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Contributed of Current Mobile Technology to Education Fields from 2010 to 2022: Analysis of Publications

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ABSTRACT

Introsuction. The rapid advancement of current mobile technology (CMT) has become a major driver of educational transformation in the 21st century, enabling ubiquitous learning access, interactive learning environments, and integration with emerging technologies aligned with Society 5.0. However, research on CMT in education is dispersed across disciplines and publication outlets, making it difficult to identify dominant themes, research growth patterns, influential contributors, and underexplored opportunities for future innovation. Therefore, this *study aims* to map the global research landscape of CMT in education and identify trends, thematic novelties, and potential future research directions through a bibliometric approach.

Materials and methods. This study employed a descriptive bibliometric analysis using metadata retrieved from the Scopus database. Publications related to CMT and education were collected for the period 2010–2020 and exported in CSV and RIS formats. Data were analyzed using Microsoft Excel for descriptive statistics (annual publication trends, document types, languages, top authors, affiliations, countries, sources, and funding sponsors). VOSviewer was used to visualize collaboration patterns and keyword co-occurrence networks to reveal thematic clusters and emerging research topics.

Results. The findings indicate a consistent yearly increase in CMT-related educational publications during 2010–2020, reflecting growing global attention toward mobile technology–enabled learning. English was the dominant publication language. In terms of institutional contribution, Beijing University of Posts and Telecommunications emerged as the leading affiliation, while China was the top contributing country. Keyword mapping revealed major research clusters focusing on mobile learning systems, wireless and mobile communication infrastructures, 5G-related learning opportunities, and the integration of CMT with technologies such as artificial intelligence and the Internet of Things (IoT). Less frequently occurring but potentially emerging topics highlighted opportunities for future research, particularly the development of CMT-based communication systems across educational institutions and evaluation of their pedagogical impacts on learning effectiveness and equity.

Conclusion. This study concludes that research on CMT in education has shown strong growth and thematic diversification over the past decade, with dominant contributions from English-language publications and Asian institutions. The novelty of this study lies in providing a decade-scale bibliometric evidence map that identifies key contributors and thematic clusters while proposing future research opportunities on CMT communication infrastructures and institution-wide learning systems. These insights can support researchers, educators, and policy makers in strengthening evidence-based innovation and implementation of mobile technology to enhance educational quality and accessibility.

KEYWORDS

mobile technology, education, bibliometric analysis, Society 5.0, VOSviewer

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INTRODUCTION

The transition toward Society 5.0 emphasizes human-centered development through the integration of digital innovation, where education is expected to cultivate not only cognitive competence but also social and emotional growth, creativity, and problem-solving skills [1]. This shift reflects a growing understanding that education must not only impart knowledge but also foster the holistic development of individuals in an increasingly digital world. In this context, emerging technologies play a central role in enabling more adaptive and inclusive learning environments [2]. Technologies such as artificial intelligence and the Internet of Things are becoming increasingly integrated into educational systems to support these adaptive learning environments. Among these technologies, current mobile technology (CMT) is projected to become a dominant paradigm in future digital ecosystems due to its high speed, low latency, broad connectivity, and increasing accessibility [3]. CMT's ability to support seamless communication across devices and locations makes it ideal for supporting learning environments that are both flexible and connected. Technological development has reshaped multiple sectors [4], and continues to offer alternative approaches for educators to enhance teaching quality, learning communication, and instructional design [5]. Furthermore, mobile-supported environments can strengthen collaborative learning practices and improve the quantity and quality of instructional activities in higher education institutions [6; 7]. Research has shown that mobile technologies are facilitating more interactive and collaborative educational models, making them increasingly relevant for modern pedagogical practices.

The increased availability of mobile infrastructure and devices has also expanded the potential for remote and flexible learning, allowing students to access learning resources anytime and anywhere. CMT supports the development of interactive and engaging educational experiences by enabling seamless access to information, improving connectivity between teachers and learners, and facilitating multimedia-based learning [8]. As a result, students are not limited by time or place, leading to more personalized and self-directed learning opportunities. In addition, CMT functions as a foundational infrastructure that strengthens the adoption of other Society 5.0 technologies in education, including augmented reality (AR) [9], virtual reality (VR) [10], 3D printing [11], artificial intelligence (AI) [12], the Internet of Things (IoT) [13], and machine learning [14]. These developments collectively create new opportunities for designing learning systems that are more immersive, data-driven, and learner-centered. The integration of these technologies further enhances the educational experience by creating environments that are not only more interactive but also more suited to the diverse needs of learners.

Previous studies have reported the increasing role of mobile technology and advanced communication networks in diverse educational areas, such as science and engineering [15], health [16], music [17], sports and physical education [18], political education [19], and language learning [20]. Research has also highlighted that advanced mobile network capabilities such as high transmission speed, bandwidth efficiency, low latency, and improved wireless connectivity facilitate technology integration and support large-scale educational transformation, including the development of IoT-based learning and smart education ecosystems [21]. These findings suggest that mobile technology is not just transforming specific areas of education but is driving large-scale, systemic changes in the way educational services are delivered. These findings indicate that CMT contributes not only as a tool for learning delivery, but also as a critical infrastructure supporting emerging educational innovation.

Despite the growing body of research, the literature on CMT in education remains fragmented and dispersed across multiple domains, making it difficult to systematically identify how research has evolved, which themes dominate the field, and where the most significant research gaps and opportunities lie [22]. This fragmentation highlights the need for a more unified approach to studying the impact and applications of CMT in education. Importantly, while bibliometric studies have been conducted in specific areas related to CMT such as security, marketing, machine learning, and language learning they are limited in scope and timeframe [23]. As a result, there is still a lack of comprehensive bibliometric evidence that maps CMT research in education over the last decade, including publication growth patterns, leading contributors (authors, affiliations, countries), and thematic novelties that shape future research agendas.

To address this gap, the present study conducts a bibliometric analysis of CMT-related research in education using the Scopus database. This study contributes by providing a decade-scale evidence

map that (1) examines publication trendlines and document characteristics, (2) identifies influential authors, affiliations, and countries, (3) highlights key publication sources and funding sponsors, and (4) explores thematic clusters and emerging topics through keyword co-occurrence mapping. The findings are expected to offer clearer insight into the development, implementation trends, and potential improvements of CMT applications in educational contexts, thereby supporting future research and innovation aligned with the rapidly evolving Society 5.0 era. By systematically analyzing trends in CMT-related publications, this study will provide valuable insights into how CMT is reshaping education worldwide.

Accordingly, this study aims to analyze trendlines, novelties, research gaps, and thematic patterns of "CMT in education/teaching/learning" publications over the last decade by using metadata retrieved from Scopus and analytical support from Microsoft Excel, VOSviewer, and Datawrapper. The remainder of this paper is structured as follows: the next section explains the research methodology and bibliometric procedures; the results section reports publication trends, contributors, and thematic mappings; and the discussion and conclusion synthesize key insights and propose future research directions for CMT-enabled education.

THEORETICAL BACKGROUND

1. Society 5.0 and digital transformation in education

Society 5.0 represents a human-centered vision of development where digital technologies are integrated to improve quality of life, social well-being, and sustainable development [24]. This vision emphasizes the importance of human-centered development in leveraging digital technologies for societal progress and betterment. In education, this paradigm shifts learning from merely transmitting content toward empowering learners with higher-order competencies, digital literacy, creativity, critical thinking, and collaborative problem-solving [25]. This shift is critical for fostering skills that are necessary in an increasingly digital and interconnected world. Educational ecosystems in the Society 5.0 era increasingly rely on technology-enabled infrastructures that support flexible access, personalized instruction, and scalable learning services [26]. This technological integration is key to creating inclusive, adaptable, and effective learning environments. Consequently, understanding how educational research responds to technological shifts becomes essential to ensure evidence-based innovation and inclusive implementation. Digital transformation in education is not only driven by the adoption of new tools but also by the development of infrastructures that enable learning systems to function seamlessly [49; 50]. Such infrastructures ensure that educational systems remain adaptable and capable of supporting diverse learning needs. Technologies such as artificial intelligence, the Internet of Things, augmented and virtual reality, and advanced communication networks are often discussed as key enablers of smart education. However, many of these technologies depend on mobile infrastructures and mobile access, making current mobile technology a foundational element for the development of connected learning environments .

2. Current Mobile Technology (CMT): Concept and characteristics

Current Mobile Technology (CMT) refers to advanced mobile and wireless technologies that support high-speed, low-latency, and ubiquitous connectivity through smart devices and modern communication networks [51; 52]. CMT provides the necessary technological infrastructure for a variety of educational applications, enabling seamless interaction and connectivity across devices and locations. In education, CMT enables learning activities to take place anytime and anywhere, supporting flexible, interactive, and learner-centered learning environments aligned with Society 5.0. The main characteristics of CMT include high-speed connectivity, mobility, and wide accessibility, which allow real-time communication, multimedia-based learning, and remote collaboration. CMT also serves as a foundational infrastructure for integrating emerging technologies such as artificial intelligence (AI), the Internet of Things (IoT), augmented reality (AR), and virtual reality (VR). These characteristics position CMT as a key enabler of educational innovation, enhancing learning effectiveness, accessibility, and digital transformation in modern education systems.

3. CMT in education: Contributions, applications, and research themes

Current Mobile Technology (CMT) contributes significantly to education by enabling flexible, accessible, and interactive learning environments through mobile connectivity and smart devices. Its applications include mobile learning, blended and online learning, virtual classrooms, and collaborative platforms, as well as the integration of emerging technologies such as artificial intelligence, the Internet of Things, augmented reality, and virtual reality to support personalized and immersive learning experiences [31]. These innovations allow for more personalized and engaging learning experiences that are increasingly necessary in the digital era. Research on CMT in education mainly addresses themes related to mobile learning systems, communication infrastructures, learning effectiveness, user acceptance, and technology integration, with emerging attention to 5G-enabled education, smart learning environments, and the role of CMT in promoting large-scale digital transformation and educational equity [32]. These areas of focus reflect the growing importance of CMT in creating accessible, equitable, and efficient educational systems.

4. Bibliometric analysis as a scientific approach to mapping research fields

Bibliometric analysis is a scientific approach used to systematically map and evaluate the development of research fields by analyzing publication metadata such as authors, keywords, citations, sources, and collaboration patterns [33]. This methodology enables the identification of trends and patterns in research, providing a comprehensive overview of the development of a field. This approach enables researchers to identify publication growth trends, influential contributors, dominant and emerging research themes, and intellectual structures within a field. By applying quantitative techniques and visualization tools, bibliometric analysis provides an objective overview of research landscapes, supports evidence-based decision making, and helps reveal research gaps and future directions across disciplines.

5. Key bibliometric indicators for understanding CMT research development

Key bibliometric indicators are essential for understanding the development of Current Mobile Technology (CMT) research by revealing patterns of productivity, impact, and thematic evolution. Common indicators include annual publication trends to measure research growth, document types and languages to describe publication characteristics, and citation counts to identify influential studies. Author, affiliation, and country productivity indicators highlight leading contributors and collaboration networks, while source and funding analyses show dominant publication venues and research support. In addition, keyword co-occurrence and thematic mapping indicators are used to identify core research themes, emerging topics, and research gaps, providing a comprehensive overview of CMT research development [55; 56]. These indicators help to map the growth and impact of CMT research, offering valuable insights into how the field is evolving.

6. Keyword co-occurrence mapping and thematic clustering (VOSviewer)

Keyword co-occurrence mapping and thematic clustering using VOSviewer are bibliometric techniques used to identify and visualize the conceptual structure of a research field. Keyword co-occurrence analysis examines how frequently keywords appear together within publications, indicating strong thematic relationships among research topics. VOSviewer applies network and clustering algorithms to group related keywords into thematic clusters, which represent dominant research areas and emerging themes [36]. This visualization helps researchers understand research focus areas, thematic evolution, and potential directions for future

7. Conceptual framework of this study: Evidence mapping for future CMT-enabled education

The conceptual framework of this study is structured as a bibliometric-based evidence mapping of Scopus metadata (2010–2022) analyzed with Excel and mapped using VOSviewer to identify trends,

key contributors, and thematic structure of CMT research in education. The evidence map shows an increasing publication trend, dominance of English, and strong contributions from specific institutions and countries (e.g., Beijing University of Posts and Telecommunications and China). Based on keyword mapping, this framework positions CMT as an infrastructure enabler that encourages technology integration (5G, AI, IoT, machine learning, VR/AR) and the development of learning systems (e-learning/online/hybrid). Based on the dominant and under-researched themes, future research directions are focused on developing a CMT communication system across educational institutions and evaluating its impact on learning and access to education [37]. This framework sets the stage for future studies that will explore the systemic integration of CMT in educational institutions and its potential impact on learning outcomes.

RESEARCH METHODS

This study uses a descriptive bibliometric approach to map the contribution of Current Mobile Technology (CMT) to education through publication metadata analysis. Data collection utilized the Scopus database, which provides extensive document coverage and comprehensive metadata, such as publication year, document type, language, affiliation, country, keywords, and number of citations [38]. The Scopus database was chosen for its extensive coverage of academic documents, ensuring a robust dataset for bibliometric analysis. The initial stage began with a keyword search in Scopus using the all-fields search mode to ensure comprehensive results and minimize the possibility of missing relevant publications [39]. This method allows for a broad search across multiple fields, increasing the likelihood of capturing all relevant studies related to CMT in education. The query focused on a combination of mobile technology or CMT concepts and educational contexts (e.g., education, learning, teaching), resulting in publications discussing the use, development, and implementation of CMT for educational purposes. This initial search yielded 42,543 documents (n = 42,543) as the initial data set, as shown in Figure 1.

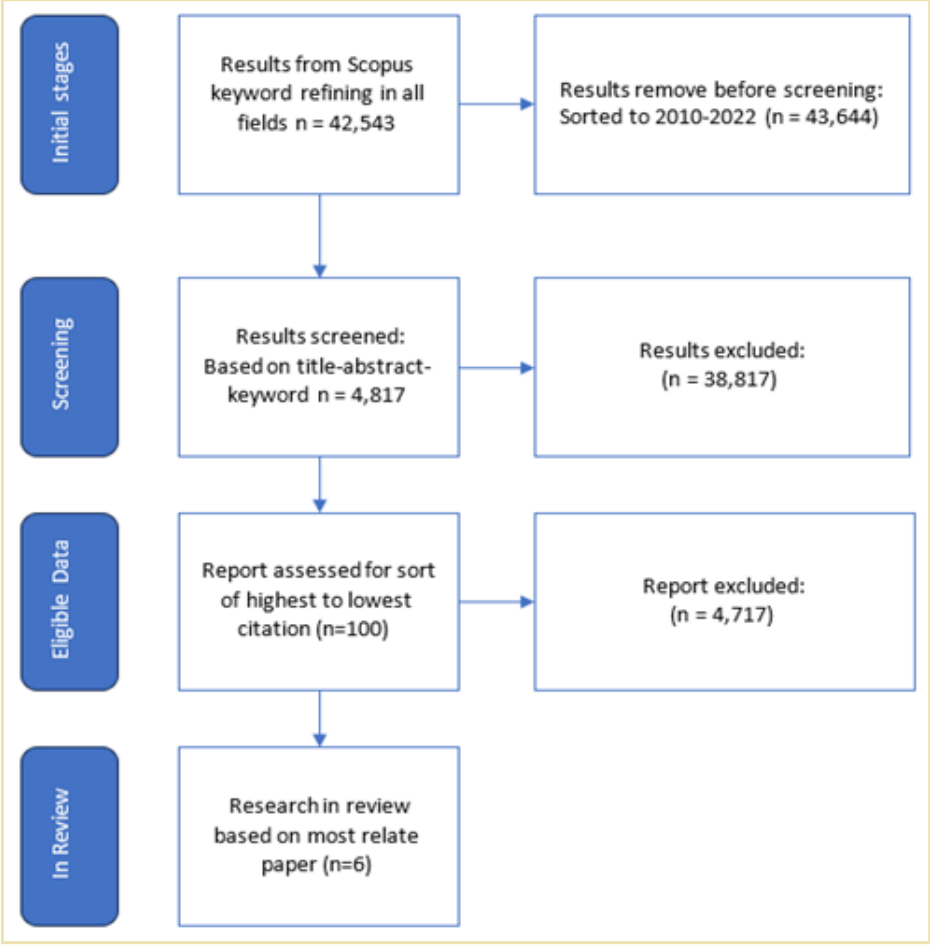

Figure 1 Research methods

After the initial data collection, a pre-screening was conducted by limiting the publication year range to 2010–2022. This step aimed to maintain consistency in the research timeframe and ensure that the publication trend mapping accurately represented the development of CMT in the educational context during the targeted period [40]. To ensure that the most impactful studies were selected for further analysis, citation counts were used as a proxy for influence, as they reflect the extent to which a work has contributed to advancing knowledge in the field. The time range filter ensured that the analysis was focused on more recent developments in CMT, which are particularly relevant to the current educational landscape. In the flowchart, this stage is shown as "Sorted to 2010–2022 (n = 43,644)," which is the number of documents remaining after the year filter is applied. Next, the research enters the relevance screening stage by reading and evaluating the titles, abstracts, and keywords of documents that have passed the year filter. Screening is carried out to ensure that publications are truly related to CMT in the field of education, learning, or teaching. Publications are excluded if their content lacks an educational context, only discusses telecommunications/mobile technology without relevance to learning, or does not meet the research topic focus. The screening results indicate that 4,817 documents (n = 4,817) were deemed relevant for further analysis, while 38,817 documents (n = 38,817) were excluded for not meeting the relevance criteria.

The next stage is determining eligibility to select the most influential and representative documents [40]. In bibliometric studies, the influence of a publication is generally proxied by the number of citations, as citations indicate the extent to which a work is cited and contributes to subsequent research development. Therefore, documents that passed the screening were then sorted from highest to lowest citations, and the top 100 documents (n = 100) were selected as the basis for a more focused analysis. Other documents not included in the top-100 citation subset were recorded as excluded reports (n = 4,717). Although excluded from the in-depth analysis subset, these documents do not necessarily indicate poor quality; rather, they were not prioritized, as the research required a core collection of the most impactful and relevant articles to develop a map of findings, novelty, and research recommendations.

In the final stage, a final review (in-review) was conducted to select the publications most appropriate and relevant to the focus of the CMT study in education. From the top-100 subset, the researchers then identified six articles (n = 6) deemed most relevant for further in-depth review. This stage was crucial because the final selection relied not only on high citations but also considered the suitability of the article's substance to the educational context, the strength of the findings, and its contribution to the discussion of key topics (e.g., mobile communication-based learning systems, 5G support for learning, AI or IoT integration in education, and the direction of CMT development for educational institutions). With this flow, the research produces two main outputs: (1) relevant datasets for quantitative bibliometric analysis (trends, distribution, contributions), and (2) core articles for qualitative discussions that support the preparation of gaps, novelty, and future research agendas [40]. This process ensures that the final selection of articles reflects the most relevant and influential contributions to the field of CMT in education.

RESEARCH RESULTS

General information of data and trends of publication

Table 1 displays the necessary details regarding the publication's content. 4,786 publications in all, distributed across 24 sources (scientific journals, conference papers, books, book chapters, etc.), were collected between 2010 and 2020.

Table 1 General information on metadata

Content	Result
General Information	
Period of year	2010 to 2022
Number of documents	4,786
The average number of citations per paper per year	39.10

Total documents cited	46,194
Total documents type	24
Total keywords	4,217
Author's keyword	244
Total author	5,070
Total affiliation	160
Total countries	114
Total source title	160
Total funding sponsor	159

Based on the metadata gathered, the trend research of CMT during a decade in educational fields is known. It is depicted in Figure 2.

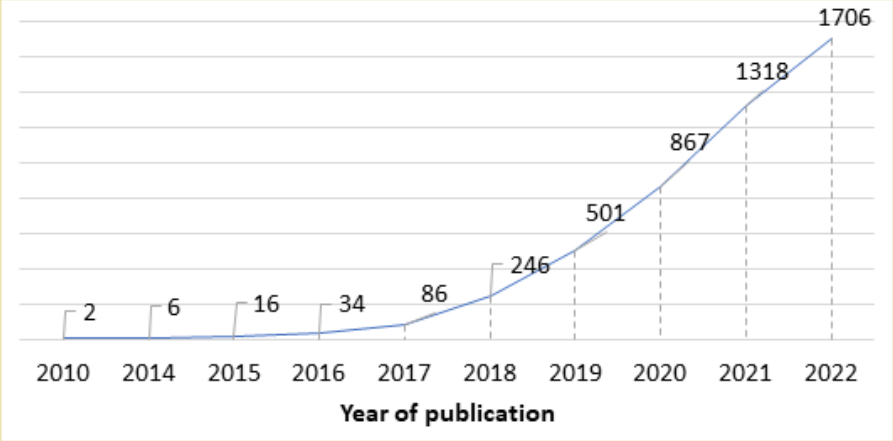

Figure 2 CMT in educational field publication trends during a decade

Based on the results of the research, Figure 2 shows the exciting results that the publication trends tend to increase yearly. Nevertheless, since the introduction of digital mobile phones and the development of the 4.0 revolution sector, especially in education [10;49;65], broadband cellular networks have evolved, which mobile telephone providers have begun to build globally and integrate with learning in the classroom. Since then, the generation technology standard for broadband cellular networks, particularly CMT, has attracted the attention of researchers. The CMT is now being considered and rapidly gaining ground in study and education. The development of IoT applications, AR, VR, AI, virtual laboratories, and any hybrid classes also became more popular as we entered the 5.0 society and as soon as the "Work from Home" trend began as a result of the COVID-19 pandemic. A new array of CMT services has emerged with highly diverse and technologically challenging design requirements.

The trend of publications in CMT to educational fields consists of various available documents. Based on the data gathered, the various types of documents were published from 2010 to 2022 as a deliberation for future researchers. Figure 3 shows various published documents on CMT in educational fields.

Figure 3 shows that the conference paper is more widely used with 2,352 documents. An 'article' is the second most common form of publication (n=2,006). In other hand, English become the prominent language that used in the CMT publication research. Figure 3 shows that conference papers have a more accessible effect since they are displayed at a summit for specialists from various disciplines to see [59;60]. According to the data gathered, Figure 4 shows that it was also the language most frequently used for publishing CMT in educational areas from 2010 to 2022. English is the most generally uttered language (4,725), followed by Chinese (42), Turkish (7), Spanish (5), and German (3). English is a universal global language [61;62]. As a result, the circulation of publications will have to be more significant and much more extensively utilized or read as a reference point

among many individuals [46]. However, the United States, China, and India have dominated the global competition to become global champions in education technology in recent years, according to the global EdTech landscape (HolonIQ). These three countries are on top for growing EdTech companies or developing new, more effective AI-driven EdTech [47].

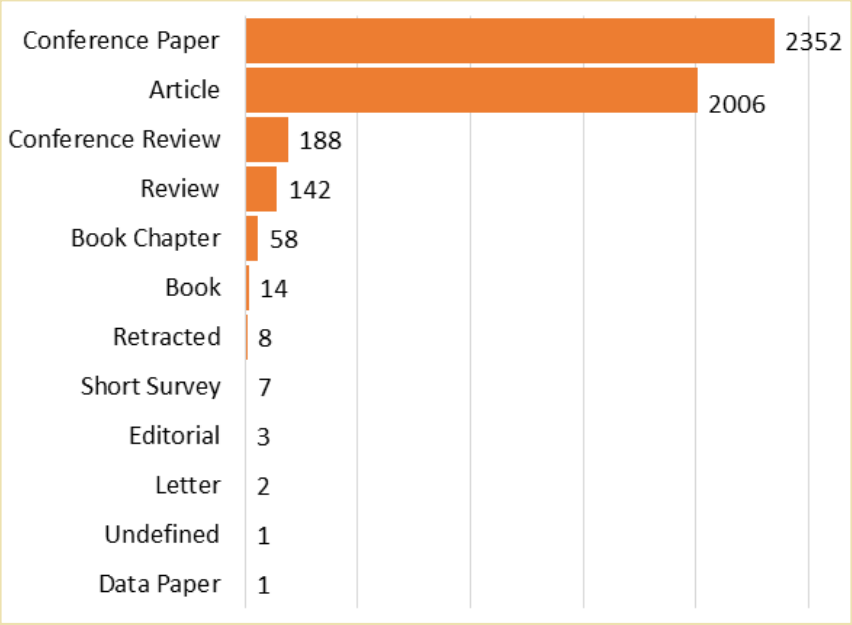

Figure 3 The document types of CMT publications

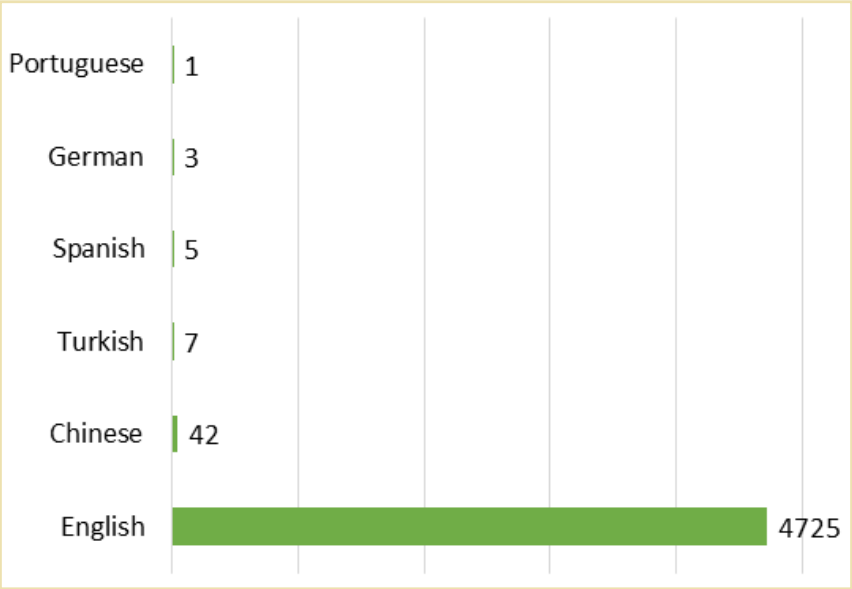

Figure 4 The most used language in CMT publications

Top contributed authors, affiliation, and countries to CMT in educational fields publication from 2010 to 2022

Furthermore, to deepen insight into the CMT in educational fields and to find out the top contributed authors, affiliations, and countries that can be used as references for further research, the top contributed authors, affiliations, and countries are analyzed. Table 2 lists the top contributed authors and affiliation of CMT in educational fields during a decade.

Table 2 The top contributed authors and affiliation

Author	N	Affiliation	N
Bennis, M.	30	Beijing University of Posts and Telecommunications	201
Guizani, M.	26	University of Electronic Science and Technology of China	85
Niyato, D.	22	Nokia Bell Labs	85
Verikoukis, C.	22	Oulun Yliopisto	70
Erol-Kantarci, M.	20	Ministry of Education China	64

Based on Table 2, Bennis, M. is the first place of the top contributed authors with 30 publications in CMT in educational fields during a decade. Following by Guzaini, M., with a total of 26 publications. Furthermore, Nivato, D. and Verikoukis, C. are within 22 publications. On the other hand, to find the most linked authors to any authors in CMT to educational fields or the most collaborated author, then conducted analysis by VOSViewer as in Figure 5. Unlike Table 1, the most linked author is Zhang, Y., with total link strength of 85, and Li, Y., with total link strength of 73.

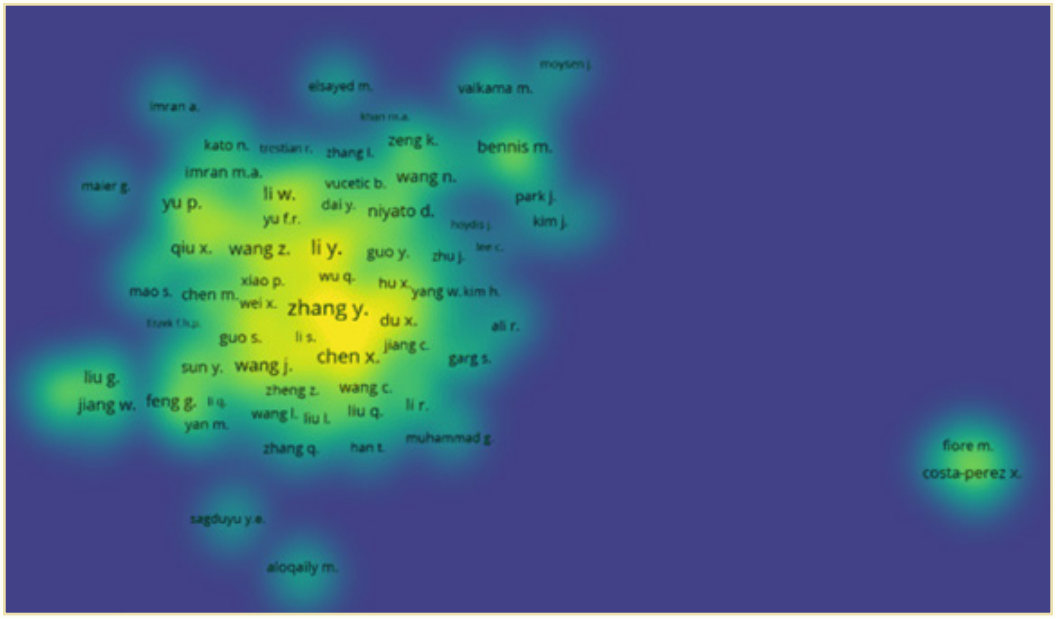

Figure 5 Density visualization of co-authorship

Furthermore, based on Table 2, the top contributed affiliation is Beijing University of Posts and Telecommunications within 201 documents. Followed by University of Electronic Science and Technology of China and Nokia Bell Labs within the same amount of 85 documents. Relating to affiliation, the top countries that contributed to CMT to education fields during a decade are also analyzed to provide details on the analysis shown in Table 3 and visualized by Figure 5.

Table 3 Top contributed countries

Countries	N	Countries	N
China	1,482	Canada	278
United States	667	Germany	207
India	466	Spain	196
United Kingdom	300	Italy	184
South Korea	295	France	168

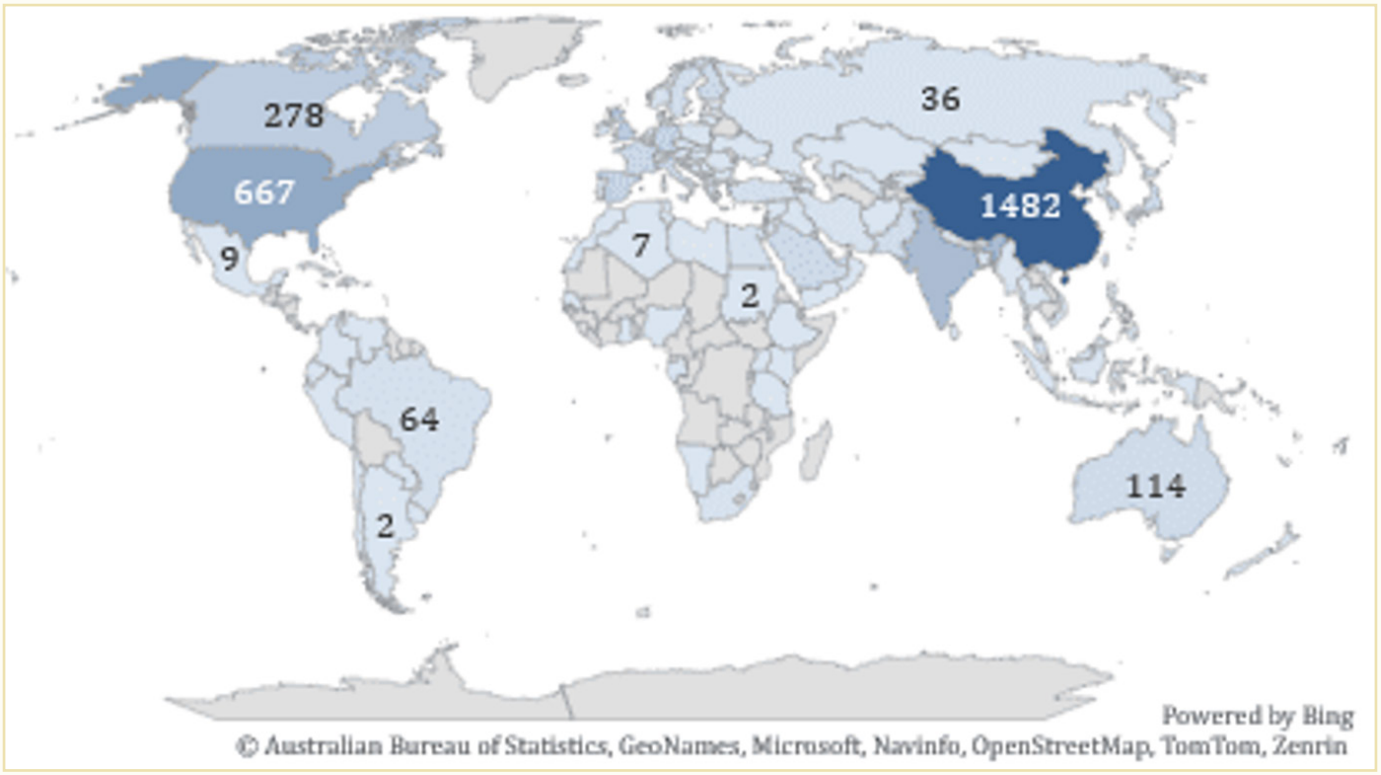

Figure 6 Top contributed countries visualization

Based on Table 3 and Figure 6, China became the top contributor country with 1,412 documents in line with the top affiliation. The second place is the United States with 667 documents, followed by India with 466 documents.

Top contributed source title and funding sponsorship to CMT in educational fields publication from 2010 to 2022

For a decade, find out who is the top contributor source title and funding sponsorship in CMT in educational fields. Hence it is analyzed based on the metadata gathered likely in Table 4.

Table 4 Top contributed source title and funding sponsorship to CMT in educational fields

Source Title	N	Funding Sponsorship	N
IEEE Access	288	National Natural Science Foundation of China	559
IEEE Vehicular Technology Conference	98	Horizon 2020 Framework Programme	211
IEEE International Conference on Communications	77	National Science Foundation	167
Sensors	72	National Key Research and Development Program of China	144
IEEE Transactions on Vehicular Technology	67	Fundamental Research Funds for the Central Universities	110

Based on Table 4, IEEE Access is the top contributed source title within 288 documents. Followed by IEEE Vehicular Technology Conference (n=98) and IEEE International Conference On Communications (n=77). IEEE became the top source title to find out who is the top contributed source title in CMT to educational fields during a decade. Furthermore, following previous analysis, the National Natural Science Foundation of China is the top contributing funding sponsor within 559

documents. However, on the Table 4, IEEE has become a top source title because, in a decade, there has been IIEEE research focused published journals in CMT education such as "5G-Enabled Education 4.0: Enabling Technologies, Challenges, and Solutions", "The New Generation of Mobile Networks: 5G Technology and its application in the e-education context", and also "Research on Key Technologies of Smart Campus Teaching Platform Based on 5G Network". To find the novelty of previous research, the mapping of metadata keywords. Based on Figure 8, the CMT communication system tends to research interest due to its significant total link strength. Hence, future research can develop CMT communication systems, such as universities, throughout the institutional education level. Alternatively, future research can use CMT communication systems throughout every educational institution and analyze the impact. However, in the fewer keywords, such as in Figure 9, the research opportunities are the development of transfer learning and the emergence of the CMT communication system to a learning system. Other keywords are used to find novelties and recommend the implementation, development, upgrade, installation, or further research.

Novelties of the CMT in educational fields publications from 2010 to 2022

Figure 7 analyzes the mapping visualization of the metadata that presumably looks at the relationships between minor or fewer keywords to identify a novelty of the research based on the mapping results.

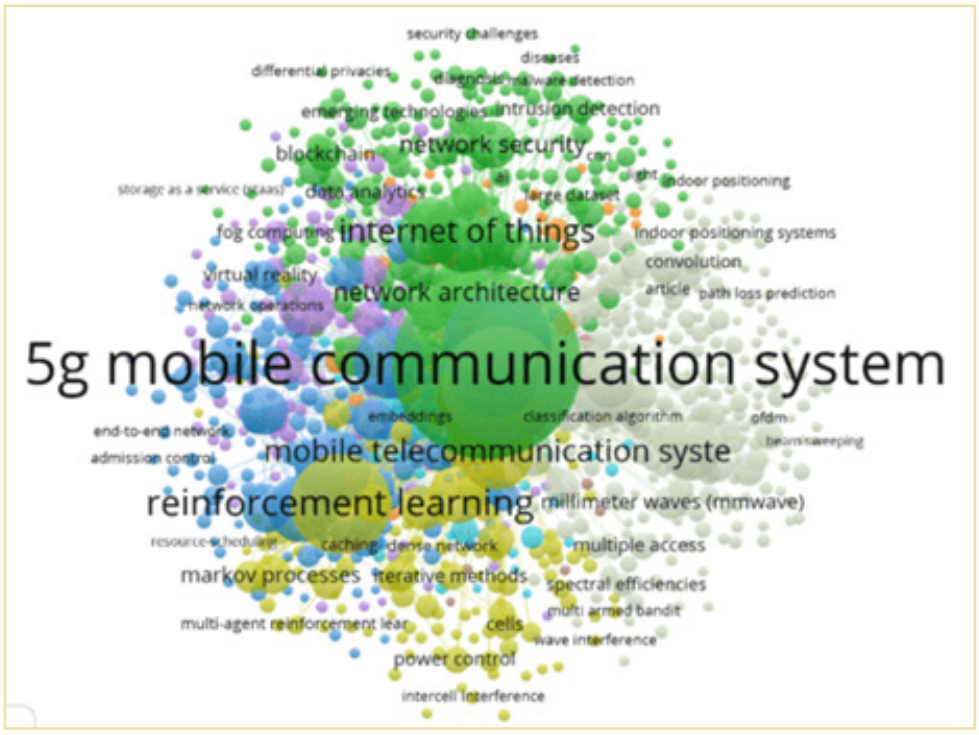

Figure 7 Mapping visualization of the CMT in education fields publications during a decade.

Based on Figure 7, it is known that there are nine clusters in total. Cluster 1, with grey node (n=274), consists of 5G and beyond, deep learning, learning systems, learning technology, and techniques. Cluster 2, with green node (n=218), consists of 5G communication, AI, engineering education, IoT, learning models, and others. Cluster 3, with blue node (n=169), consists of machine learning, mobile networking, VR, and others. Cluster 4, with chartreuse node (n=129), consists of e-learning, learning methods, online learning, mobile telecommunication, and others. Cluster 5 with purple node (n=108) comprises 5G cellular network critical technologies. Cluster 6, with a turquoise node (n=55), consists of intelligent computing, mobile communication, and others. Cluster 7 with xanthous node (n=38) consists of 5G communication, cellular Network, and data-driven. Cluster 8 with brown node (n=8) and Cluster 9 with nilla node (n=1). Hence, from the CMT in educational fields during a decade, the novelties are found in Figure 8 and Figure 9.

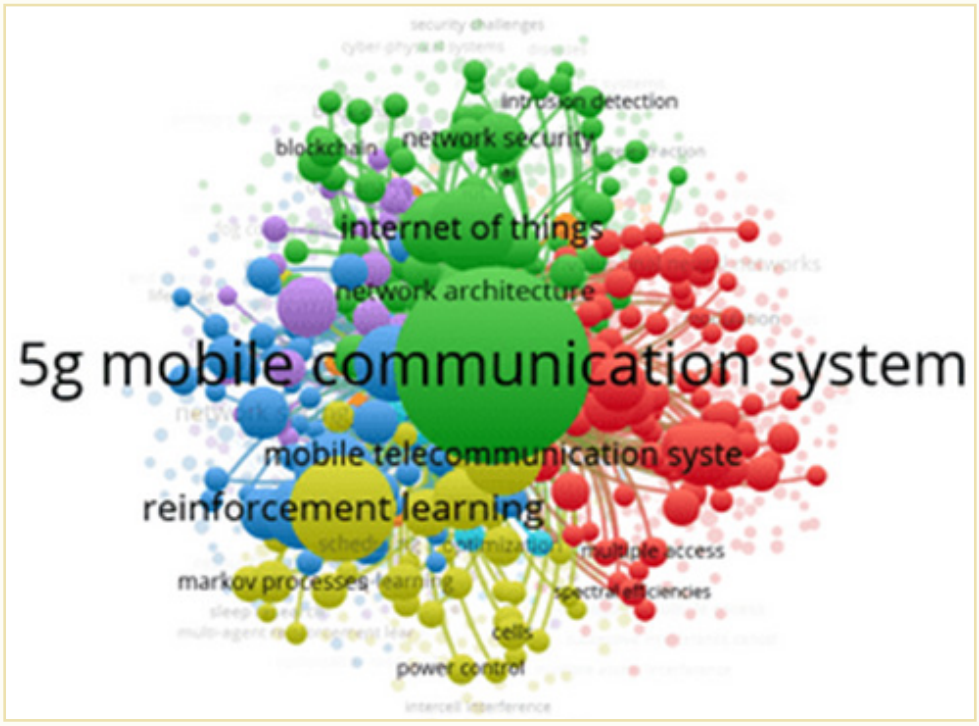

Figure 8 The most occurred keyword

Figure 9 The less occurred keyword

Paper distribution from 2010 to 2022

Based on the metadata gathered, the paper on CMT in educational field distribution from 2010 to 2022 is likely in Table 5.

Table 5 Paper distribution of CMT in educational fields during 2010 to 2022

Year	Paper	Cited	ACPP	ACPPY	Citable Years
2010	2.00	7.00	3.50	0.27	13
2014	6.00	401.00	66.83*	7.43*	9
2015	16.00	394.00	24.63	3.08	8

2016	34.00	705.00	20.74	2.96	7
2017	86.00	2,659.00	30.92	5.15	6
2018	246.00	5,254.00	21.36	4.27	5
2019	501.00	11,560.00	23.07	5.77	4
2020	867.00	13,702.00*	15.80	5.27	3
2021	1,318.00	8,901.00	6.75	3.38	2
2022	1,706.00*	2,611.00	1.53	1.53	1
Total	4,78200	46,194.0	215.3	39.10	-
Description: *=the highest number; ACPPY= Average Citation Per Paper Per Year ACPP= Average Citation Per Paper					

Table 5 shows that CMT publications during 2011 to 2014 had no published documents. On the other hand, 2022 became the year with the most publications. Furthermore, the years with the highest citation were 2020 (13,702 citations) fewest citation were 2010. Whereas 2014 had the most ACPP (66.83) and ACPPY (7.43).

Most influential paper on CMT in educational fields publication from 2010 to 2020

Table 6 reviews the top 5 publications cited as the most influential paper on CMT in educational fields publication during 2010 to 2020. Each article was analyzed based on the citation, Scimago Journal and Country Rank (SJR) accessed on www.scimagojr.com, CiteScore accessed on www.scopus.com (per March 2023), also findings and recommendations in the publication.

Table 6 Most influential paper on CMT in the education field during 2010 to 2022

Author(s)	Publication Source	Citation	SJR	CiteScore	Findings & Recommendations
[48]	IEEE Transactions on Mobile Computing	46	Q1 (2.43)	12.60	The software-defined radio testbed is used to execute the proposed scheme, which combines both methods. The obtained findings and simulation results support the idea that the suggested resource allocation strategy in H-CRANs greatly improves energy efficiency while maintaining users' quality of service.
[49]	China Communications	39	Q1 (0.92)	5.70	Mobile Augmented Reality (MAR) gives users immersive experiences by supplementing Reality with virtual items. Compared to solutions based on wearable technology and apps, web-based MAR is ubiquitous. Future research on MWAR over 5G and B5G networks will benefit from understanding the practical deployment and performance outcomes. For instance, front-end computing, mobile edge cloud, standardization, real-time object monitoring and recognition, low latency mobile Web AR, and neighborhood collaboration.
[50]	IEEE Transactions on Vehicular Technology	35	Q1(2.52)	11.90	Due to the proposed problem's complexity, we proposed a distributed learning method in which the online running phase employing game theory finds a solution, i.e., NE. In contrast, the offline training phase based on DRL is responsible for action selection. As mentioned, the proposed algorithm retains better scalability and adaptability than current learning approaches. Last but not least, the outcomes of the simulations demonstrated the suggested algorithm's superiority to the other three baseline algorithms.

[51]	Microprocessors and Microsystems	32	Q2ь(0.54)	3.20	Innovative Network In light of the possible risks associated with some of the contentious manufacturing equipment, a firewall linked to the source and 5G network security. There will be a significant delay in the swift deployment of 5G networks if these problems are partially fixed. Physical education requires the addition of more content. More crucial than a varied curriculum is improving physical fitness. To improve the Network's performance and physical education's significance in the modern world.
[52]	2016 IEEE International Conference on Communications (ICC)	29	Not Assigned	-	A cooperative plan to address the interference issue, including both co-tier interference and cross-tier interference, which impact users from different tiers and macro users from the same tier, respectively. The system uses an online learning algorithm for effective spectrum distribution with power and modulation adaptation capabilities. The results of our evaluation demonstrate that our online scheme works better than others and achieves notable gains in throughput, spectral efficiency, fairness, and outage ratio.
[53]	2021 International Conference on Computational Intelligence and Knowledge Economy (ICCIKE)	27	Not Assigned	-	In this paper, a cognitive radio application for the future WCN is designed using ATLBO. Performance metrics like detection ratio, PUS, SUs sensing, and false alarm rate are all improving for the suggested method. This WCN model, built on ATLBO, achieves 78% energy efficiency, 47% data rate, and decent BER vs. SNR dB.

Furthermore, based on Table 6, these publications become fundamental for future research, so they have outstanding citations and impact LMS subjects' development. Based on March 2023, the top cited publications are listed in the rank journal Quartile 1 (Q1) has CiteScore 12.60-5.70. Journals with quartile rank 2 (Q2) have CiteScore 3.20. This shows that publications that become the most influential publications with undoubted credibility. Because the publisher of the publication has a good reputation. Analysis of the SJR indicator assigns a different score to citations based on the importance of the citation source journal. Hence, citations from influential journals will be more valuable, and the journals receiving them will gain more fame.

DISCUSSION

The growth trajectory of Cellular Mobile Technology (CMT) research in educational contexts over the period 2010–2022 reflects a broader transformation in how education systems engage with digital technologies. The steady increase in publications, followed by a pronounced surge after 2018, indicates that CMT has evolved from an exploratory research topic into a mature and institutionalized field of study. This maturation aligns closely with the transition from Industry 4.0 to Society 5.0, where technological advancement is no longer driven solely by efficiency and automation, but by human-centered objectives such as accessibility, inclusion, and learning quality. In this context, CMT functions as a key infrastructural layer that enables flexible, mobile, and networked learning environments capable of supporting diverse educational needs [54].

The acceleration of CMT-related educational research during and after the COVID-19 pandemic further underscores the central role of mobile and broadband technologies in sustaining educational continuity. The global shift toward remote learning and work-from-home arrangements transformed CMT from a complementary innovation into an essential educational infrastructure. Rather than declining after the crisis, publication trends continued to rise, suggesting that CMT adoption has transitioned from emergency response to long-term strategic integration within educational systems. This shift reflects a structural change in pedagogical practices, where mobile connectivity supports not only content delivery but also interactive, collaborative, and hybrid learning models [55]. Consequently, CMT research increasingly addresses systemic and institutional dimensions, rather than isolated technological applications.

The dominance of English as the primary language of publication highlights the globalized nature of CMT educational research and its orientation toward international scholarly communication. While this dominance enhances global visibility and citation potential, it simultaneously raises concerns regarding unequal knowledge representation and access, particularly for researchers from non-English-speaking regions. Nevertheless, English-language dissemination has facilitated cross-national collaboration, comparative studies, and the consolidation of shared research agendas within the field. This linguistic pattern, coupled with the concentration of highly productive authors and institutions, suggests the emergence of global research hubs that shape knowledge leadership and methodological standards in CMT-enabled education [46].

At the regional and institutional levels, the concentration of research output in specific countries and affiliations reflects the interplay between national policy priorities, research funding structures, and EdTech ecosystems. Countries with strong investment in digital infrastructure and educational technology, supported by consistent funding from national and international agencies, have positioned themselves as leading contributors to CMT educational research. The prominence of technology-oriented publication venues and funding bodies further explains why much of the research emphasizes system performance, network architecture, and technological scalability. While this technological orientation has strengthened the technical foundations of CMT research, it also signals the need for more balanced integration of pedagogical, social, and policy-oriented perspectives in future studies.

The thematic structure revealed through keyword clustering indicates that CMT research in education has reached a stage of partial saturation in dominant areas such as mobile communication systems, artificial intelligence, and network-enabled learning environments. At the same time, the presence of less frequent keywords points to emerging research opportunities related to transfer learning, adaptive learning systems, and institutional-level integration of CMT. These gaps highlight the potential for future research to move beyond technological capability toward deeper investigations of educational impact, equity, and sustainability. In this regard, the present study contributes by offering a comprehensive bibliometric mapping that not only captures publication growth and thematic dominance but also identifies underexplored directions, thereby positioning itself as a reference point for subsequent CMT educational research [41].

CONCLUSION

According to the results and discussion it is concluded that the trendline results that publication trends tend to increase each year. The conference paper is more widely used, and 'article' is the second most common form of publication. Beijing University of Posts and Telecommunications is the top contributing affiliation. In line with the top affiliation, China became the top contributing country, second place in the United States, followed by India. The novelties for future study can research using CMT communication systems throughout every educational institution and analyze the impact. However, in the fewer keywords, the research opportunities are the development of transfer learning and the emergence of the CMT communication system to a learning system. Another keyword is used as a guide to finding further novelties and the recommendation of the implementation, development, upgrade, installation, or further research. The most influential studies are in Q1 and Q2 Scopus rank.

The implication of this research tends to digest the information about CMT publications during 2010 to 2020 trends and their contribution to the education field. Furthermore, future researchers can develop or improve the CMT in educational fields ideas research to contribute to increasing education. The type of research presented allows future researchers to define a profile of the documents that can be given to further focus on the research path. The researchers can find the topics most relevant to Scopus' CMT in educational fields and the authors who have had the most significant impact and identify the main research lines of scientists in each defined period. Therefore, it also helps to narrow down the following trends that can be developed in this field of research.

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