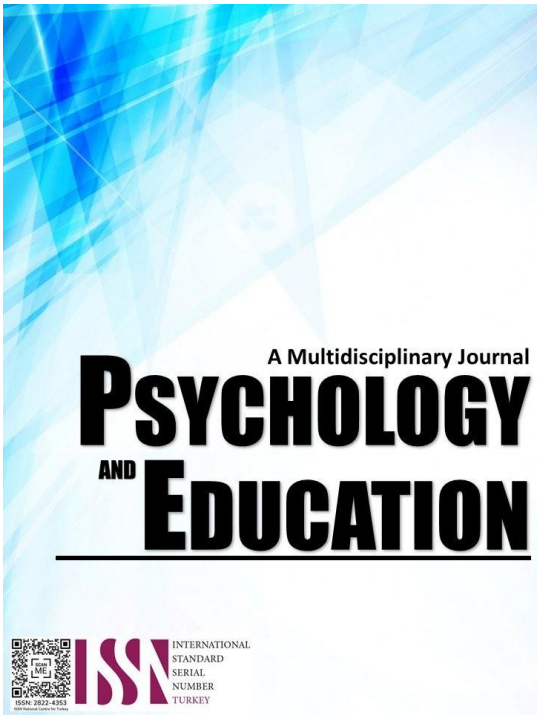
STUDIES ON CHATBOTS IN EDUCATION OVER 14 YEARS: A BIBLIOMETRIC STUDY



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Research Article

Studies on Chatbots in Education Over 14 Years: A Bibliometric Study

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Abstract

With the rapid advancement of artificial intelligence, chatbots have become increasingly integrated into educational settings, offering personalized learning experiences, real-time feedback, and enhanced student engagement. While global interest in educational chatbots is growing, regional trends within Southeast Asia, particularly the ASEAN countries, remain underexplored. This study investigates the research landscape of chatbot applications in education across ASEAN through a bibliometric analysis of 215 publications indexed in Lens.org from 2010 to 2024. Using VOSviewer, the study conducted co-authorship analysis to examine research collaborations, keyword co-occurrence to identify prevailing themes, citation analysis to assess influential publications, and bibliometric coupling to explore thematic linkages. Results indicate that Malaysia leads the region in terms of publication volume, though regional collaboration remains limited. Key research themes include artificial intelligence, ChatGPT, curriculum development, and adaptive learning, demonstrating the growing role of chatbots in pedagogical innovation. Influential sources are predominantly technology-focused journals, reflecting the interdisciplinary nature of the field. The findings reveal a maturing but unevenly distributed research environment, with emerging trends pointing to the increasing relevance of conversational AI in education. The study highlights the need for stronger international and regional collaboration, particularly within ASEAN, to build a more cohesive research community. It also emphasizes the importance of aligning chatbot development with educational objectives while addressing ethical, usability, and accessibility concerns. Future research should focus on inclusive design and long-term pedagogical impacts to maximize the educational benefits of chatbots.

Keywords: *chatbots in education, bibliometric analysis, ChatGPT, artificial intelligence*

Introduction

Technology is evolving rapidly, and one of the most transformative innovations in recent years is chatbots—artificial intelligence (AI) systems designed to simulate human conversation through text or voice interactions (Brandtzæg & Følstad, 2018). These AI-powered tools have gained widespread adoption across customer service, healthcare, tourism, and education due to their ability to provide quick and efficient responses (Benaddi et al., 2024). With advancements in natural language processing (NLP) and machine learning, chatbots are becoming more sophisticated in understanding and responding to human queries (Kumar, 2024; NSAIF et al., 2024).

The importance of chatbots extends beyond convenience. They are now widely used to enhance user experience, streamline processes, and facilitate knowledge sharing (Hwang & Chang, 2021; Kooli, 2023). In customer service, chatbots handle up to 70% of routine inquiries, significantly reducing response times and operational costs (Uzoka et al., 2024). Their 24/7 availability ensures instant responses, improving customer engagement and satisfaction (Kumar, 2024). Additionally, in mental health services, chatbots offer therapy, training, and screening, making psychological support more accessible to individuals in need (Abd-Alrazaq et al., 2019).

In the business sector, chatbots have played a crucial role in improving interaction quality and task efficiency (Ranieri et al., 2024). Businesses utilize these AI tools to increase digital trust and reduce customer stress when handling inquiries and transactions. As chatbot technology advances, their capacity to handle complex tasks, understand user preferences, and provide personalized recommendations has significantly improved (Uzoka et al., 2024). Despite these advantages, chatbot adoption comes with technical limitations that need to be addressed for optimal functionality (Gaikwad et al., 2024).

One major challenge in chatbot implementation is natural language understanding. While chatbots have improved in recognizing text and voice commands, they still struggle with context, nuances, and complex interactions, leading to user frustration (Bhambri & Rani, 2024). Additionally, data privacy concerns remain a significant barrier, as the increasing reliance on AI-driven systems raises ethical questions about user security and information protection (Bhambri & Rani, 2024). Overcoming these challenges requires continuous advancements in AI algorithms and stronger data protection policies.

In the education sector, chatbots are transforming teaching and learning experiences. These AI-powered tools assist in virtual tutoring, academic advising, and student engagement, making learning more interactive and accessible (Hwang & Chang, 2021). By providing real-time feedback, answering student queries, and guiding learners through coursework, chatbots help create a more personalized and adaptive learning environment (Lambebo & Chen, 2024; Zou, 2024).

However, improper use of chatbots in education may lead to pedagogical drawbacks. Studies suggest that over-reliance on chatbots can negatively impact students' critical thinking and problem-solving skills if they become too dependent on AI for answers (Parsakia, 2023). Integrating chatbots into education must be done carefully to ensure that they complement rather than replace traditional teaching methods. Additionally, chatbot effectiveness varies depending on usability, engagement strategies, and alignment with pedagogical goals (Lambebo & Chen, 2024).

The adoption and acceptance of chatbots in higher education depend on various factors, including perceived usefulness, ease of use, and social influence (Aldulaimi et al., 2024; Lambebo & Chen, 2024). Research frameworks such as the Unified Theory of Acceptance and Use of Technology (UTAUT2) and the Expectation-Confirmation Model (ECM) highlight key drivers in technology adoption. These studies emphasize that hedonic motivation, habit formation, and perceived efficiency significantly influence whether educators and students fully embrace chatbots in learning environments (Aldulaimi et al., 2024).

The integration of chatbots in education is not just about technology but also about understanding how students and teachers interact with AI tools. Effective chatbot implementation requires addressing user needs, engagement levels, and long-term impact on learning behavior (Rosas & Rodríguez, 2024). Moreover, chatbots should be designed to encourage active participation and knowledge construction, rather than passive learning or over-dependence on AI-generated responses (Zou, 2024).

This study aimed to analyze the research landscape on chatbots in education over the past 14 years through a bibliometric analysis. The study examined co-authorship networks to understand research collaborations, co-occurrence of keywords to identify trending topics, citation analysis to assess the most influential works, and bibliometric coupling to explore thematic connections among studies.

Research Questions

This study aimed to analyze the trends and patterns in chatbot-related research in education over the past 14 years through bibliometric analysis. It focused on research collaborations, keyword trends, citation impact, and thematic connections among studies. Specifically, it sought to answer the following questions:

1. Who are the most influential authors and research collaborations in chatbot studies in education based on co-authorship analysis?
2. What are the most frequently occurring keywords in chatbot-related research in education based on co-occurrence analysis?
3. Which documents, sources, and authors have the highest citation impact in chatbot studies in education?
4. How are chatbot-related studies in education thematically connected based on bibliometric coupling?

Methodology

Research Design

This study used a bibliometric research design to explore how chatbot-related research in education has evolved over the past 14 years. A bibliometric approach helped in identifying trends, research collaborations, and the most influential studies in the field. Instead of focusing on the content of individual papers, this method looked at patterns in publications, such as the most common keywords, frequently cited works, and connections between researchers.

Procedure

This study employed a bibliometric approach to explore chatbot-related research in education within ASEAN countries from 2010 to 2024. Data were exclusively sourced from Lens.org, an open-access academic database. The search strategy utilized Boolean operators to combine relevant keywords, using the string: (“chatbot” OR “conversational agent” OR “AI tutor” OR “ChatGPT”) AND (“education” OR “learning” OR “teaching”) AND (country name), where country names included Brunei, Cambodia, Indonesia, Malaysia, Myanmar, the Philippines, Singapore, Thailand, Vietnam, and Laos. The initial search yielded 379 records.

To ensure relevance and accuracy, the dataset underwent a systematic cleaning and filtering process. This involved removing duplicate entries, non-English articles, and non-academic materials such as news articles or policy reports. Studies that did not focus on the educational application, development, or impact of chatbots were excluded. Each entry was manually reviewed to verify author affiliation or study context within the ASEAN region. As a result, no relevant studies were identified from Myanmar and Laos. After refinement, a final dataset of 215 academic publications was obtained, consisting of peer-reviewed journal articles, conference proceedings, and academic theses directly addressing chatbot use in educational settings.

The curated dataset was exported in CSV format and analyzed using VOSviewer software. The analysis included co-authorship to assess research collaboration, keyword co-occurrence to identify thematic trends, citation analysis to determine influential works, and bibliometric coupling to explore thematic relationships between studies. This structured methodology ensured the reliability, transparency, and reproducibility of the research findings.

Data Analysis

The collected data were analyzed using VOSviewer, a bibliometric analysis tool that visualizes relationships among publications, authors, and keywords. The study focused on four key analyses: co-authorship, to examine collaborations between researchers and countries; co-occurrence, to identify frequently used keywords and research themes; citation analysis, to determine the most influential documents, sources, and authors; and bibliometric coupling, to explore connections between studies based on shared references. The processed CSV dataset from LENS was imported into VOSviewer, where network maps and clusters were generated to highlight significant patterns and trends in chatbot-related research within ASEAN countries. The findings provided insights into the research landscape, identifying influential contributors and emerging areas in chatbot education studies from 2010 to 2024.

Ethical Considerations

This study ensured ethical research practices by using only publicly available data from LENS, an open-access academic database. Since the study did not involve human participants or personal data, there were no risks related to privacy or confidentiality. The analysis focused solely on bibliometric data, such as publication details, citations, and author networks, without modifying or misrepresenting the original research.

Results and Discussion

Problem 1. Who are the most influential authors and research collaborations in chatbot studies in education based on co-authorship analysis?

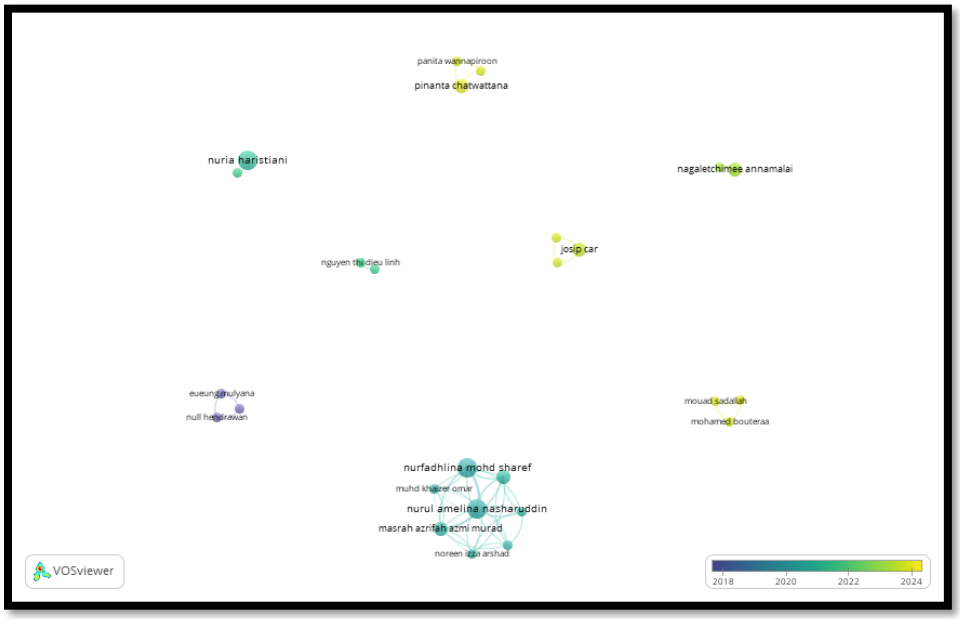

Figure 1. *A Clustering Map of Co-authorship with a Minimum Number of Document of the Author ≥2 and Minimum Number of Citations of an Author ≥5*

The co-authorship clustering map provides the picture of research collaboration between the scholars who engage in chatbot-related educational studies in the ASEAN countries. Every node is an author with the size of each node showing the strength of Co-authorship links, i.e. number and frequency of CO experiences. Different colours represent different research clusters or collaborative groups, but the gradient of a particular colour contains important information about the timeline of publication activity, more recent contributions are marked with green and yellow hues.

A highly dominating and closely networked cluster begins from Malaysia surrounding Nurfadhlina Mohd Sharef and her fellow writers, i.e., Muhd Khair Omar and Nurul Amelina Nasharuddin. This cluster not only shows a high output of collaborative research but also persistence over time, minting Malaysia as a regional key driving force behind chatbot studies in education. The robust intra-institutional cooperation indicates the availability of existing research centers or endeavors aimed at AI and studying.

By comparison, smaller or more disaggregated groups, including the ones that incorporate the researchers of Indonesia, Vietnam, and Thailand, suggest isolated work or poor national collaboration. Such as Niku Haristiani (Indonesia), and Nguyen Thi Dieu Linh (Vietnam) appear as a solitary node or loosely connected, indicating little co-authorship networks. Such solitary positions can impede the spreading of ideas, collective practices, and co-creation of knowledge, essential for the development of a multidiscipline such as educational AI. The fact that there is absence of any authors from Myanmar and Laos also demonstrates imbalances in local research capacity/visibility. The overall clustering pattern brings out a major weakness in cross-border synergies among ASEAN countries.

Reflections for the field are wide-ranging. First, the supremacy of the national clusters indicates a prospect for a more conscious regional integration. Cross national synergies could be supported by ASEAN-level research programs, or joint conferences, or grant-funded collaborative projects. Second, the present clustering can also suggest topics to be chosen: researchers from underrepresented nations may work on the burgeoning or special subjects which have not been thoroughly discussed in the prevailing Malaysian cluster, by means of bringing fresh approaches to the table. Finally, the creation of stronger co-authorship networks can contribute to improving the quality of research, to increasing international visibility, and to equal contributions to the future of chatbot applications in education. Expressing more engagement, especially from underserved countries and enhancing inter-institutional engagements are critical next moves towards creating a more balanced, as well as influential research environment in ASEAN.

Table 1. *Co-authorship Analysis of Chatbot Studies in Education within ASEAN Countries (2010-2024)*

Name		*Cluster*	*Link*	*Total Link Strengths*	*Documents*	*Average Publication Year*
Nurfadhlina Mohd Sharef	Malaysia	1	7	18	4	2020.25
Nurul Amelina Nasharudin	Malaysia	1	7	18	4	2020.25
Evi Indriasari Mansor	Malaysia	1	7	17	3	2020.67
Muhd Khaizer Omar	Malaysia	1	7	11	2	2020.50
Masrah Azrifah Azmi Murad	Malaysia	1	7	17	3	2020.67
Normalia Samian	Malaysia	1	7	13	2	2020.50
Noreen Izza Arshad	Malaysia	1	7	13	2	2020.50
Faaizah Shahbodin	Malaysia	1	7	13	2	2020.50
Eueung Mulyana	Indonesia	2	2	4	2	2018
Null Hedrawan	Indonesia	2	2	4	2	2018
Rifqy Hakimi	Indonesia	2	2	4	2	2018
Nguyen Thi Dieu Linh	Vietnam	8	1	2	2	2021.50
Shivani Agarwal	India	8	1	2	2	2021.50
Nuria Haristiani	Indonesia	7	1	2	4	2021
Mumu Muhammad Rifai	Indonesia	7	1	2	4	2021.50
Pinanta Chatwattana	Thailand	5	2	4	3	2023.67
Thanarat Kingchang	Thailand	5	2	4	2	2023.50
Panita Wannapiroon	Thailand	5	2	4	2	2023.50
Nagaletchimee Annamalai	Malaysia	6	1	2	3	2023
Bilal Zakarneh	Malaysia	6	1	2	3	2023
Tien Yin Wong	Singapore	3	2	4	2	2023.50
Yih-chung Tham	Singapore	3	2	4	2	2023.50
Josip Car	Singapore	3	2	4	3	2023.23
Mohamed Bouteraa	Malaysia	4	2	4	2	2023.50
Mouad Sadallah	Malaysia	4	2	4	2	2023.50
Saeed Awadh Bin-Nashwan	Malaysia	4	2	4	2	2023.50

Table 1 presents the co-authorship analysis of chatbot studies in education within ASEAN countries from Table 1 below reveals the co-authorship terrain of chatbot-focused education research for the ASEAN during the years 2010 to 2024, reflecting regional differences in coordination. Malaysia becomes the busiest and the most connected hub, dominated by a powerful cluster gathered around scholars such as Nurfadhlina Mohd Sharef and Nurul Amelina Nasharudin, which indicates the number of studies conducted and also long-term cooperation. This degree of focus implies the presence of institutional support and a national drive in terms of AI in education.

On the contrary, smaller, less integrated networks are witnessed in nations like Indonesia, Thailand, Vietnam, and Singapore, thus showing that there is minimal collaboration within or across the borders. Other authors such as Niku Haristiani (Indonesia) and Nguyen Thi Dieu Linh (Vietnam) are grouped in more insular spots, pointing out disparate research endeavours and the lack of scholarly partnership. A stronger problem of uneven research capacity and commitment across the region is highlighted by a slender cross-national connections glow and lack of contributors from countries like Myanmar and Laos. This fragmentation could hamper the spread of the knowledge and collaborative innovation important for the growth of educational technology.

To counter such challenges, the ASEAN institutions may focus on implementing initiatives that are aimed at enhancing regional networks, including joint research grants, conferences, and joint platforms, enhancing participation even from underrepresented countries. Such initiatives can improve the quality and scope of research as well as inclusivity of the research community toward creating a more balanced environment for chatbot applications in education in Southeast Asia.

Problem 2. What are the most frequently occurring keywords in chatbot-related research in education based on co-occurrence analysis?

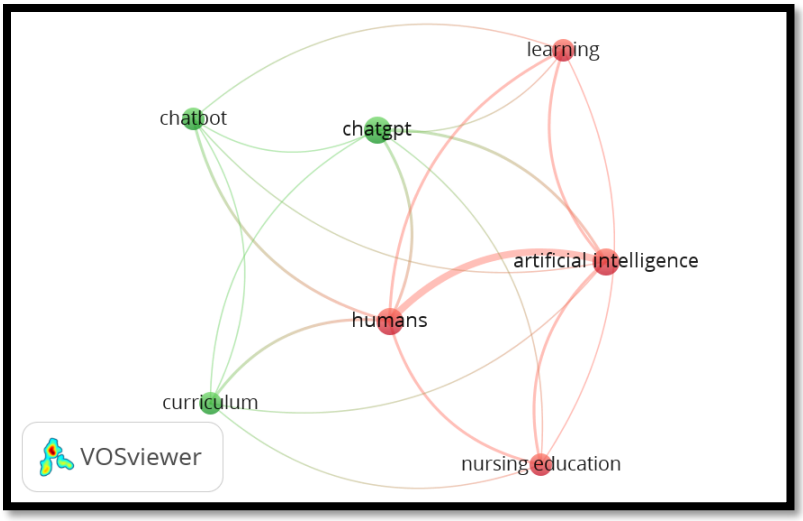

Figure 2. *A Clustering Map of Occurring Keywords ≥2*

The co-occurrence network visualization which is created using VOSviewer charts the conceptual terrain of chatbot- focused educational research in ASEAN based on the most commonly used keywords. The network shows pronounced two clusters. the red cluster that centers around such words as "artificial intelligence"," learning", "nursing education", and the green cluster that includes such words as "chatbot", "ChatGPT", "curriculum". The keyword "humans" is a bridging node that connects these clusters and represents the role of human interaction as being pivotal in the AI-facilitated learning settings.

These clusters are an indication of the thematic diversification in the field. The red cluster implies the accentuation of AI-augmented schemes of learning and discipline-oriented applications, including nursing school, indicating the increase of the interest in the use of AI for professional and competency-based teaching. On the other hand, green cluster points to the infiltration of chatbots and large language models (LLMs) such as ChatGPT into curriculum design, as a sign of the shift towards embedding the conversational AI tools into the teaching and learning processes.

The advent of "ChatGPT" as an independent keyword outlines the growing academic interest in the generative AI and its revolutionary potential for education. This trend is reflective of world trends and implies a paradigm shift to scalable, conversational learning environment that can deliver real-time personalized context-aware feedback. From a strategical perspective, these thematic clusters map out a way forward for future research and collaboration. For example, the distribution of keywords for the topic "nursing education" implies a fruitful ground for selective studies in other professional spheres, such as engineering, law, or teacher education, in which the chatbot tool has yet to be applied. In the same vein, the close relations between "artificial intelligence" and "learning" warrant further exploration of pedagogical frameworks that promote integration of AI having educational soundness.

Moreover, the conceptual division of the clusters implies the possibility of the existence of research communities, which seem to be acting in relative isolation from each other – technical development focused and application oriented education focused. This points out the need for interdisciplinary addressing, especially among educators, curriculum designers, and AI developers, to bridge the gap between the technological potential and pedagogical relevance.

To support this implication, Krishna et al. (2024) point out that chatbots enhance learning through assistance, an adaptive form of tutoring, and instant feedback, increasing the engagement of students. Chen et al. (2024) discovered that they also promote metacognitive and collaborative learning and at the same time create a reduced level of student stress. Lambebo and Chen (2024) further detail the flexibility of chatbots within various domains, such as learning of the language and healthcare. Such insights support the need to promote different and cross-sectorial uses of chatbots in education.

In conclusion, the keyword clustering not only reflects contemporary research priorities but traces expansion opportunities as well, e.g. the penetration of underrepresented domains, intersectional collaboration, and pedagogically-informed chatbot solutions' development. Knowledge of such clusters helps researchers and policymakers make judicious decisions on the choice of topic, source of funds, and partnership associated with emerging educational AI.

Problem 3. Which documents, sources, and authors have the highest citation impact in chatbot studies in education?

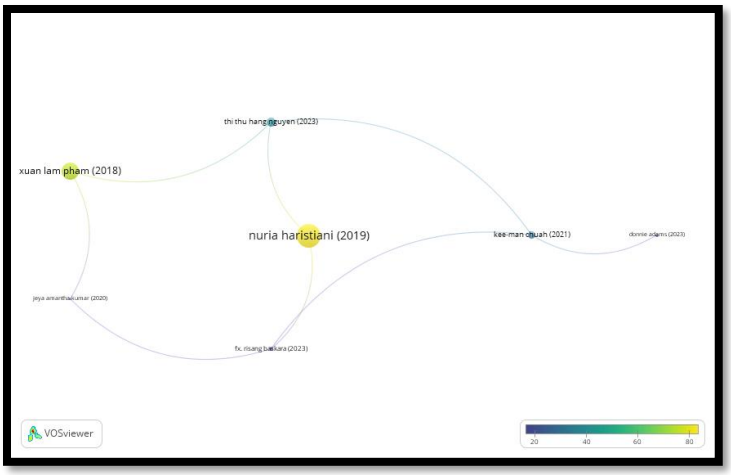

Figure 3. *A Clustering Map of document and authors with Highest Citation Impact Keywords with ≥10 Minimum Number of Citations of a Document*

Citation impact analysis map identifies the most influential publications and authors in the field of chatbot-related educational research in ASEAN countries. The size of each node corresponds with the number of citations, and the color gradient from blue to yellow reflects citation impact over time, with older publications usually generating more citations. The most important node is Nuria Haristiani (2019), which then stands out as the most common reference in the dataset, proving its crucial position in establishing the research field. Other prolific publications include those of Xuan Lam Pham (2018), Kee-Man Chuah (2021) and Donnie Adams (2023) connected to several other works indicating their impact on the discussion of different thematic areas in the discipline.

These key works create separate clusters that reflect a certain theme of research/subfield, e.g., language learning, curriculum integration, or the use of AI in education. The key nature of Haristiani's work, presumably devoted to the topic of chatbots in language teaching, implies the early focus on the domain-specific applications, whereas the most recent work of Chuah and Adams reflects the increased interest in system-level educational design and AI-augmented pedagogy. The presence of the new writers such as Nguyen (2023) and Risang Bakkara (2023) who, for now have fewer citations indicate the emerging areas of the research that are commencing to boast of the attention such as the large language models and the adaptive learning technologies.

These citation clusters function as important landmarks that point out the well-researched and under-explored themes. For the novice researchers, following in the track of established works that are highly cited can provide relevancy and scholarly agreement; while, addressing budding issues allows opportunity to contribute new findings. Also, the citation network proposes ways in which collaboration can be undertaken and especially with authoritative authors or institutions that act as research hubs. It could enhance research visibility and academic impact to enhance such partnerships. Moreover, knowledge of which subjects are most cited will help create strategic choices for research preparation, application for funding, and interdisciplinary efforts. Overall, the citation impact analysis does not only highlight the leading works but also provides useful recommendations for further research in term of collaboration options and topic choice for the study in the field of educational chatbots.

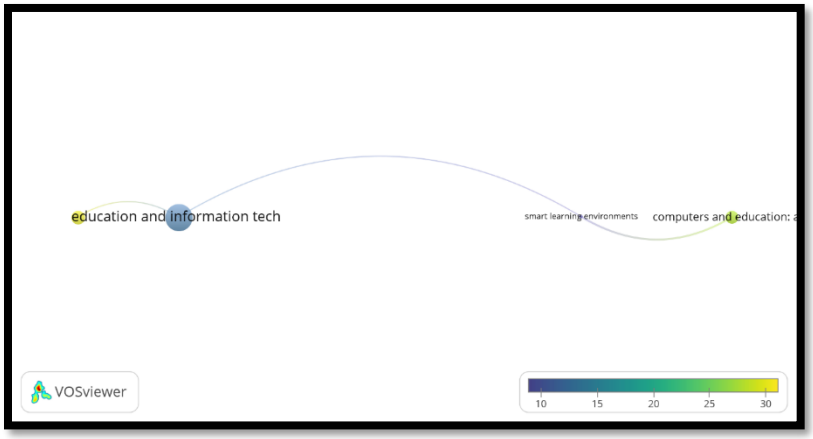

Figure 4. *A Clustering Map of Source with Highest Citation Impact Keywords with ≥10 Minimum Number of Citations of a Document*

The citation impact map of sources provides information about the most influential journals devoted to chatbot-related studies in education of the ASEAN countries. From among the sources, Computers and Education and Education and Information Technologies stand out as the most visible and popular ones, as evidenced by the larger node sizes and stronger citation linkages they have with other sources, which displays their centrality in creating discourse at the scholarly level. Showing the citation intensity, from blue to yellow, places Computers and Education in the high impact spectrum. Smart Learning Environments in the network, despite smaller scale of their presence, clearly reflects its increasing relevance and thematic alignment with leading sources, particularly, in AI-enhanced and adaptive learning environments.

These groups represent the interdisciplinary character of chatbot research, combining the disciplines of computer science, educational technology, and pedagogy. The supremacy of machine-centered educative journals emphasizes the importance of AI, data science, and the learning innovation in the development and research on chats bots. This means that the field is not only changing through education, but it also borrows methodological/conceptual framework from neighbors into adjacent disciplines such as human-computer interaction and cognitive science. For further researchers, this clustering is a strategic direction as regards future targets for journals and topics. To increase scholarly visibility and impact, the articles can be published in high-impact, well-cited journals, such as Computers and Education. In addition, the coming-of-age significance of such journals as Smart Learning Environments indicates the increased interest in individual and intelligent learning platforms, which is a promising area for researchers to expand on new applications of chatbots. Furthermore, knowledge of such patterns of publications can provide grounds for joint initiatives among fields, the establishment of cross-disciplinary discourse, and development of more available and creative chatbot solutions for education purposes.

Problem 4. How are chatbot-related studies in education thematically connected based on bibliometric coupling?

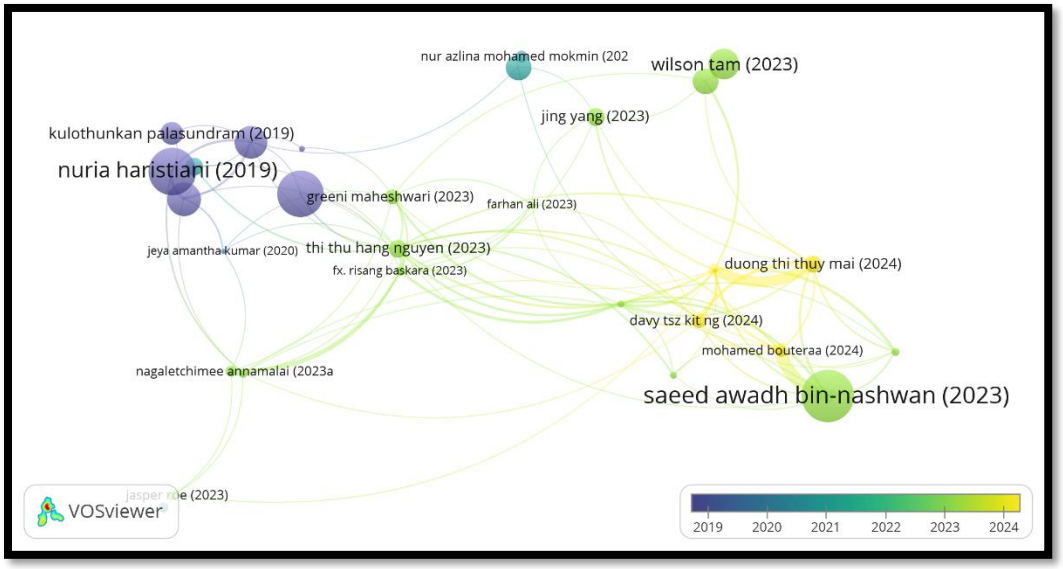

Figure 5. *A Clustering Map of Source in Bibliometric Coupling (Documents) with ≥10 Minimum Number of Citations of a Document*

The bibliometric coupling map shows thematic interconnectedness of the chatbot-related studies in education through shared references and demonstrates how the clusters of documents are shaped with the help of common conceptual frameworks. Some seminal studies, including those by Saeed Awadh Bin-Nashwan (2023) and Nuria Haristiani (2019) are the cornerstones of the network, as it is indicated by their central placement and high coupling strength. This work has informed several following publications, which points to the leading role in shaping the early discourse of this field. The fact that there are newer studies, such as the studies by Duong Thi Thuy Mai (2024) emerging as clusters signifies dynamism in the research field. The gradation of the colour – from blue (old studies) to yellow (newer studies) – graphically indicates the chronological evolution of thematic trajectories (over time).

The patterns of clustering reveal that the chatbot research within education is growing with the cumulative development of knowledge. The older clusters tend to have central themes that are fundamental, like the integration of chatbot, AI-driven learning, and design of system. In comparison, newer clusters are extending the discourse into intricate issues such as personalized learning experience, ethics, interaction between human and AI in pedagogical contexts. These changing implications show that researchers are becoming more attentive to the issues of technological innovation and its practical and humanistic aspects.

For future scholarship, these clusters are viable heuristics. They do not only assist in pointing out seminal works in need of deeper investigation but also indicate under/emerging themes worthy of investigation. Furthermore, with the help of bibliometric coupling patterns, the researchers can find potential collaborators who are exploring similar themes; therefore, promoting a more profound

intellectual interaction and cross-subjective relations. Aligning the work with well-cited studies and contributing to newer clusters can help scholars increase the relevance and the impact of their research in the area of AI in education that is rapidly developing.

Conclusions

Chatbot research in education has been developing in the last 14 years considerably, especially in the countries like Malaysia, which exhibits high internal cooperation. Nevertheless, the narrow chain of cross-country collaboration in ASEAN and beyond continues to be a challenge to achieving the potential of chatbot innovations. Enhancing international and regional cooperation in the sphere of research is a crucial step to speed up development, increase knowledge sharing, and contribute to the fact that various educational requirements are met in various settings. The research realm of current times, for the most part, revolves around such themes as artificial intelligence, learning, ChatGPT, and curriculum formation. Applications are coming to play, especially in areas such as nursing education and individualized learning, which shows that the technology is flexible in fields of application. With the development of the chatbots, more and more attention is drawn to the improvement of the interactivity, engagement of the users, and ethical issues in AI-based learning. Cited many times by researchers such as Nuria Haristiani and Xuan Lam Pham demonstrate the impact of the pioneering studies, and leading journals like Computers and Education and Education and Information Technologies provide the effective outlets for the distribution. For educators and policymakers, these insights suggest the potential value of making use of chatbot technologies not only as instruments of experimentation, but as well as established features of the process of learning. To take forward the things, practical steps should entail designing inclusive, contextual, and easy-to-integrate chatbots for diverse educational settings. Cross-nation research endeavor, educator trainees' programs and pilot trials in actual classroom settings might link theory and practice. By paying attention to collaboration and real-world application, the field can ensure that AI chatbots can have meaningful impacts on the teaching and learning outcomes in all regions.

To make chatbot research in education more practical in the ASEAN, it is critical to improve cooperation at the regional level. Creating ASEAN research consortia that would be specializing in educational AI can help maintain joint projects, co-authored articles, and joint-funding endeavors. These partnerships can be facilitated by periodic conferences and shared platforms that aim at knowledge exchange. At the level of policies, public governing of the member states of the ASEAN should create a unified framework related to ethical use, data privacy, and inclusive chatbot access in education for equal implementation between the states.

Moreover, the implementation of the standardized evaluation measures (such as student engagement, learning outcomes, and accessibility) can measure the efficacy of chatbots in different learning settings. Different pilot programs in various educational levels and subjects, including STEM and language learning, can provide real-world data for future directions. Educator training should also be given top priority in order to develop AI literacy and practical skills on using chatbots in the classroom. When combined, these steps can serve to enhance innovation, optimize learning results, and develop a more integrated and impactful research world in the region.

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