et al., 2021; Timotheou et al., 2023) is happening in all areas in ways never seen before, including education. Of course, technology changes (Abdallah et al., 2022). This is very helpful for both educators and students in learning. We commonly refer to this technological advancement in education as educational technology (Timotheou et al., 2023; Stojan et al., 2022; Kuo et al., 2023).

Originally, educational technology meant the same thing as technology in education, namely facilities that support teaching and learning activities, such as computers, overhead projectors, projectors, videos, etc (Munoz et al., 2022). Educational technology is a complex and integrated process involving people, processes, ideas, equipment and organizations to analyze problems. There are also those who provide the understanding that educational technology is the development, application and evaluation of systems, techniques and tools to enhance and enhance the human learning process (Susanti, 2013).

Given the changes in the age of Industrial Revolution 4.0 (Szabo et al., 2021; Kinal, 2021; Prahani et al., 2022) to the era of Industrial Revolution 5.0, where technology and innovation continue to develop, further analysis of the topic of technology education becomes increasingly important. Because we need to understand how to improve students' and teachers' understanding of educational technology amid dynamic changes in the learning environment (Ennouamani et al., 2020; Pears et al., 2023). New technologies in education such as applications and learning media can also be used as a means of learning or creating new learning methods (Ahmed et al., 2020; Ratten, 2023).

Bibliometric indicators play a crucial role in evaluating the outcomes of scientific research. They are not only used to measure the impact of publications but also to analyze the interaction between science and technology, illustrate the mapping of various fields of science, and track the development of new knowledge in specific disciplines (Love et al.,

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2020; Melynk et al., 2021). Moreover, bibliometric indicators (Vazquez et al., 2022; Romero et al., 2023) provide a valuable foundation for future strategic planning, helping research and academic institutions to direct their resources more effectively and formulate policies based on data and evidence. Therefore, bibliometric indicators are essential tools in the research world to help understand, measure, and plan the development of science (Deng et al., 2023; Weil et al., 2021).

This study aims to examine the development and research trends related to the theme of "Technology Education" in publications listed in the Scopus database from the post-COVID-19 pandemic period, starting from 2020 to 2023. The use of the year 2020 as the starting point of the study was chosen based on the fact that the effects of the COVID-19 pandemic were significant and felt by everyone, including researchers.

## Literature Review

Research conducted by Rinto Alexandro and Basrowi (Alexandro et al., 2024) It examines the mediating effect of intelligent digital organizations on the relationship between digital leadership, digital talent development and digital learning management systems through the adoption of advances in digital technology. This research found that digital leadership, digital talent development and management systems have a positive and statistically significant impact on the adoption of digital technologies (Aldekheel et al., 2022).

The study conducted by Rima Shishakly and Mohammed Amin Almaiah examined the benefits of educational technology in advancing educational development. Educational technology plays a role as a component of online learning and new teaching methods. The study in this research introduces the Technology Integration for Educational Sustainable Development (TIFESD) framework, which serves as an assessment tool to assess students' awareness of technology-based elements (Shishakly et al., 2024).

The next study is a study conducted by Ra'ed Masa'deh and Dmaithan Abdelkarim Almajali that discusses the use of innovative technology (Enzai et al., 2020; Montiel et al., 2020; Wang, 2023) to impart learning to students amid the Covid-19 pandemic. This innovative technological approach is based on the use of Mobile Learning Applications (MLA). This application (MLA) leverages some of the outstanding features of mobile applications to enable students to collaborate and participate in online learning (Masa'deh et al. 2024).

## Method

This research uses bibliometric analysis methods. Data was retrieved using a Boolean search engine to search the Scopus database from 2020 to 2024. The search was conducted on December 15, 2023 at 3:00 p.m. WIB. The researchers used R and Rstudio, VosViewer and Microsoft Excel tools to analyze citations, document content and networks. The research included three phases of processing the data set.

In the initial phase, researchers conduct a literature review of related topics to ensure that the research conducted remains relevant to the bibliometric focus. Additionally, the literature review is helpful in identifying appropriate keywords that are considered appropriate to reflect the scope of the research.

Second Stage: In this stage the researcher uses Boolean operators TITLE-ABS KEY (TECHNOLOGY AND EDUCATION) Conducted a search on Scopus which returned 260,514 documents. The filtering is then carried out using Boolean operators TITLE-ABS KEY ( technology AND education ) AND PUBYEAR > 2019 AND PUBYEAR < 2024 AND ( LIMIT-TO ( DOCTYPE , "ar" ) ) AND ( LIMIT-TO ( SRCTYPE , "j" ) ) AND ( LIMIT TO ( LANGUAGE , "english" ) ) AND ( LIMIT-TO ( SUBJAREA , "soci" ) ) AND ( LIMIT-TO ( EXACTKEYWORD , "education" ) ) To limit only articles as an article document type, the source documents were only journals and only English language articles, resulting in a final document of 2,289.

In the third phase, an analysis of the final documents of the search was performed using the Scopus analyzer and R and Rstudio to determine the number of documents per year, documents based on journal, author, affiliation, country and subject/field. Analysis was then carried out at the document network level with visualization via VOSviewer and Microsoft Excel data processing.

The process of this research can be seen in the following figure (x):

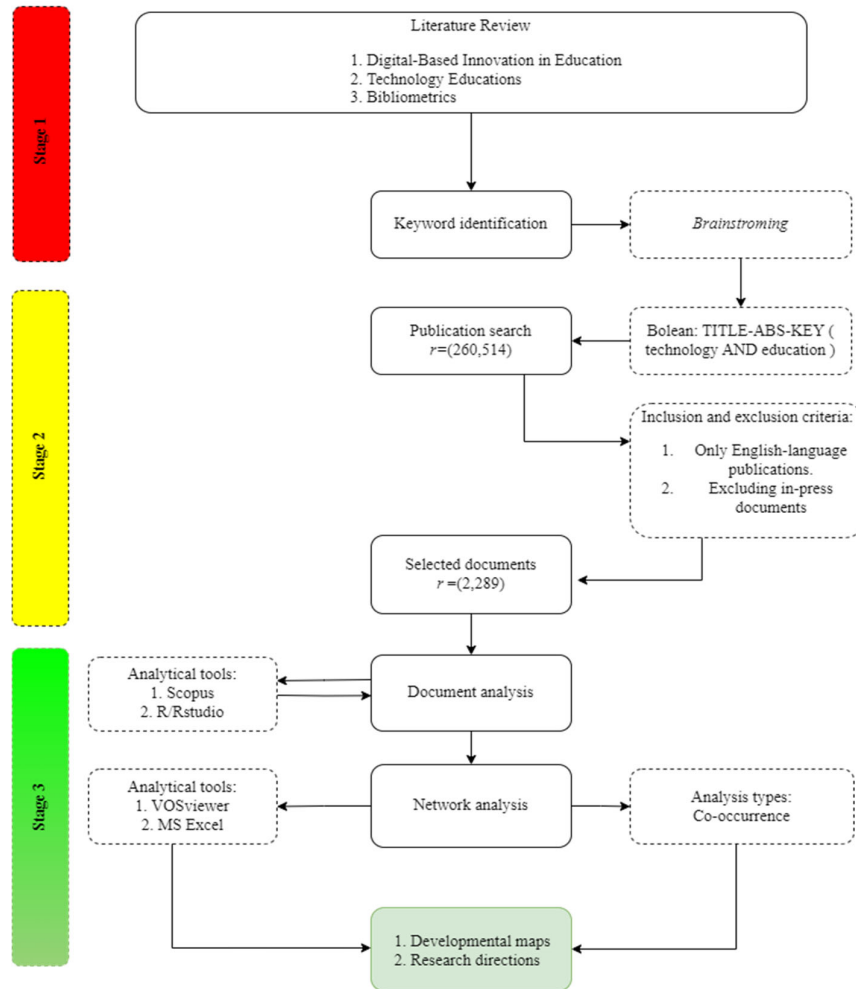


Figure 1. Research Workflow

## Result and Discussion

### Document Analysis

#### Main Information About Data

Table 1 provides an overview of the 2289 documents collected over 4 years. Includes 8135 authors, 279 single authors, 20.71% international authorship collaboration, 105624 references with an average citation per document of 9.112 citations.

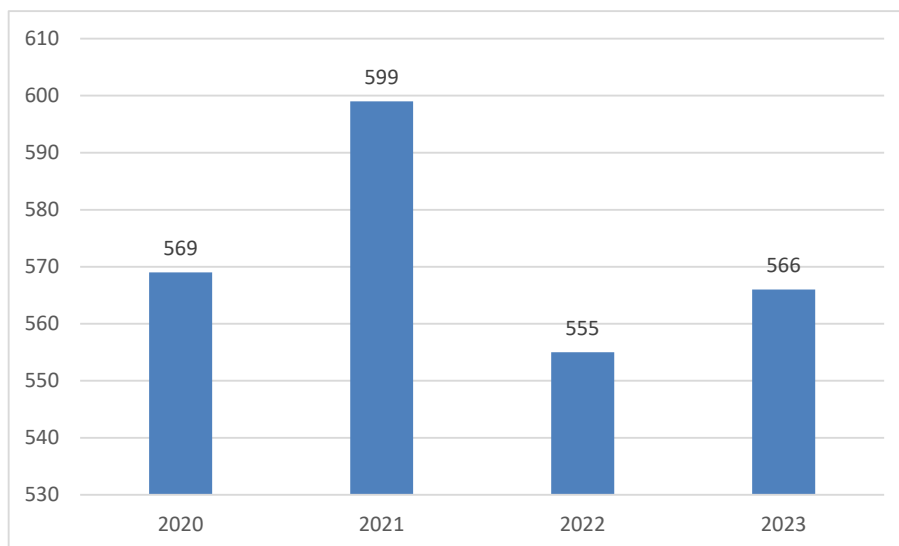
Tabel 1. Main Data Information

Description	Results
MAIN INFORMATION ABOUT DATA	
Timespan	2020:2023
Sources (Journals, Books, etc)	716
Documents	2289
Annual Growth Rate %	-0.18
Document Average Age	1.51
Average citations per doc	9.112
References	105624
DOCUMENT CONTENTS	

Keywords Plus (ID)	4757
Author's Keywords (DE)	5978
<b>AUTHORS</b>	
Authors	8135
Authors of single-authored docs	279
<b>AUTHORS COLLABORATION</b>	
Single-authored docs	287
Co-Authors per Doc	3.81
International co-authorships %	20.71
<b>DOCUMENT TYPES</b>	
article	2289

### *Document by Year*

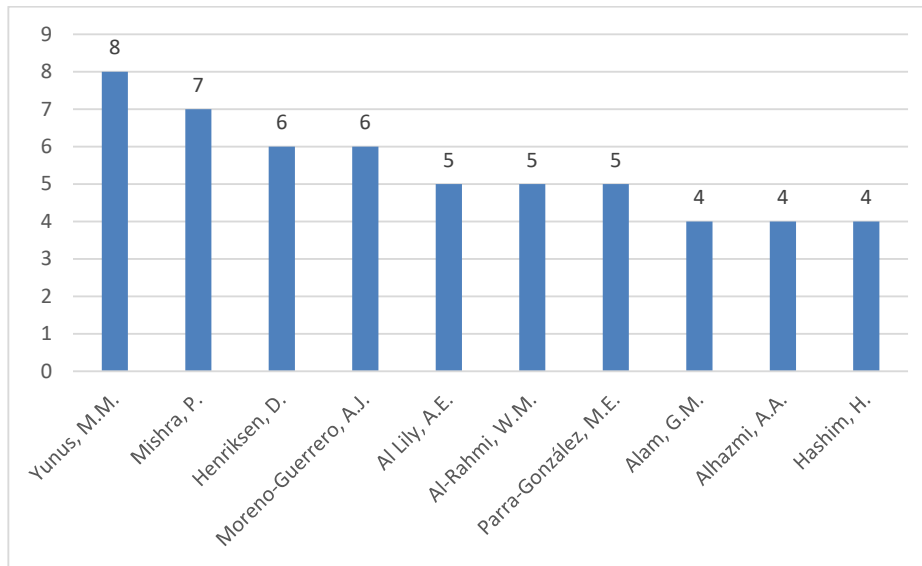
The image below shows the development of publications on the topic of “Technology education after the Covid-19 pandemic” based on the year of publication. In 2020, 569 documents appeared, with an increase and a peak in 2021. This year, 599 documents related to technology education were published. In 2021, this year is the worst peak of the Covid-19 pandemic. where many people use technology to work, learn and socially interact as the impact of Covid-19 prohibits people from face-to-face contact. From the increase in data, it can be seen that many researchers are interested in researching technology education, so the number of published documents is increasing.



**Figure 2.** Graphical document publication by year

### *Most Relevant Author`s*

The following graphic shows the 10 most influential authors in publishing articles on technology education in the wake of the Covid-19 pandemic. Yunus, M.M. is the most relevant author with 8 published documents, followed by Mishra, P. with 7 published documents and Henriksen and Moreno with 6 published documents each.

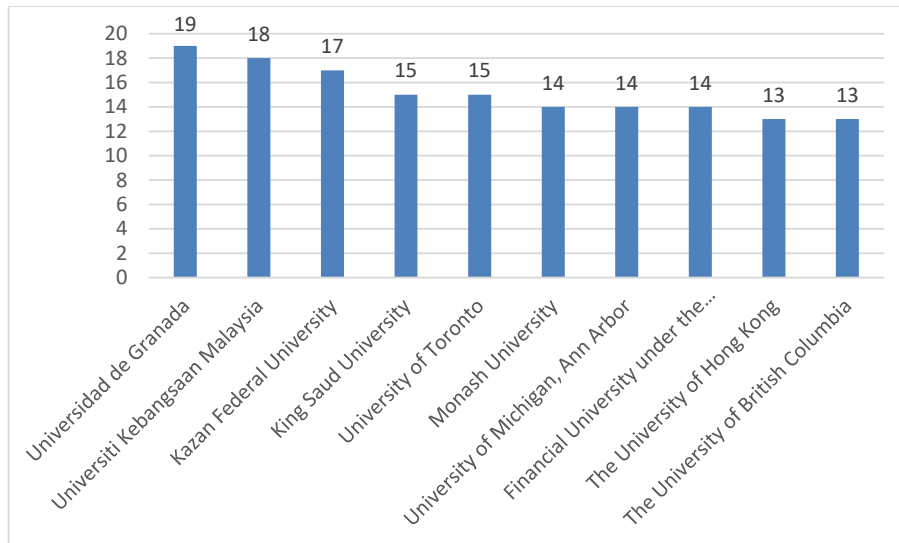


**Figure 3.** Graphical document most relevant author's

#### *Document by Affiliation*

The image below shows the 10 affiliates most commonly used in publishing technology education articles after the Covid-19 pandemic. The analysis on this topic was largely carried out by researchers at the Universidad de Granada in Spain and included a total of 19 articles. This was followed by researchers from Universiti Kebangsaan Malaysia with 18 documents and then Kazan Federal University in Russia with 17 documents.

We can see that the distance between ranking partners 1, 2 and 3 is only different by one document. This shows that after the Covid-19 pandemic, there is not a very strong dominance in the affiliation of article publications on technology education.



**Figure 4.** Graphical document publication by affiliation

#### *Document by Country*

The following image shows the distribution of publications by country after the Covid-19 pandemic in the field of technology education. The country with the most publications is the United States with 550 documents, followed by Spain with 179 documents and the United Kingdom in third place with 164 published documents.

The dominance of the United States is clearly visible. It is obvious that the United States has a very large gap in terms of publications compared to the next ranked country, Spain. The Covid-19 pandemic was caused by the United States. This country is a very advanced country in terms of education and technology compared to other countries.

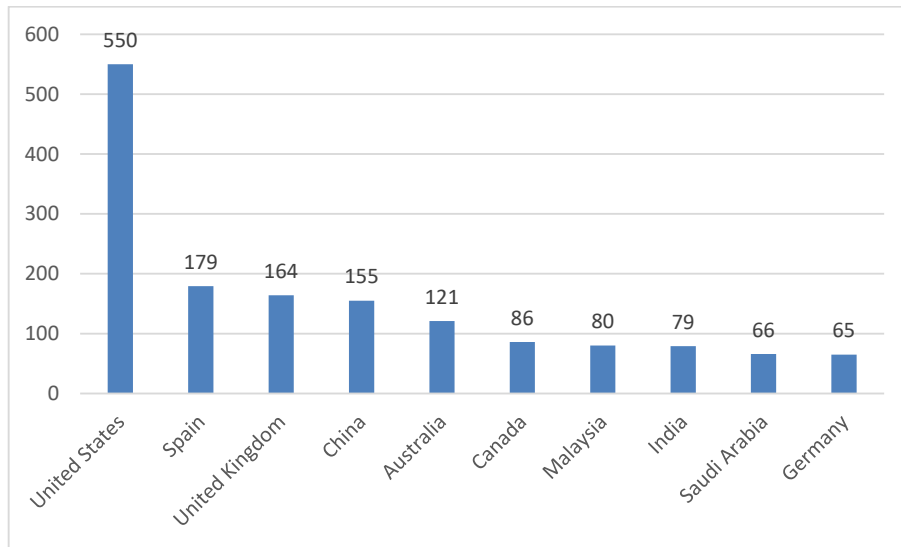


Figure 5. Graph of the number of publications by country

### Three-Field Plot

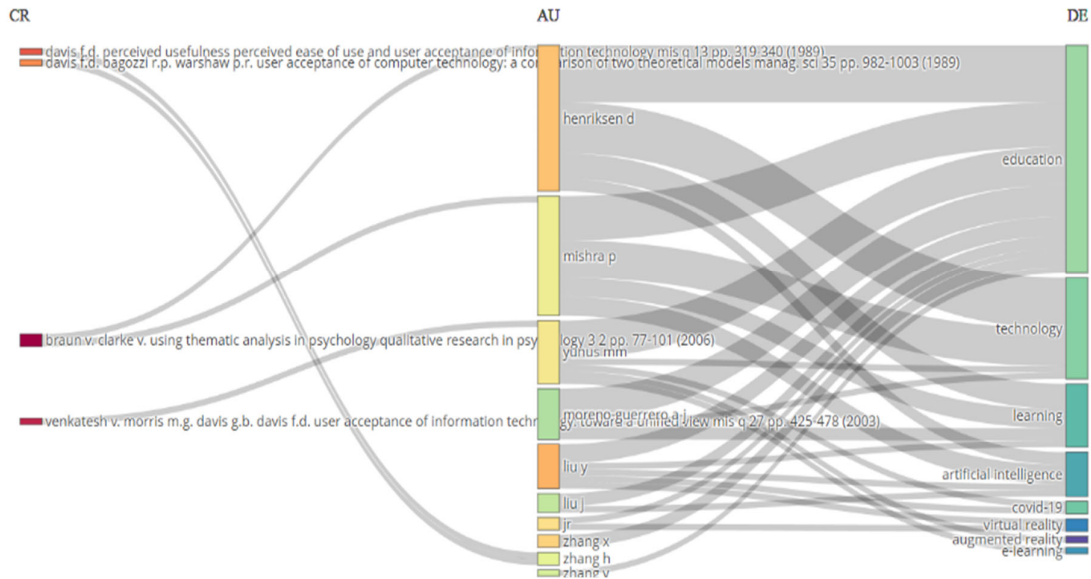


Figure 6. Three field-plot (Reference, Author, Keywords)

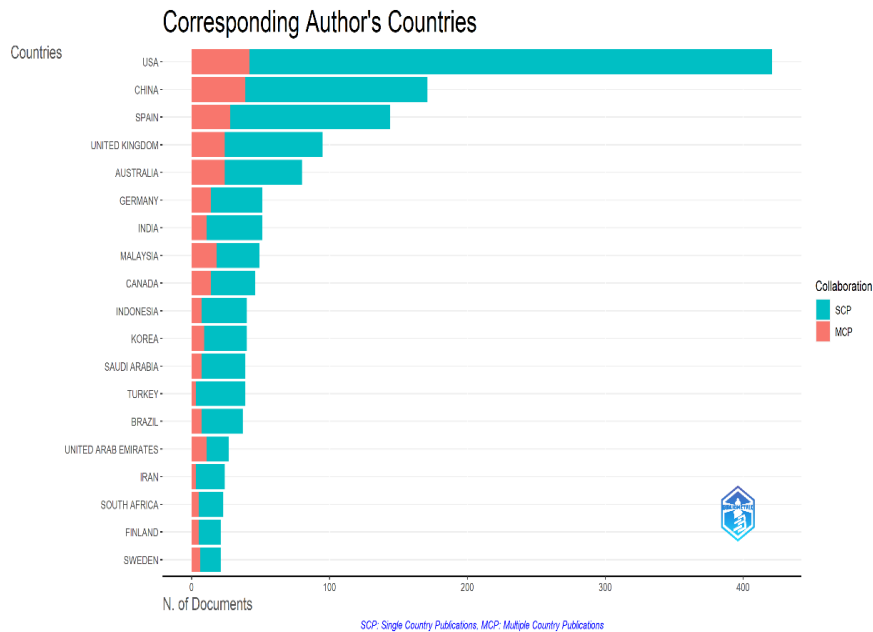
Figure 6 contains three observed elements: the name of the author who published the document, keywords used, and references. The three elements are then connected by gray lines of action that relate to each other.

The first element contains references cited by the authors when researching related topics. Based on the picture above, there are 4 references. The most cited reference in research on technology education in the post-Covid-19 pandemic period is “Using thematic Analysis in Psychology,” qualitative research in psychology, shown in dark red and associated with two authors, namely Mishra and Henriksen.

Based on the image above, there are 10 authors in the second element. The size of the bar chart shows how many research publications each author has published. The ten authors who wrote the most articles on technology education in the post-Covid-19 pandemic period included Henriksen, Mishra and Yunus.

In the third element, each research topic has a connection to authors actively involved in the production of works related to technology education in the post-Covid-19 pandemic period. The results of the analysis identified 8 keywords, with the words “education” and “technology” ranking highest. This shows that these two words have a close connection with research related to technology education in the post-Covid-19 pandemic.

## Corresponding Author's Countries



**Figure 7.** Corresponding author's countries

From the perspective of Multiple Country Publication (MCP) and Single Country Publication (SCP), the number of SCPs is larger than that of MCPs. Regarding MCP, the United States (US) achieved the highest number of publications with 42 documents, followed by China with 29 documents and Spain with 29 documents. However, on the SCP side, the USA is also at the top with a much larger number of publications, namely 379 documents. China came second with 132 documents, while Spain came third with 116 documents. According to the continental data, the Asian continent dominates with a total of 8 countries, while the European continent comes second with a total of 5 countries.

## Most Global Cited Document

The article with the highest total citations (TC) is "Aggarwal Rk, 2000, J Money Credit Bank" with 229 citations. Meanwhile, "Hayat R, 2011, Emerg Mark Rev" is the newspaper with the highest TC per year with 13.77 citations per year.

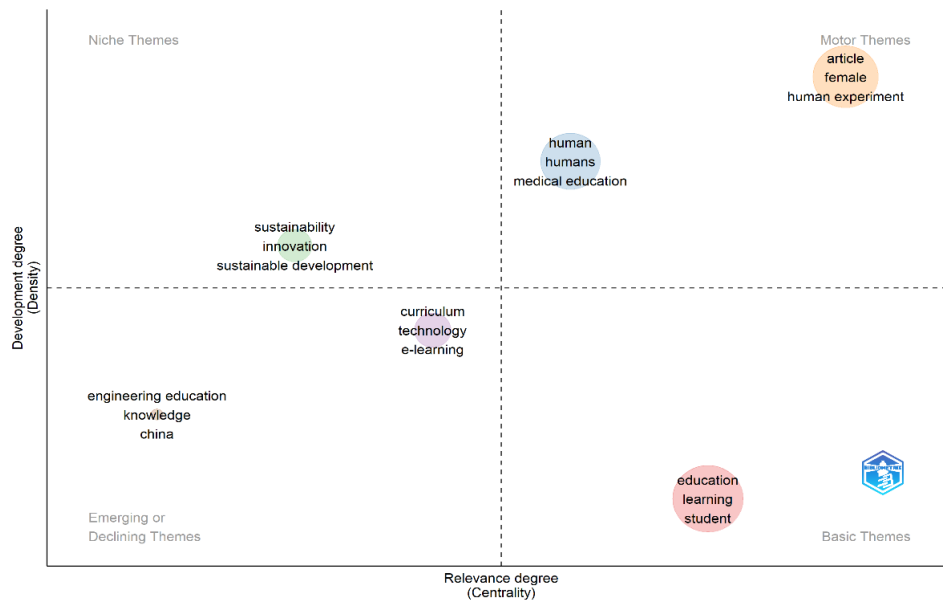
Based on this data, it can be seen that TC (total citations) tends to influence TC per year (citations per year). In general, works with larger TCs also tend to have significant TCs per year. Although it is not always true that securities with large TCs necessarily have higher TCs per year than others, and vice versa.

However, the publication year of the paper tends not to have a significant impact on TC. Although there are some papers with older publication years that have lower TCs than papers with newer publication years, there are also exceptions where papers with older publication years can have high TCs. From the data provided, no consistent influence between the year of publication and the number of citations (TC) can be derived.

**Table 2.** Most global cited document

Paper	Total Citations	TC per Year	Normalized TC
Aggarwal Rk, 2000, J Money Credit Bank	229	9,54	2,00
Hayat R, 2011, Emerg Mark Rev	179	13,77	3,01
Wilson Jaj, 2013, J Islam Mark	150	13,64	5,57
Pollard J, 2007, Trans Inst Br Geogr	145	8,53	1,86
Amin H, 2011, J Islamic Account Bus Res	124	9,54	2,08
Taib Fm, 2008, Int J Islam Middle East Financ Manage	119	7,44	2,89
Wajdi Dusuki A, 2008, Int J Islam Middle East Financ Manage	106	6,63	2,57
Nobanee H, 2016, Renewable Sustainable Energy Rev	97	12,13	13,10

## Thematic Map



**Figure 8.** Thematical Map

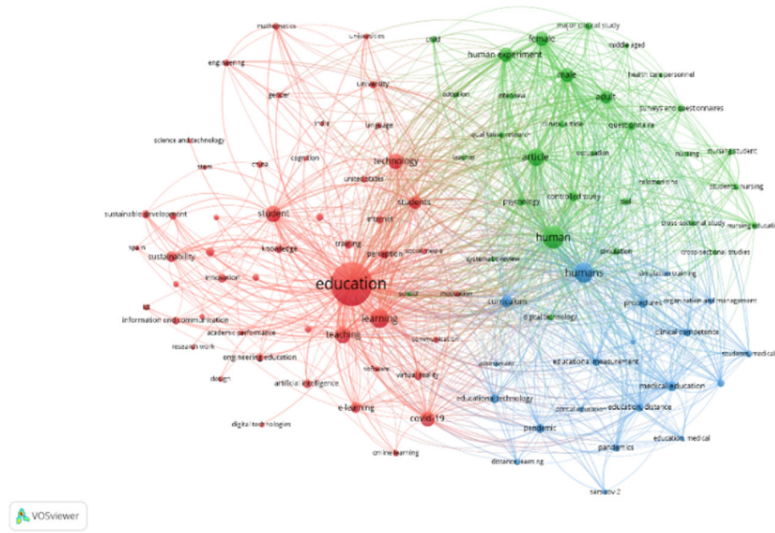
The topic mapping shown in Figure 8 consists of base topic, motorcycle topic, niche topic, emerging topic and declining topic. Basic topic is a category that includes basic topics from existing research. In the data provided, the education cluster is an example of an underlying theme. Fundamental topics are usually the focus of research and receive intensive attention from researchers.

**Motor Topics:** This category includes topics that are the driving force behind research development. The “Human” cluster is an example of a motor theme in this data. The topic of medical education is a topic that is being actively researched and influencing research directions and trends related to learning. Motor topics often influence the development of research and publications over time.

**Niche Topics:** This category includes topics that are more specific and less general compared to basic and motorcycle topics. An example of a niche topic in this data is the “Sustainability” cluster. The topic “Innovation and Sustainable Development” is placed in the “Niche Topics” category because it may have a smaller scope of research or be of interest only to certain groups of researchers.

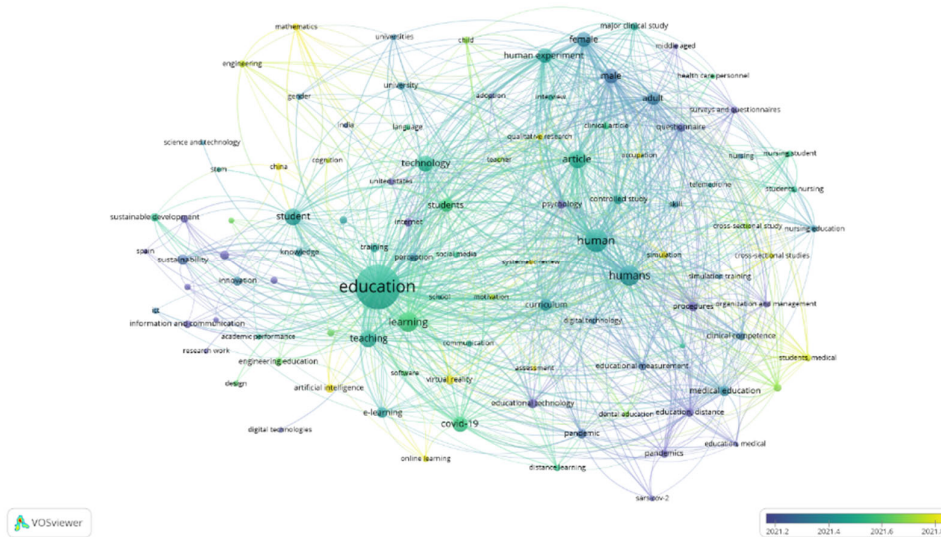
**Emerging or Declining Topics:** This category includes topics that are emerging or declining in popularity in research or publications. In this data, the topic of “technology” can be classified as an emerging topic because the number of incidents and their relevance to research are still significant, but the number is not as large as the topic of “learning”. By conducting analysis based on this classification, we can understand the distribution and trends of topics in existing research data or publications. This categorization helps identify important topics that dominate a particular research area, new topics, and topics that may require more attention and further research.

## Network Analysis



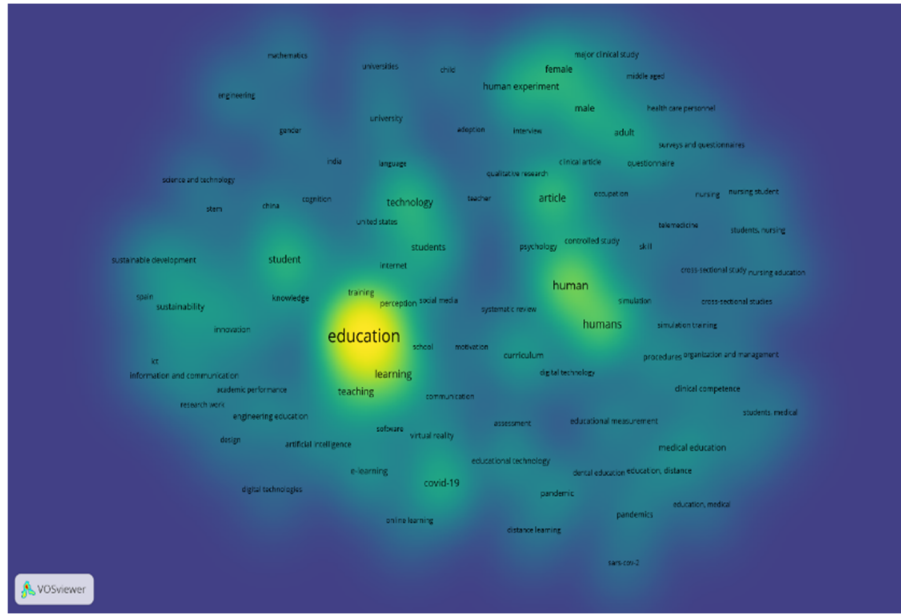
**Figure 9.** Visualization network analysis based on occurrence

This figure analyzes the number of research findings on technology education after the Covid-19 pandemic with a minimum number of clusters of 10. Three clusters are formed, where the number of elements in each cluster is as follows: Cluster 1 with 50 elements, Cluster 2 with 32 elements, and Cluster 3 with 20 elements. The dominant keyword is “education” with a total frequency of 2288 and a link strength of 9702.



**Figure 10.** Visualization network analysis based on overlay

The image above shows keyword network analysis based on overlay. It turns out that the keywords artificial intelligence, virtual reality, online learning are keywords that were used in the most recent year, namely around 2022. Meanwhile, the keywords pandemic, questionnaire and middle age are keywords that have been used for a relatively long time around 2020.



**Figure 11.** Visualization network analysis based on density

Density analysis in a study describes that the keywords “education”, “technology” and “people” have a high density in this research topic. Therefore, focusing on this aspect plays a central role in the context of technology education after the Covid-19 pandemic. And conversely, keywords such as “distance learning”, “digital technologies” and “artificial intelligence” are researched relatively rarely. Nevertheless, further research into these rare keywords could provide valuable insights into the discovery of elements that may not have been fully explored yet.

**Table 3.** Keywords and occurrence on each cluster

	Keyword	Occurrences	Cluster
1.	Education	2288	
2.	Learning	449	
3.	Student	318	1
4.	Teaching	314	
5.	Technology	307	
1.	Human	622	
2.	Article	366	
3.	Female	264	2
4.	Human Experiment	253	
5.	Male	245	
1.	Humans	477	
2.	Curriculum	180	
3.	Educational Technology	114	3
4.	Pandemic	108	
5.	Producers	104	

The table above shows the occurrence of each cluster, which represents the main topics of research in the field of technology education. The topic in the first cluster is “Educational Transformation in the Technology Age,” and the topic in the second cluster is “The Impact of Technology on Human Health.” The theme in the third cluster is “Educational Technology in the Age of Pandemic.”

## Conclusion

Publications on technology education after the Covid-19 pandemic peaked in 2021 with a total publication number of 599 documents. The most relevant author in articles on this topic is Yunus, M.M. with publications of 8 documents. The subsidiary with the most publications is the Universidad de Granada with a total of 19 publications. The country with the most publications is the USA with 550 documents. The largest MCP is the USA. And the most cited document is Aggarwal Rk, 2000, J Money Credit Bank with 229 cited documents. The basic topic in technology education research is education

and learning, education is the dominant keyword with a link strength of 2288. The keywords Artificial Intelligence, Virtual Reality, Online Learning, Systematic Review are keywords used in the last year, namely around 2022 became . There are three major themes, namely, “Education Transformation in the Technology Age,” “The Impact of Technology on Human Health,” and “Education Technology in the Pandemic Age.”

The limitations of this research are to only examine Scopus-indexed datasets and only analyze documents with English-language journal article types, without considering other global indexing, languages, and document types other than articles.

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