PROCEEDINGS OF INTERNATIONAL CONFERENCE ON EDUCATION
TEACHER TRAINING & EDUCATION FACULTY
UNIVERSITAS SERAMBI MEKKAH
NO. ISSN 2987-4564

ICT TRENDS IN EDUCATION: A BIBLIOMETRICS STUDY OF THE PAST TWENTY YEARS OF STUDIES

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ABSTRACT

Technology is a major component in education. Therefore, it must be investigated in order to gather knowledge for additional study. 185 articles were assessed using the PRISMA approach in conjunction with VOS-Viewer via Scopus data collecting. Analysing the quantity of articles, nations, citations, journals, and research partnerships on digital assessment in education is how evaluation is done. Knowledge map analysis is another way to investigate co-occurrence mapping. According to the research findings, the number of articles published rises annually, with the UK having the highest number of published publications. The research with the most citations is "Affordances of ICT in science learning: Implications for an integrated pedagogy," the journal with the most publications is "International Journal of Science Education," and the most well-liked partnership is the work done in Germany and the United Kingdom. The author with the most citations is "Webb M.E." Additionally, cluster analysis indicates that there are five primary categories—computer science education, education, science education, teaching, and science learning—that are most closely related to one another. Teaching, education, and computer science education are hot subjects right now.

Keywords: *education, ICT, science learning*

1. INTRODUCTION

The 21st century can be identified as an era dominated by advances in information and communication technology (ICT) (Wu et al., 2018). Rapid developments in this field have brought profound transformation to various aspects of human life. Communication that was once limited is now faster and more efficient, having a significant impact on the way we interact and share information. The internet, as the backbone of the digital revolution, has changed the paradigm in terms of access to information, learning, business and entertainment (Bryda & Costa, 2023). This phenomenon not only broadens global horizons, but also creates new opportunities and challenges that need to be overcome. Therefore, the 21st century can be considered an era that requires understanding and optimal use of information and communication technology so that society can develop sustainably amidst the dynamics of ever-changing times.

The significant impact of advances in Information and Communication Technology (ICT) is clearly visible in the field of education. Changes in the traditional learning paradigm to become more dynamic and open thanks to the adoption of technology. Online learning platforms, educational applications and digital resources have provided wider access for pupils and students to obtain information and learn interactively (Noskova et al., 2021). Distance learning has become the norm, providing students with flexibility in time and place. Additionally, technology enables the integration of innovative learning methods, such as game-based learning, simulations, and augmented reality, which can increase student engagement (Adipat et al., 2021). Thus, advances in ICT have not only changed the way we access information, but have also redefined the way we understand and experience the learning process.

Technology has a very significant role in the world of education today. Its presence is not only a necessity, but also a driving force for transformation in learning methods. One of the biggest contributions of technology in education is enabling access to distance learning. With the existence of online learning platforms, pupils and students can access study materials from anywhere, overcoming geographical limitations and providing extraordinary flexibility in the teaching and learning process. In this way, technology is not only a tool, but also a foundation for creating an educational environment that is inclusive and accessible to all groups. The use of Information and Communication Technology (ICT) in the education sector is very important, especially during the Covid-19 pandemic. In the face of situations that require physical restrictions and restrictions on face-to-face activities, educational institutions from school to university level are switching quickly to online learning solutions. Online platforms, video conferencing applications, and digital resources are the main means of

maintaining the continuity of education without compromising the safety of students and teaching staff. Distance education via ICT is not only an alternative, but also a necessity to ensure the continuity of the learning process amidst the limitations caused by the pandemic. Thus, the role of ICT in education during the Covid-19 pandemic has proven that technology plays a very crucial role in maintaining the continuity and accessibility of education in these difficult times.

However, several studies highlight that the overall use of technology in the teaching and learning process is not completely effective, and is even considered wasteful (Ulkhaq, 2021). Meriyanti and Jasmina (2022) revealed that the availability of ICT facilities in the household has a significant positive effect on the learning performance of junior high school students in Indonesia, however, the availability of ICT access in schools has no effect on student learning achievement. Even though technology makes a positive contribution by opening access to various information and facilitating distance learning, the main role of teachers is still very necessary in the success of education. Teachers are not only transmitters of information, but also as guides, motivators and managers of the learning environment. The teacher's ability to guide, provide in-depth understanding, and provide personal response and support to students, is a key element in forming solid understanding and sustainable skills. Therefore, along with the integration of technology, it needs to be understood that quality teachers remain the main pillar in creating an effective and meaningful learning experience for students.

Therefore, this article will review technology trends in education over the last ten years. The period marked a major shift in the way we manage and deliver education. Over the past decade, technology has infiltrated every aspect of learning, from elementary to tertiary levels. Use of the device Educational tools, online platforms and digital resources have become increasingly common as learning support tools. In addition, the concept of distance education and flexible learning models is increasingly developing, especially amidst events such as the global pandemic that encourage rapid adaptation to online learning solutions. Through this article, we can reflect on the significant changes that have occurred in educational paradigms due to technological advances and assess their impact on the learning experiences of current and future generations.

2. METHODS

This study used the PRISMA framework to review the existing literature. Following the PRISMA guidelines, the scoping process was employed to find the most relevant articles about conceptual understanding in physics education. This research uses bibliometrix analysis using R software and vos-viewer. Bibliometrix analysis is carried out to identify technology trends over time. This research uses the Scopus database with the keywords. The search was limited to articles that used "English". The document type used is article. This data was taken at 11:34 on 2/19/2024. A total of 185 documents were processed and then interpreted according to their respective categories. Several keyword combination queries were undertaken to acquire relevant published papers from a known and trustworthy research database, namely Scopus, in order to discover the relevant scientific journals and publications. To discover relevant material, the terms "ICT" AND "science education" OR "science learning" OR "physics learning" OR "physics education". The keyword released in this analysis is "Students". were used in a database search.

The duration of the literature search was set to cover the last decade (2002-2024) to ensure that current ICT was highlighted. Initially, 185 documents were displayed; however, this contained only research articles and reviews, Then, this study was limited to simply using English. The data was then exported to an Excel file so that the systematic review could begin.

3. RESULTS & DISCUSSION

The field of education is now one of those that is greatly impacted by the trend of information and communication technology's (ICT) rapid development. The learning process has changed as a result of this phenomena, which has also accelerated the growth of research into its implications, difficulties, and new prospects. The goal of this research's bibliometric analysis is to present a thorough picture of ICT trends in education throughout the previous 10 years. Using this methodology, we examined a range of research conducted

throughout that time, highlighting significant trends, contributing authors, cross-national partnerships, and publishing journals.

3.1 Annual trends

Over the last several years, research on ICT in education has been steadily increasing. The most significant decline occurred in 2018–2019. Conversely, the most notable decline occurred in 2011–2012. In 2023–2024, it remains to be seen whether public awareness of this research is increasing or decreasing. For this reason, the year 2024 is essentially the beginning of the batch data generation process. This can be seen by looking at **Figure 1** below.

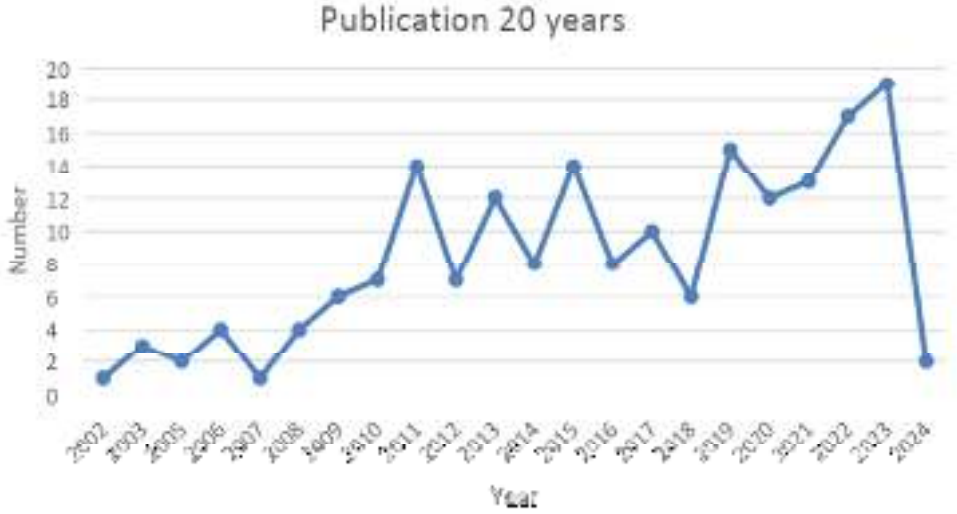

Figure 1. Distribution of Published Documents from 2002 to 2024

The significant increase in research publications in 2018-2019 reflects that research topics are very popular and urgent to research. This is supported by Indonesia's first participation in the computer-based PISA study in 2018. Based on the results of the 2018 PISA study, Indonesia experiences weaknesses in ICT (Putrawangsa and Hasanah, 2022). So, one of the recommendations given by the government is that optimizing information and communication technology (ICT) needs to be used for more effective learning. One form of optimization that can be done is not to use ICT excessively in education (Bhutoria & Aljabri, 2022).

3.2 Country

In the discipline of scientific publications, the state plays a major role. A nation's level of research activity can give insight into the popularity and importance of particular subjects in that nation's society. A topic's interest and significance in the academic and social spheres of a nation are more clearly indicated by the number of scientific publications on it. The state-imposed intellectual breakthroughs and research agendas that are deemed essential to the advancement of science and technology are reflected in scientific publications.

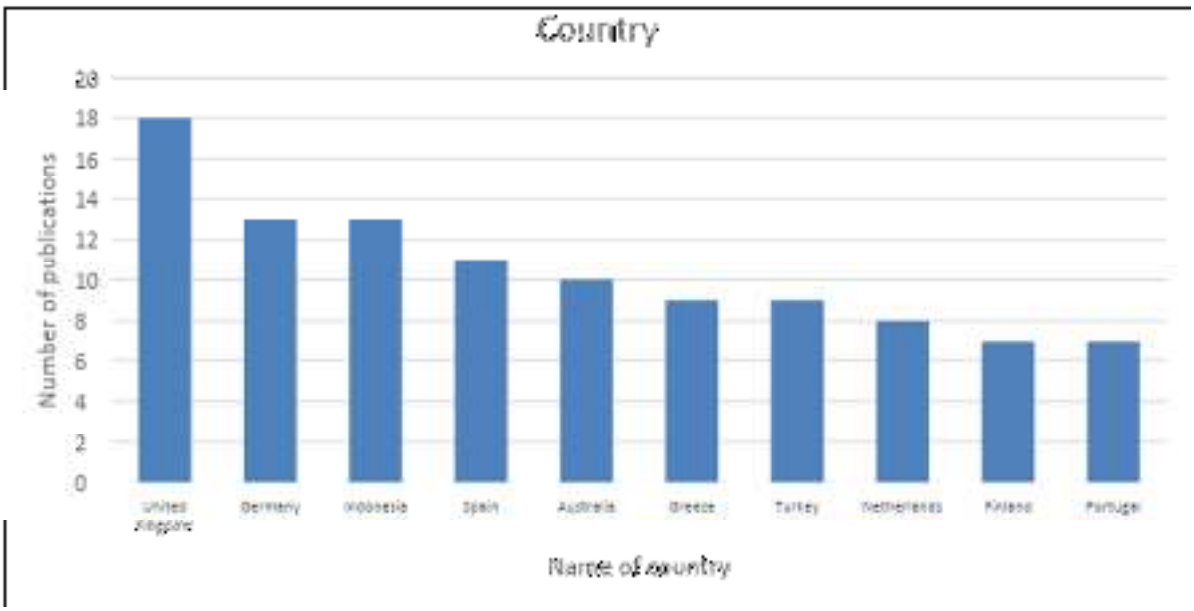

Figure 2. Distribution of Published Documents among Top 10 Countries

The topic of ICT in Education is dominated by the United Kingdom. The UK's leadership in integrating ICT in educational contexts is reflected in the number of research and scientific publications originating from the country. This is in line with research conducted by González-Zamar et al. (2020) regarding research on ICT management to encourage sustainable education in higher education.

3.3 Article Most Cited

One common measure of a scientific article's quality is its number of citations by other scholars. When assessing the effect and relevance of research within the scientific community, citation count is a crucial metric to consider. A study's contribution and relevance to the advancement of the relevant field of knowledge are acknowledged to a greater extent when it is cited in more articles. When the writing and research process may contribute meaningfully and positively influence scientific advancement and general comprehension, it is considered to be of higher quality. As a result, a high citation count may be interpreted as an indication of the importance and caliber of a scientific publication.

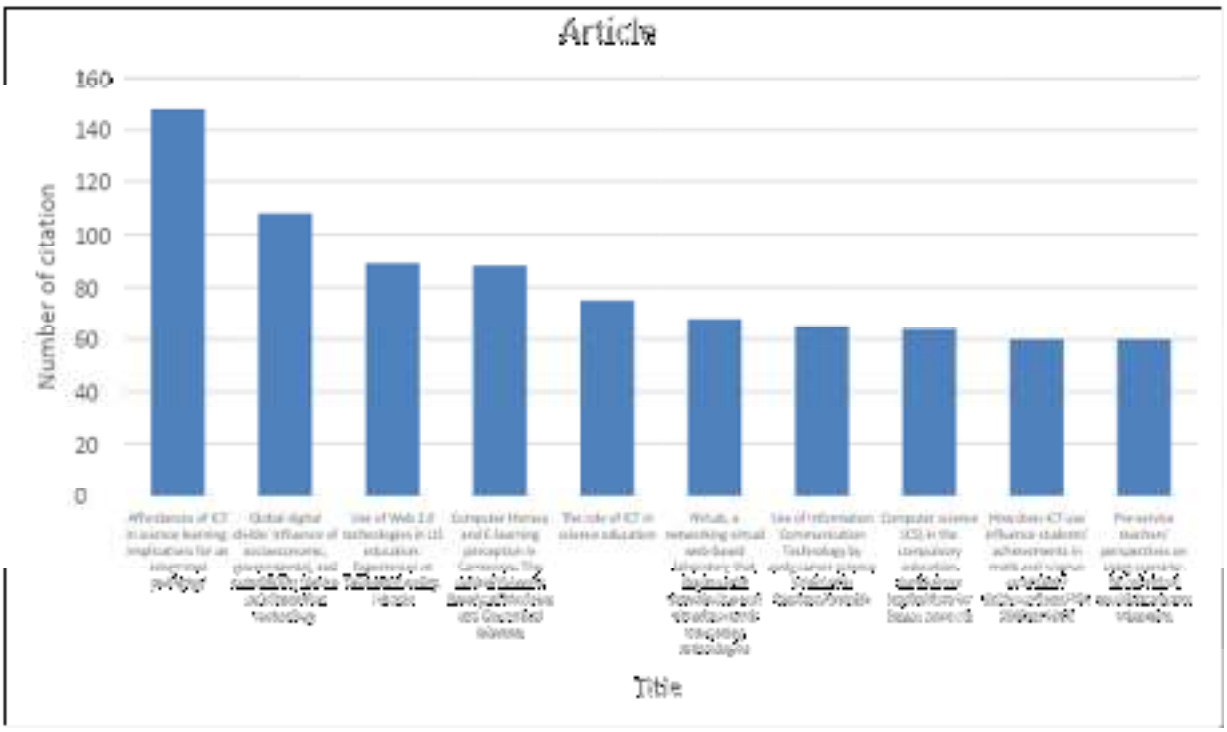

Figure 3. Most Cited Articles in The Last Ten Years

The article with the title "affordances of ICT in science learning: implications for an integrated pedagogy" is the most cited article. This article was published in 2005 and published by the "International Journal of Science Education". This article analyzes how the affordances of ICT-rich environments identified from a literature review support students in learning science at school (Webb*, 2005).

3.4 Journal

The journal that publishes the most about ICT is the "International Journal of Science Education". This journal publishes a significant amount about ICT compared to other journals. This journal covers science research, STEM, and the integration of science education with other scientific disciplines. This journal is in the Q1 quartile with the highest percentile of 84%.

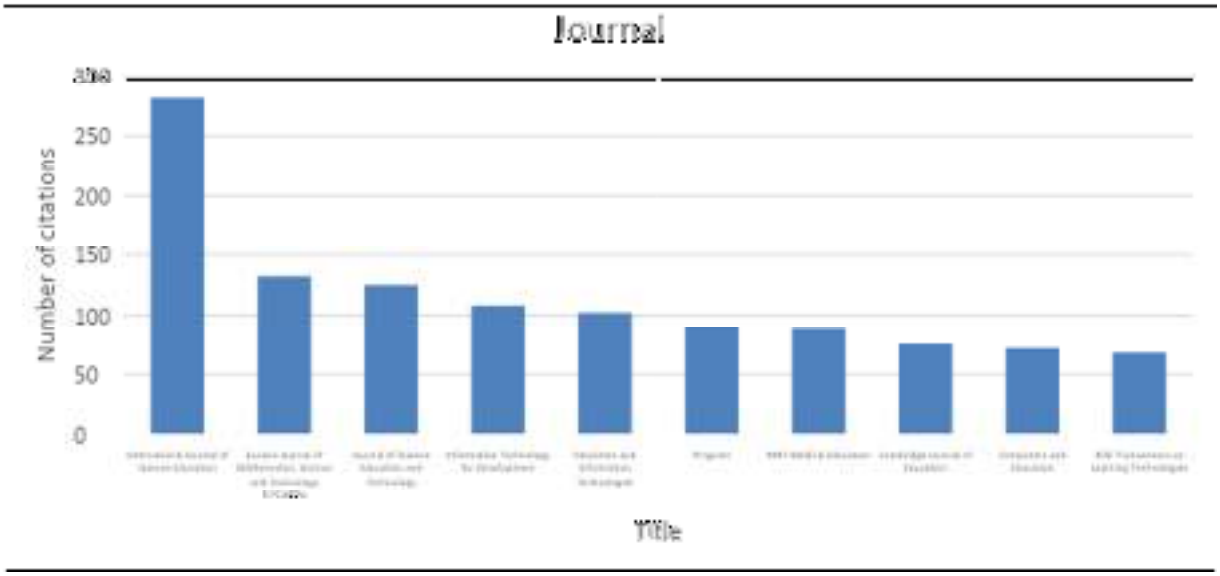

Figure 4. Journal Distribution of Published Records

3.5 Collaboration between Countries

International research collaboration is one of the keystones supporting the advancement and long-term viability of science. Studying with participants from different nations broadens the range of viewpoints and improves the methods and insights employed. Collaboration between nations makes it possible for various groups of scholars with various academic and cultural backgrounds to share ideas, knowledge, and expertise. This improves study quality and fosters a more thorough comprehension of intricate global concerns. Cooperation among nations also makes it possible to divide the workload, speed up research, and make the most of the resources at hand. Cross-border cooperation so becomes a crucial foundation for improving science and attaining more comprehensive problem solving.

Table 1. Collaboration between Countries on the Topic of ICT in Education

From	To	Frequency
Germany	United Kingdom	3
Germany	Austria	2
Germany	Greece	2
Germany	Israel	2
Portugal	Brazil	2
Australia	Denmark	1
Australia	Singapore	1
Austria	Israel	1
Austria	Norway	1
Canada	Rwanda	1

Based on Table 1, collaboration between countries is dominated by Germany and the United Kingdom with a frequency of 3. This means that collaboration between the two countries has occurred three times in ICT research in education. The results of this study are in line with Lee et al. (2019) which states that collaboration between these countries is also known through patent documents: The case of information and communication technology.

3.6 Most Relevant Author

Writing for academic audiences requires writers or authors to plan, produce, and deliver their work in the form of articles, papers, or other scientific publications. A publication's list of authors identifies the people or teams that worked on developing concepts, carrying out investigations, or gathering data.

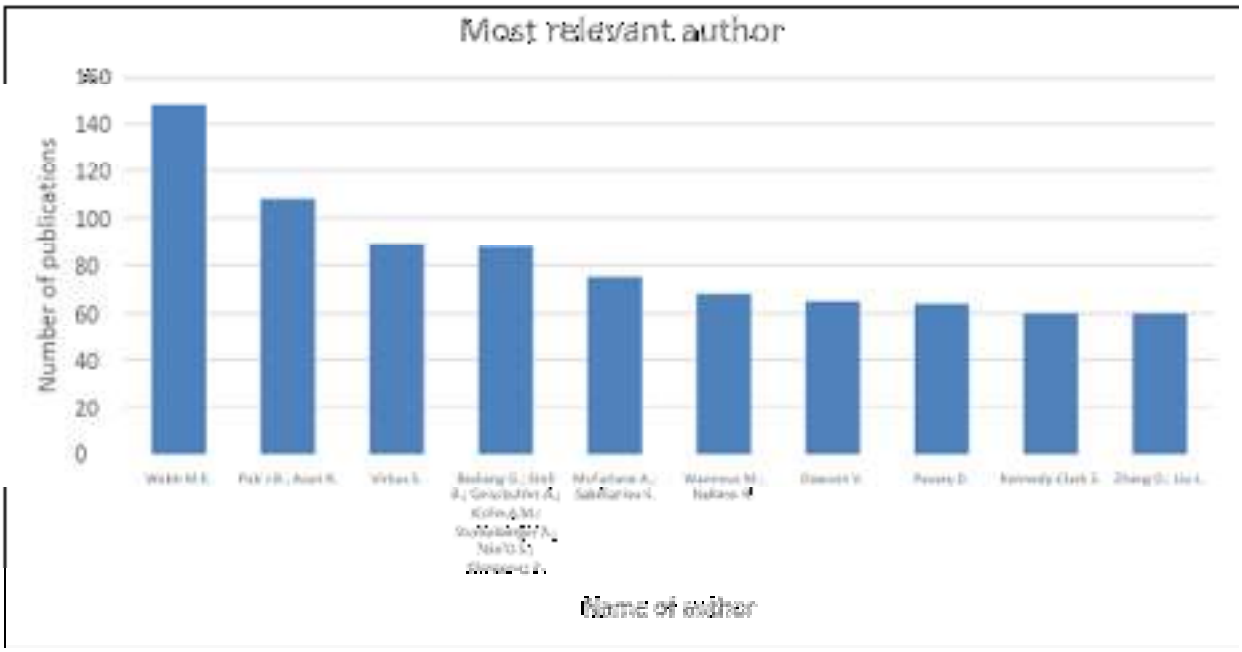

Figure 5. Authors Who Contribute to ICT Research in Education

Webb M.E is the author who has published the most on ICT topics in the field of education. He is also the author of one of the most cited articles on this topic.

3.7 Analysis cluster

In VOS Viewer, the term "cluster analysis" is a technique for classifying or clustering things according to connectedness or resemblance patterns inside a network. Cluster analysis aids in locating and visualizing groups or clusters of these elements in the context of VOS Viewer, which is frequently used to examine links between articles or keywords in scientific literature. Element similarity or high association is grouped together into a group in VOS Viewer's cluster analysis method. Researchers can find clusters of related concepts or research foci by using these clusters, which can reflect certain themes or topics in the literature.

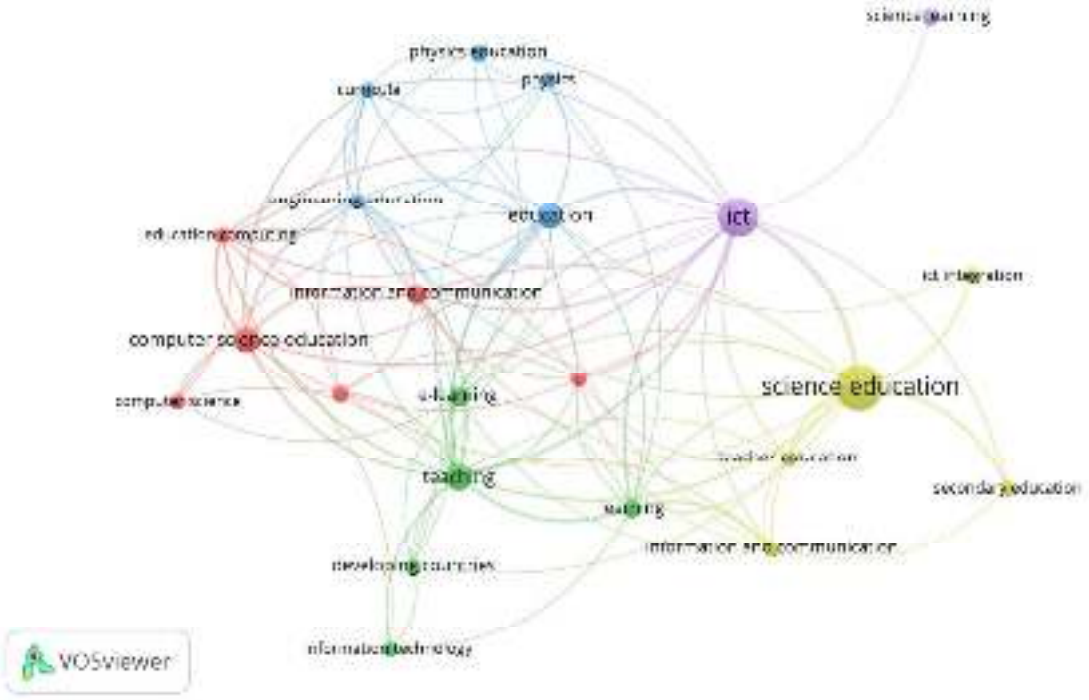

Figure 6. Cluster Analysis Using Vos-Viewer

Based on the figure above, it can be seen that there are five clusters. The five clusters are depicted in purple, yellow, green, red and blue. Computer science education, education, science education, teaching, and science learning—that are most closely related to one another. Teaching, education, and computer science education are hot subjects right now.

4. CONCLUSION

Technology plays a pivotal role in the field of education, necessitating comprehensive investigation to accumulate knowledge for further study. To achieve this, 185 articles were meticulously assessed using the PRISMA approach in conjunction with VOS-Viewer through Scopus data collection. The evaluation process involved analyzing the quantity of articles, nations involved, citations, journals, and research partnerships, specifically focusing on digital assessment in education. Co-occurrence mapping through knowledge map analysis was employed as an additional method of investigation. The research findings revealed an annual increase in the number of published articles, with the United Kingdom emerging as the leader in terms of the highest number of publications. The research article titled "Affordances of ICT in science learning: Implications for an integrated pedagogy" garnered the most citations. The "International Journal of Science Education" stood out as the journal with the highest number of publications, and the most notable research partnership was identified between Germany and the United Kingdom. Notably, "Webb M.E." emerged as the author with the most citations. Furthermore, cluster analysis illuminated five primary categories—computer science education, education, science education, teaching, and science learning—that exhibited strong interconnections. Currently, teaching, education, and computer science education are recognized as hot topics within this domain, reflecting the dynamic and evolving landscape of educational technology research.

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