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Trends and collaborations in case-based learning for online health education: a bibliometric analysis (2014-2024)

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ABSTRACT

Case-based learning is one of the interactive learning methods that uses real case scenarios or simulations to involve students in the active learning process. This study aims to map and analyze publication trends related to using case-based learning (CBL) in online health education from 2014–2024. This study focuses on publication trends and author collaborations without directly assessing the effectiveness of CBL. Using bibliometric analysis methods on data taken from the Scopus database, this study analyzes the frequency of publications, emerging topics, and collaboration networks between authors, with tools such as VOSviewer for visualization of collaboration maps and topic trends. The results show that publications on CBL have increased significantly since 2018, with a peak occurring between 2020 and 2023. This increase is closely related to changes in education policies during the COVID-19 pandemic, which have encouraged the adoption of interactive methods in distance learning, especially in the health sector. In addition, integrating educational technologies such as digital simulation platforms and artificial intelligence (AI) has strengthened the adoption of CBL in online environments. This study also found a collaboration network between authors with Al-Omran Mohammed as a central figure in international collaboration. These findings provide implications for educators, institutions, and policymakers to expand the application of CBL methods and train educators in designing effective case-based curricula.



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Introduction

Health education has undergone changes and transformations in recent years, especially in the rapid development of technology in the field of information and communication technology. One of the innovations that is an alternative to learning is online learning which offers great flexibility for its users. However, the implementation of online learning in the health sector has its own challenges given the importance of practical experience and skill development at a distance. Although online learning has been widely applied in various fields, its application in health education still faces several obstacles. One of the main gaps is how to ensure that online learning can provide a learning experience that is close to real clinical situations and develop the critical thinking skills of health students (Dickinson et al., 2018). The researcher provides a solution that case-based learning (CBL) emerges as a promising approach to bridge this gap.

Healthcare education, case-based learning (CBL) methods play a crucial role in developing in-depth clinical and problem-solving skills (Rushby et al, 2021). CBL involves discussing real-life cases or case simulations that

allow students to analyze, discuss, and make decisions as they would in actual clinical settings (McLean, 2016). Unlike traditional lecture methods, CBL focuses on practical applications and encourages students to think critically and learn from complex situations that reflect real-world challenges in healthcare practice (Rushby et al., 2021). In the online context, adopting CBL methods is increasingly important because it facilitates independent and interactive learning, where students can collaborate virtually to solve clinical problems, discuss, and receive direct feedback. However, despite its potential to enrich the learning experience, implementing CBL in online platforms faces significant challenges, such as adequate simulation technology and limitations in direct interaction. In addition, the gap between theory and practice is a pressing challenge because many students have difficulty applying their theoretical knowledge in real clinical situations. Case-based learning (CBL) methods are important in this discussion because CBL encourages students to be actively involved in problem-solving and clinical decision-making based on real facts in the field or simulations that resemble clinical situations in the world of work. Through this method, students learn to understand the theory and apply it in dynamic and complex contexts, which is very important in the health sector (McLean, 2016).

Case-based learning is one of the interactive learning methods that uses real case scenarios or simulations to involve students in the active learning process (Kulak & Newton, 2014). This approach allows students to apply their theoretical knowledge in practical contexts, develop problem-solving skills, and improve critical thinking skills – a very important aspect of health education (Gade & Chari, 2013). However, there are several significant challenges to integrating case-based learning (CBL) methods into online health learning. According to Dewi (2023), one of the main obstacles is the limited ability of technology to replicate complex medical case simulations realistically, potentially reducing learning effectiveness. Emphasized that the lack of direct interaction in online learning makes discussions and collaborations between students less spontaneous, impacting their engagement and learning motivation (Dickinson et al., 2018). On the other hand, noted that technical challenges such as dependence on internet connections and adequate hardware often hinder the online CBL learning process, especially for students with limited access to technology. In addition, assessing practical skills in online CBL is difficult without direct interaction, so providing timely feedback is also a challenge. Addressing the challenges in implementing online case-based learning (CBL) in the health sector requires targeted solutions, ranging from the use of simulation technologies such as virtual reality (VR) or augmented reality (AR) that provide near-real clinical experiences to the use of interactive videos for case studies that encourage student engagement and critical thinking (Gade & Chari, 2013). In addition, collaborative platforms that support active discussions, such as breakout rooms, can increase interaction and collaboration between students, which is essential in case analysis.

The integration of case-based learning with online learning is becoming increasingly important in the context of modern health education. Case-based online learning allows students to access a rich and diverse range of clinical scenarios, which may be difficult to encounter in traditional learning environments. This approach also facilitates more flexible and independent learning, allowing students to develop their clinical decision-making skills according to their individual learning pace (Ali et al., 2018). Several studies have shown the effectiveness of the implementation of case-based learning in the context of online learning in the health sector. For example, research by (Lee Chin et al., 2014) found that CBL in an online environment can improve student engagement and conceptual understanding in pharmacy education. Meanwhile, (Raurell-Torredà et al., 2015) reported that the combination of CBL and simulation in online learning was effective in improving the clinical skills of nursing students. Case-based learning (CBL) is essential to study for several fundamental reasons. First, CBL allows students to integrate theory with real-world practice, enhancing their understanding and decision-making skills in a clinical context (Klassen et al., 2021). Second, it encourages collaboration and communication among students, essential skills in healthcare practice. Third, with the rise of online education, research on applying CBL in online contexts is relevant to ensure meaningful learning experiences (Ma et al., 2024). Finally, CBL can identify gaps in the healthcare curriculum and provide recommendations for improvement (McCarthy & Russo, 2023). Thus, research on CBL is crucial to improving the overall quality of healthcare education.

However, there is still a need to understand more comprehensively how research trends related to case-based online learning in the health sector develop over time. Bibliometric analysis offers a systematic approach to mapping the development of this research field, identifying key themes, and uncovering gaps and opportunities for future research (Sweileh et al., 2017). The urgency of this research lies in the need to understand the development direction and effectiveness of case-based online learning in health education. By understanding existing research trends, we can better design and implement effective online learning strategies for future health education.

The main purpose of this bibliometric analysis is to map and analyze research trends related to case-based online learning in the health sector during the period 2014-2024. Specifically, this study aims to: 1) Identify the pattern of publication and literature growth in this field; 2) Analyze the geographical distribution and

collaboration of research; 3) Determine the most influential journals and authors; 4) Uncovering the main research themes and their development over time.

Method

This study adopts bibliometric analysis to evaluate studies on CBL from 2014-2024. Data was collected from the last ten years because this topic is still considered new, allowing researchers to identify variables that have appeared in CBL studies over the previous ten years. The database analyzed consists of articles published in Scopus journals. This bibliometric analysis was carried out using VOSviewer software to build and visualize bibliometric networks that include journals, titles, authors, publications, and others. In the current context, visual analysis of bibliometric data using mapping tools is critical to gain insight and information regarding developments in the field of science and the performance of research that has been carried out. Bibliometric analysis was chosen because it has advantages in terms of quantification, objects, and activities, so it can reduce the potential for subjective bias and confirm the conclusions that have been drawn by experts in the field of intellectual capital (Hermawan, et al., 2021).

Bibliometric analysis is one of the popular methods for revealing trends in developing articles in a research field. (Rusly, FH, Ahmi, Talib, & Rosli, 2019). Bibliometric analysis is a methodological approach that can provide more detailed information about publications, including authors, keyword frequency, the language used, and citations (Hermawan et al., 2021). According to the researchers, this study uses bibliometric analysis. Bibliometric analysis can facilitate the mapping of large amounts of scientific literature.

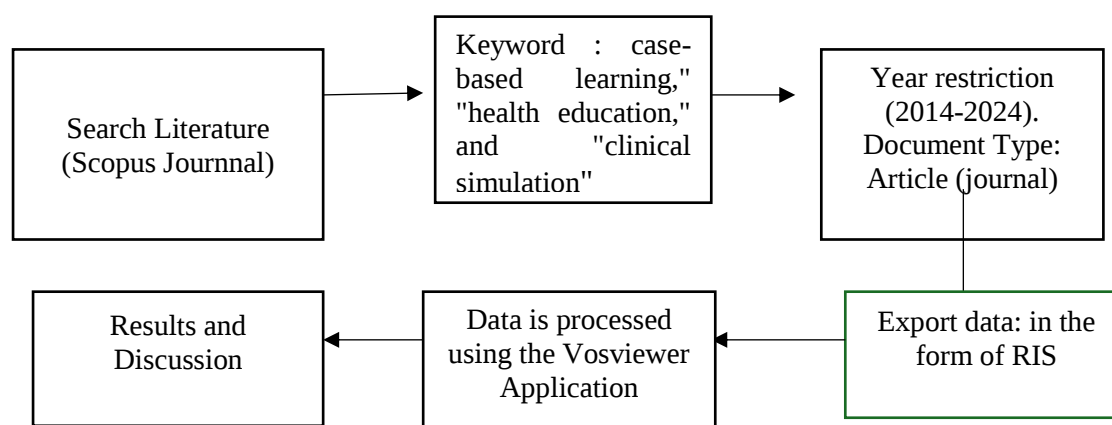


Diagram alur 1 <CBL Research Framework>

Data from the Scopus database shows that choosing a journal indexed in Scopus compared to other journals has several advantages. First, journals indexed in Scopus generally undergo a rigorous selection process and meet high-quality standards. This includes criteria such as robust research methodology, thorough peer review, and relevance and significant contributions in their fields, thus ensuring that published articles have higher credibility and validity. Second, Scopus provides access to a broad database, allowing researchers to conduct bibliometric analysis and better map research trends. By using Scopus journals, researchers can more easily track citations and the impact of their research, which are important indicators in the academic world; third, publication in Scopus journals often provides greater recognition in the educational community, as many institutions and funding agencies assess the quality of research based on where it is published. Therefore, research published in Scopus-indexed journals can enhance researchers' reputations and increase their chances of obtaining funding support or research collaborations.

This study uses articles indexed in the Scopus Journal of Health Education in the Scopus Journal database for the period 2014-2024. After the data is imported into the VOSviewer bibliometric software, the first step is identifying and removing duplicate data to prevent bias. In this stage, filters in VOSviewer ensure that each publication is counted once so that duplications may arise due to double indexing or author errors can be eliminated. In addition, only articles containing relevant keywords, such as "case-based learning," "health education," and "clinical simulation", are included. In contrast, articles that are not relevant to the focus of the study are ignored. The selection of these keywords is essential to increase the data's validity so that the analysis results data's validity so that the analysis results truly reflect research in health education.

This research method uses a bibliometric analysis approach to examine the trends and patterns of publications related to case-based online learning in the health sector. Bibliometric data is obtained from the

Scopus database, one of the largest sources of academic reference and has a high index (Marmoah et al., 2022). With keyword search using: title (online and course) and pubyear > 2012 and pubyear < 2025 and (limit-to (doctype , "ar")) and (limit-to (language , "english")) and (limit-to (subjarea , "psyc") or limit-to (subjarea , "medi") or limit-to (subjarea , "heal") or limit-to (subjarea , "nurs") or limit-to (subjarea , "nurs") or limit-to (subjarea , "envi")). With the restriction of the publication year 2013-2024, the type of research article document, English, and health-related subject areas (psychology, medicine, health sciences, nursing, and health-related environmental sciences).

Inclusion criteria include research articles in English published between 2013-2024 in the field of health, while review articles, non-English articles, and articles outside the field of health are excluded. This search resulted in 811 documents that met the criteria. The search result data is downloaded in RIS (Research Information Systems) format and imported into Mendeley's reference management software for duplicate management and checking.

Furthermore, the RIS file from Mendeley is exported and imported into the VOSviewer software for bibliometric analysis and visualization. VOSviewer is used to analyze co-authorship networks, keyword co-occurrence networks, citation density maps, and trend analysis of research topics. The results of the bibliometric analysis are then interpreted narratively to identify publication trends over time, the most productive authors and institutions, the countries that contributed significantly, the main research topics and themes, and the development of the research focus over the specified period.

The bibliometric analysis approach in this study has several limitations that need to be acknowledged. First, this study uses one central database, Scopus, to collect relevant articles. Although Scopus is one of the largest databases and provides access to various reputable journals, reliance on a single database can lead to coverage bias because not all relevant articles may be included. In addition, language bias is also a significant limitation. This analysis is mainly based on English articles because of the dominance of this language in international databases such as Scopus. Access bias can also be a factor that affects the validity of the results. Articles from open-access journals may be more likely to be indexed, while studies from paid or lesser-known journals may be missed.

Results and Discussions

The results of the findings are presented in the sub-sub-bibliometric about the transformative-based entrepreneurship learning model in higher education, which identifies patterns, trends and keywords and the direction of future research topics. Bibliometric results are an important step towards the development and improvement of the knowledge base about transformative entrepreneurship education in higher education.

Publication Trends and Most Productive Authors

In point 3.1 the researcher wanted to reveal the number of publications and authors most productive on case-based online learning in the health sector in the last decade see (Figure 1).

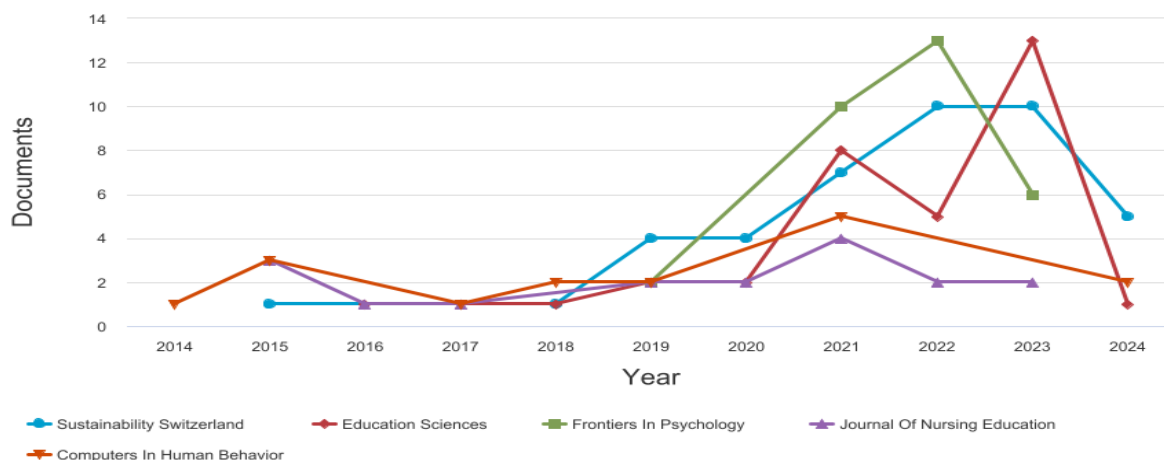
In Figure 1. It shows that the graph of publications related to case-based online learning in a decade provides an interesting trend. It can be seen that the featured sources such as the Journal of Nursing Education, Education Sciences, and Frontiers in Psychology appear to be the most relevant to the topic. Publication trends for these journals generally increased from 2014 to 2023, with peak activity seen between 2020-2023. The Journal of Nursing Education peaked in 2020-2021 with 4 publications per year, while Education Sciences showed fluctuations with a peak of 13 publications in 2023. Frontiers in Psychology experienced a significant increase from 2019-2022, reaching 13 publications in 2022.

Then this has increased, especially during the 2018-2023 period, this surge can be attributed to a significant event, the COVID-19 pandemic, which prompted educational institutions worldwide to shift teaching online. The widespread implementation of distance learning policies during the pandemic necessitated adapting more interactive and case-based teaching methods to ensure effective learning, especially in healthcare settings that require hands-on experience.

Documents per year by source

Compare the document counts for up to 10 sources. Compare sources and view CiteScore, SJR, and SNIP data

Scopus



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Figure 1 <Number of Publications Per Year by Source>

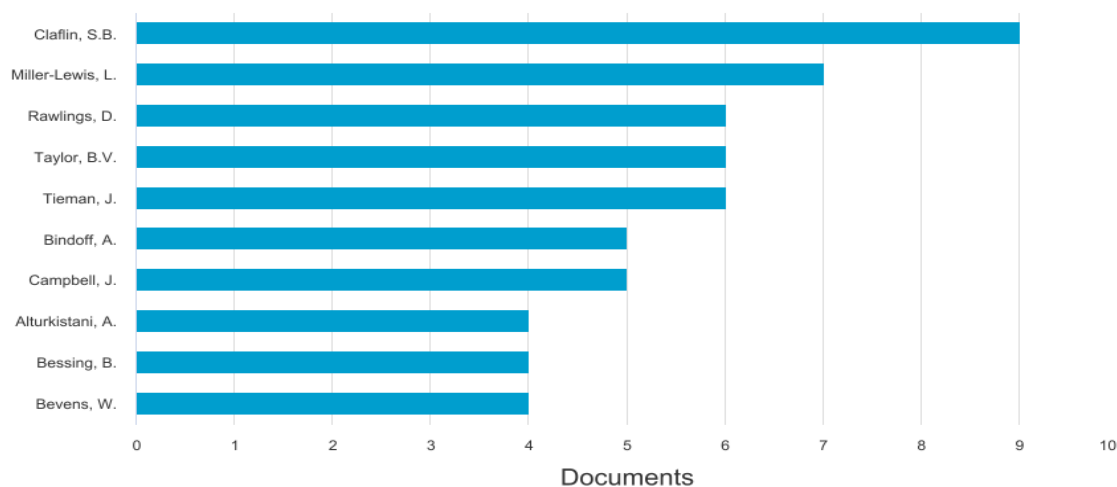
In addition to the pandemic, adopting new educational technologies such as digital simulation platforms, telehealth applications, and collaborative software has also increased the use of CBL in online settings. These technologies allow students to access interactive case simulations and clinical scenarios online, significantly enhancing the effectiveness of case-based learning in online education settings. At the same time, the need for healthcare professionals with critical thinking and problem-solving skills has become even more prominent as the pandemic has highlighted the importance of being prepared for complex clinical situations. As such, many healthcare institutions have adopted CBL as a primary approach to ensure students are prepared for real-world practical challenges (McLean, 2020).

From an educational policy perspective, governments and academic institutions in various countries also support the increasing use of CBL. For example, policies that direct innovation in health education, such as providing technological infrastructure and developing competency-based curricula, have helped strengthen this trend. These policies aim to ensure that graduates of health programs have relevant clinical competencies through learning methods that emphasize practical application and case-based problem-solving.

Documents by author

Compare the document counts for up to 15 authors.

Scopus



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Figure 2 <The Most Prolific Author in the Field of Online Learning>

In figure 2. It shows that the author is the most productive with the highest number of documents, which is 9 publications. This productivity shows Claflin's significant contribution in the field. Followed by Miller-Lewis, L. in second place with 7 papers, signifying the important role of this author in related research.

Authors Rawlings, D., Taylor, B.V., and Tieman, J. each have 6 documents, ranking third in terms of productivity. All three show an equal and substantial contribution in this field. Bindoff, A. and Campbell, J. followed up with 5 papers each, signifying their active involvement in related research. Authors from Alturkistani, A., Bessing, B., and Bevens, W. close the list of top 10 authors, each with 4 documents. Although they have fewer publications than other authors, their contribution remains significant in the development of knowledge in the field of case-based online learning in health. Thus, this author's graph provides a good overview of the distribution of productivity among researchers in this field. The difference in the number of publications between authors provides an understanding that understanding authors is driving progress in case-based online learning in the health sector, as well as to identify potential collaborations or key sources of reference in this field.

Collaboration analysis: patterns of collaboration between authors, institutions and countries

In point 3.2, the researcher wants to reveal a pattern of collaboration between authors and countries on related to case-based online learning in the health sector in the last decade, see (Figure 2).

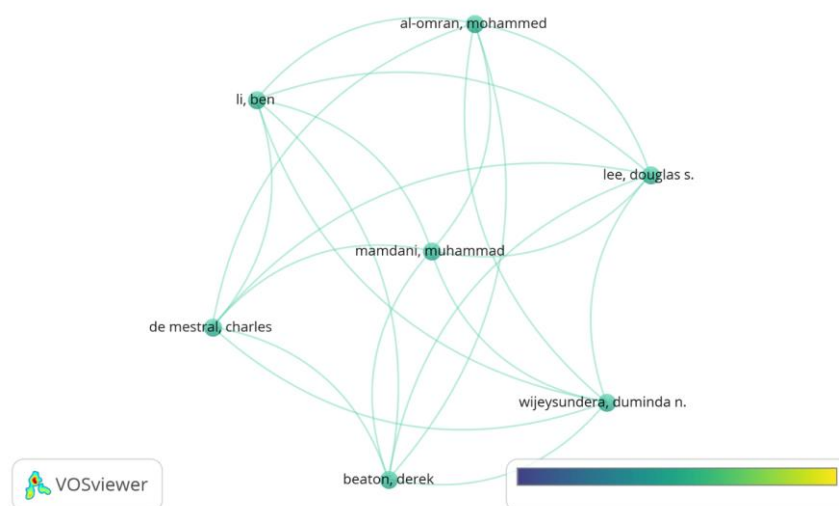


Figure 3 <Author's Collaboration>

Figure 3. Showing a pattern of network bibliometric collaboration between several authors who often collaborate, Al-Omran Mohammed emerged as a central figure in this network, having connections with almost all other researchers. There is a core group consisting of Al-Omran Mohammed, Li Ben, Lee Douglas S., Mamdani .Muhammad, and Wijeyundera Duminda N., which shows intense collaboration between them. Meanwhile, Beaton Derek and De Mestral Charles appear to be collaborators with more limited connections. The diversity of researcher names in this network may indicate cross-disciplinary or even international collaboration, enriching perspectives in research in this field. The existence of authors or institutions that actively collaborate across countries has contributed to the dissemination and adaptation of CBL across cultural and geographic contexts, broadening this methodology's impact. Institutions that engage in extensive collaboration tend to be more innovative in adapting CBL methods to local needs, resulting in research relevant in academic settings and practical benefits in clinical settings across countries (Chen, 2024).

In a collaborative network, some researchers play the role of hubs or connectors, which makes them contribute more to the advancement of the field. This is predicted because several countries have successfully implemented case-based learning (CBL) in health education, showing positive results in developing students' skills. In the United States, medical schools such as Harvard and Stanford use CBL to improve analytical and decision-making skills in clinical contexts. Australia also applies this method at universities such as the University of Sydney and Monash University, which have been shown to increase student engagement and understanding (Duncan et al., 2018). Institutions such as McGill University and the University of Toronto, Canada, utilize CBL to prepare students for real-world challenges in medical practice. Singapore, the National University of Singapore (NUS) integrates CBL into its medical programs to provide contextual learning experiences (Tsekhmister, 2023). The Netherlands and Sweden have also implemented CBL in health education,

strengthening students' practical skills and encouraging active learning. These successes suggest that CBL can enhance students' learning experiences and better prepare them for challenges in the field.

Documents by affiliation

Compare the document counts for up to 15 affiliations.

Scopus

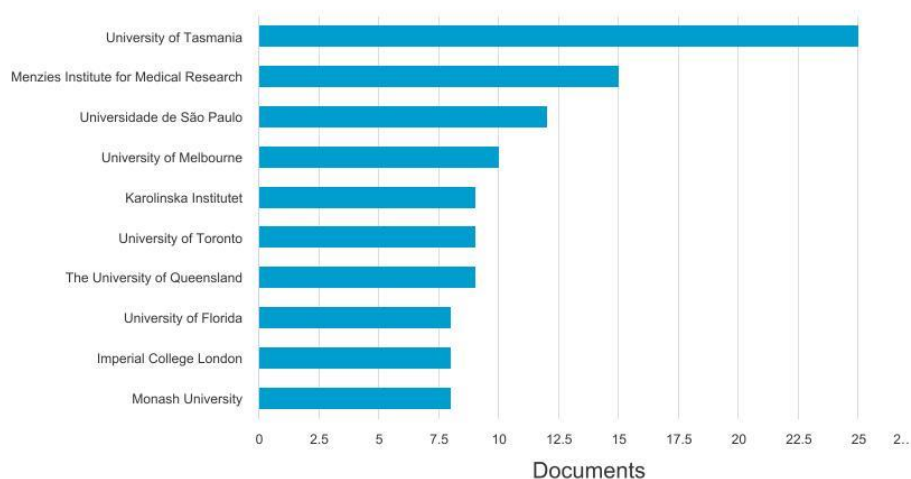


Figure 4. Top Universities

Figure 4 shows that the top universities provide interesting findings, namely the University of Tasmania emerging as the leader in the number of publications, indicating a strong focus on the development of this learning method. The Menzies Institute for Medical Research and the Universidade de São Paulo followed in second and third place, affirming the importance of medical research institutions and large universities in advancing online case-based learning in the health sector. The presence of the University of Melbourne, Karolinska Institutet, and the University of Toronto at the top of the list shows the wide geographical distribution of centres of excellence in these areas. Significant contributions also came from The University of Queensland, the University of Florida, Imperial College London, and Monash University, illustrating the diversity of institutions involved in the development of these innovative learning methods. This diversity reflects the university internationally from its efforts to improve health education through technology and case-based teaching methods.

Documents by country or territory

Compare the document counts for up to 15 countries/territories.

Scopus

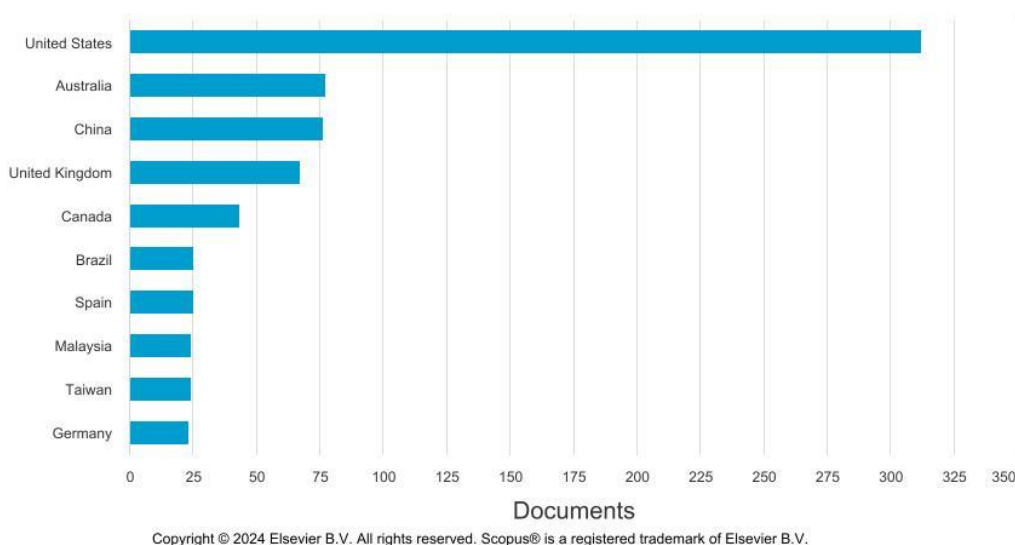


Figure 5. Top Countries

To complete figure 4, the top countries provide different but complementary perspectives. Figure 5 shows that the United States emerged as the largest contributor in terms of the number of documents, demonstrating the dominance and large investment in the research and development of this learning method. Australia came in second place, consistent with the strong presence of the University of Tasmania and other Australian institutions in the top list of institutions. China, the United Kingdom, and Canada have also emerged as significant contributors, signaling their important role in the global arena. The presence of Brazil, Spain, Malaysia, Taiwan, and Germany on this list further emphasizes the international nature of efforts to develop online case-based learning in the health sector (Tsekhmister, 2023).

Trend analysis of research topics

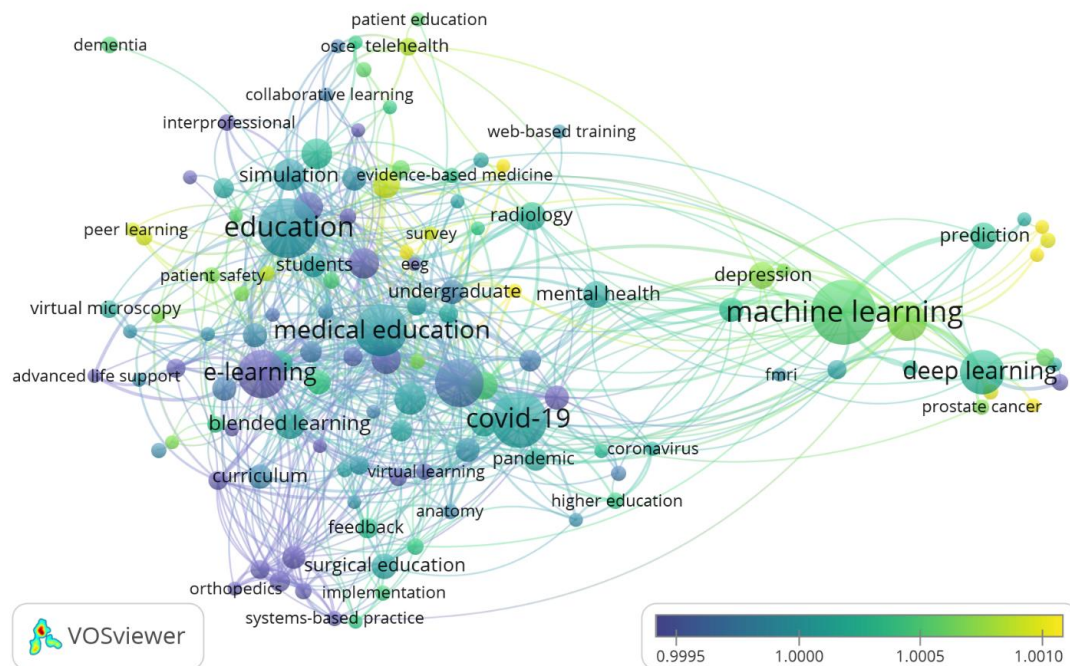


Figure 6. Distribution of Bibliometric Topic Trends

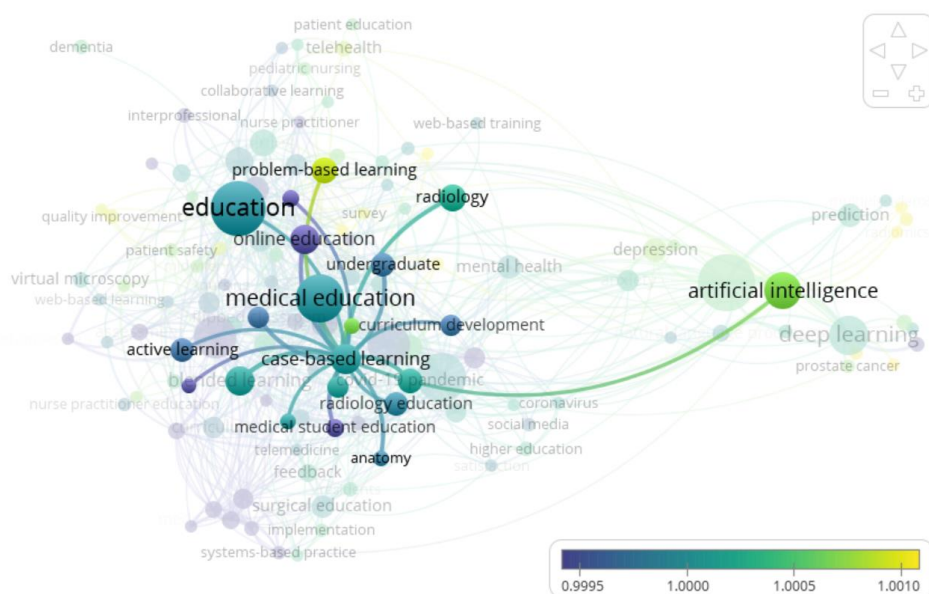


Figure 7. Spread of Cased based Learning Topics

Figure 6 shows that the visualization of the keymap of case-based learning online course trends in the health sector from 2014 to 2024 shows that the topic dominance of "education" and "medical education" as the center of attention, with "online education" and "e-learning" emerging as important subtopics, reflects a significant shift

towards digital learning. "Problem-based learning" is seen as a learning method that has received attention, while the presence of "artificial intelligence" signifies the integration of AI technology in health education. Meanwhile, Figure 7 shows that "case-based learning" looks less prominent than other learning methods. The relatively small size of the nodes, their uncentral position in the network, and limited connections with other topics prove that case-based learning is still rarely researched in the context of online courses in the health sector. The dominance of topics such as "covid-19", "machine learning", and "virtual learning" indicates that the focus of research is more focused on these areas. The absence of a specific cluster around "case-based learning" also indicates that there has not been a large and focused research community on this method in online health learning.

It can be concluded that although Online Courses Based on Case-Based Learning in the Health Sector have been recognized as a learning method, research on this topic is still relatively limited compared to other learning methods and technologies during the period 2014-2024. These findings underscore the current opportunities in future research for further research on the effectiveness and development of case-based learning in the context of online courses in the health sector, which has the potential to unlock the latest research and improve the quality of health education in the digital era.

Discussion

This study aims to map and analyze research trends related to case-based online learning in the health sector during the period 2014-2024. Bibliometric results show several interesting findings in 2014-2023, especially between 2018-2023 with the peak of 2020-2023 which increased due to the COVID-19 pandemic (Dickinson et al., 2018). The Journal of Nursing Education, Education Sciences, and Frontiers in Psychology emerged as major publication sources, demonstrating a strong focus on nursing education and educational sciences in the context of health. Research from (Claflin et al., 2022) emerged as the most prolific author, signifying the presence of experts who consistently contributed to the development of this method (Kulak & Newton, 2014). The analysis of the collaboration network shows Al-Omran Mohammed as the central researcher, with the formation of a core group of researchers indicating intensive collaboration (Gade & Chari, 2013). The University of Tasmania leads in the number of institutional publications, while globally, the United States emerges as the largest contributor, indicating a wide geographical spread in the study (Huang et al., 2018; Lee Chin et al., 2014).

Then in point 3.3 it shows that "education" and "medical education" are the main focus, "case-based learning" looks less prominent than other learning methods. The dominance of topics such as "covid-19", "machine learning", and "virtual learning" indicates that the focus of research is more focused on these areas (Sweileh et al., 2017). These findings underscore the current opportunities in future research to explore the effectiveness and development of case-based learning in the context of online courses in the health sector.

This study still has limitations, namely, the number of articles used is still very limited where researchers only use data from the Scopus ScienceDirect journal, researchers have limited years, and researchers have not been able to reveal more specific data contained in ScienceDirect. The suggestion from this study is for CBL researchers with future literature reviews; it is hoped that they can use more articles worldwide. The use of bibliometric analysis with VosViewer is still wide open in research on CBL and other variables, especially variables that still receive special attention in this case that have not been studied by other researchers, as well as the use of diverse keywords.

Conclusion

This study uses the last ten documents, starting from 2014 to 2024. The purpose of selecting the last 10 years is that researchers want to know the trends of variables that are often used in relatively new CBL research. The results of this study show that the publication trend of these journals generally increased from 2014 to 2024, with peak activity seen between 2020 and 2023. This spike can be attributed to a significant event, namely the COVID-19 pandemic, which prompted educational institutions around the world to shift teaching online. The distance learning policy that was widely implemented during the pandemic required adaptation to more interactive and case-based teaching methods so that the learning process remained effective, especially in the health sector, which requires practical experience (Chen, 2024). In addition to the pandemic, the adoption of new educational technologies such as digital simulation platforms, telehealth applications, and collaborative software also contributed to the increased use of CBL in online environments.

The most productive author in this study is Claflin. Followed by Miller-Lewis, L. in second place with seven papers, indicating the important role of this author in related research; the third most productive author is Rawlings, D., Taylor, BV, and Tieman, J. while in the collaboration between authors, several authors were found to collaborate frequently, Al-Omran Mohammed emerged as the main figure in this network, who has

connections with almost all other researchers. There is a core group consisting of Al-Omran Mohammed, Li Ben, Lee Douglas S., Mamdani Muhammad, and Wijesundera Duminda N., indicating intense collaboration among them. Meanwhile, Beaton Derek and De Mestral Charles appear to be collaborators with more limited connections.

Research topic trends from 2014-2024 show the dominance of “education” and “medical education” as the center of attention, with “online education” and “e-learning” emerging as important subtopics, reflecting a significant shift towards digital learning. “Problem-based learning” is seen as a learning method gaining attention, while “artificial intelligence” indicates the integration of AI technology in Health education. Research trends in education and medical education from 2014 to 2024 are driven by the development of digital technology, the need for skilled medical personnel, and the COVID-19 pandemic, which has accelerated the adoption of online learning and e-learning. Digital-based education has become more popular due to its flexibility and accessibility, especially during the pandemic. In addition, the Problem-Based Learning (PBL) method is in the spotlight because it improves critical thinking and problem-solving skills, which are essential in medicine. Artificial intelligence (AI) integration is also starting to be applied in medical education to provide more personalized and adaptive learning, support medical simulations, and patient data analysis. This shift demonstrates a focus on flexible, affordable, and student-centered education, producing a medical workforce ready to face future challenges with deep understanding and high adaptability.

The integration of cased based learning does not seem to be a central topic, its emergence along with themes such as e-learning and educational technology indicates a paradigm shift in health education. This indicates that there is still an opportunity for further research to integrate case-learning-based online courses. The implications of this research lie in the fact that all stakeholders need to consider and be aware of the further integration of these methods into their curricula, especially in the context of distance learning.

This study is expected to encourage educators to start integrating real-world cases into their teaching materials to increase student engagement and understanding. Educational institutions can consider allocating resources to train lecturers in designing and implementing effective case-based curricula, especially on online platforms. Meanwhile, policymakers can see these findings as a basis for supporting further research and curriculum development that emphasizes this method, especially in health education, to address challenges and needs in the field.

Implications of this study Researchers can leverage the findings on international collaboration trends by building collaborative networks between health faculties in different countries to share real-world cases and relevant cross-cultural experiences. In addition, measures such as creating an online repository of health cases and training faculty in designing interactive case-based learning through digital platforms will help optimize this method. With adequate technological infrastructure support, institutions can also use digital simulations and synchronous online discussions to ensure that students receive learning experiences close to actual clinical practice, even if they are conducted online.

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