
A BIBLIOMETRIC ANALYSIS OF CHATBOT APPLICATION PRINCIPLES IN EDUCATIONAL CONTEXTS

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ABSTRACT

The application of chatbots in education is an emerging study with the potential to facilitate remote education paradigms and empower students with the flexibility to study at their desired time and location. The existing studies rarely take a perspective of chatbot application principles to explore teaching design in educational contexts. To bridge this research gap, this study aims to conduct a bibliometric analysis through visualization and citation network analyses. We find that intelligent chatbots in education continue to attract increasing attention due to technological improvement and diversification of teaching means. This study pinpoints prevalent research topics about chatbots in educational applications, including strategies for designing chatbots, users' expectations, the contrast between human-human and human-chatbot partners, and motivations, etc. Due to its insufficient study on the application principles of chatbots in the process of education, the study provides a model and specifies some key variables used for future studies on chatbot application principles in educational contexts.

KEYWORDS

Bibliometric analysis, intelligent chatbots, education, visualization and citation network analyses, application principles

INTRODUCTION

During the spread of COVID-19, e-learning has drawn more attention for its efficiency and interactivity. Chatbot is an artificial intelligence program supported by Natural Language Processing (NLP) techniques to provide appropriate human-like responses (Ahdul-Kader, et al., 2015). The use of chatbots, known as conversational agents, has experienced significant growth thanks to the development in AI and natural language processing techniques (Pérez, J. Q., Daradoumis, T., & Puig, J. M. M, 2020). Due to its ability to carry out meaningful human-computer interaction, the artificial intelligence chatbot, a popular technology involves a wide

range of contexts like commercial, elderly care, entertainment, tourism, journalism, e-commerce, and education (Liu & Yu, 2023; Pavlik, 2023). In recent years, there is a rising concern about the application of chatbots for teaching and learning in educational settings (Yang et al., 2022). Chatbots are useful tools for second language learners to improve their language skills (Fryer, Nakao & Thompson, 2019) and experience a personalized learning process (Benotti et al., 2018). AI chatbot serves as a scaffolding agent to help students improve their motivation and engagement levels (Neo, 2022). The ongoing studies are related to the sustainability and overall impact of chatbots (Fryer et al., 2017), the comparison of chatbot and human task partners (Fryer, 2017), teachers' attitude and acceptance (Chocarro, Cortiñas & Marcos-Matás, 2023), and affordances of chatbots as well as drawbacks for language teaching and learning (Kohnke, Moorhouse, & Zou, 2023). However, a citation network analysis is still needed to reveal the entire developmental path to explore the insufficient research area around educational contexts. Literature reviews made previously give a summary from a general perspective of education contexts, but the perspective of chatbot application principles in educational contexts is significant as an intermediate research scope.

To bridge this research gap, this study intends to carry out a bibliometric analysis utilizing visualization and citation network software. The primary purpose of this study is to examine the progression of chatbots and the more contemporary research concentrations in the field of education. This study may help show current application contexts and research hotspots of chatbots, encouraging further design of application principles in educational contexts. In the following parts, we first do a retrospection on the existing empirical studies and literature reviews related to the application of chatbots to educational contexts. Based on the popular teaching model, we establish one certain research model pertaining to chatbot application principles in education. Then, literature search and visualization are done by VOSview and CitNetExplorer. Finally, we analyze the results, discuss the research questions, and draw implications from this study.

LITERATURE REVIEW

Educational Applications of Chatbots

Studies on chatbots have undergone several decades in human history, Allen Turing first gave a discussion: "Can a machine think?" in his imitation game in 1950, people began to wonder if machines would eventually compete with men in intellectual fields. The initial conversation between computer machines and humans was implemented with a computer program called ELIZA, a keyword-matching program (Weizenbaum, 1966). Hochreiter and Schmidhuber introduced a long short-term memory (LSTM) method to store information setting a foundation for research on artificial intelligence and neural networks (1997). The continuously sparked

empirical study was pioneered by Papineni et al.'s (2002) introduction of automatic evaluation of machine translation, a substitute for human evaluations, which is a frequently cited publication. With regard to the application of chatbots to education contexts, a variety of systematic analyses have been made to explore the current state-of-the-art of this educational technology (Pérez, 2022; Fryer et al., 2020; Huang et al., 2022; Winkler & Sollner, 2018; Wollny, 2021; Lorenzo, 2013). Research on the usage of chatbots in educational contexts involved designing for improving language speaking and listening skills (Hassani et al., 2016; Lin & Mubarak, 2021; Yang et al., 2022), vocabulary learning (Jeon, 2023), writing skills (Escalante et al., 2023, etc. Online chatbots could solve a variety of problems in education from a lack of time to shyness or limited opportunity for quality feedback in those learning contexts (Fryer et al., 2006). An open learner model showed the feasibility of using a chatbot to support negotiation and support students' reflection on their learning (Kerly et al., 2007). Chatbots as a learning artifact, together with time machines could help with the learners' sense of immersion and presence in learning English as a Foreign Language (EFL) (Wang et al., 2015).

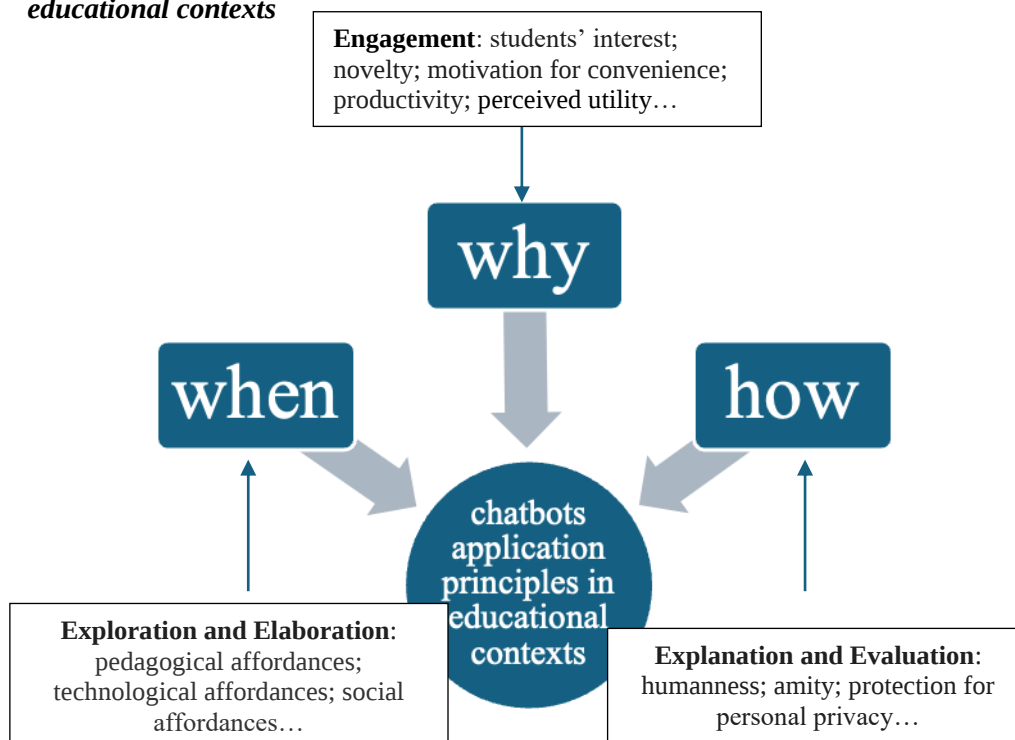
Chatbots have given plenty of help to learners. However, several studies suggested that human-chatbot interactions had their flaws in comparison with human-human interactions. Chatbot interactions often lacked vocabulary richness and displayed a higher degree of profanity (Hill, 2015). Compared with human partners, students' task interest in chatbots had an obvious decline in sustained learning courses (Fryer et al., 2017). The key factors influencing the utilization of chatbots for learning engagement and practice included students' preference for human conversation partners, their language proficiency, and the qualitative experience of having "gained more knowledge" through interacting with the chatbot (Fryer et al., 2019). Chen et al. proved that perceived usefulness was the predictor of students' intention with reference to the Technology Acceptance Model (TAM) (2020). We saw few researchers have discussed the application principles of chatbots in education.

Theoretical frameworks of chatbots application principles in educational contexts

Intelligent chatbots are auxiliary teaching technology and tools. In the actual process of education, we need to apply certain teaching models to give lessons. The widely used BSCS 5E Instructional Model, an exploratory teaching model, is student-centered and emphasizes active exploration, independent thinking, and in-depth learning by students (Joswick, C., & Hulings, M., 2024). The classroom teaching was segmented into five distinct phases: engagement, exploration, explanation, elaboration, and evaluation. Engagement was the starting point of the 5E instructional model to attract students' interest in learning tasks and stimulate their active exploration, that was the second stage. The third stage allowed students to

explain their understanding of concepts through their own cognition. Elaboration needed students to explain new situations or problems with new concepts. In the final stage, teachers' evaluation and peer evaluation was given to judge students' understanding and application of new knowledge through formal or informal methods. Bakri analyzed relevant literature on mathematics education and teaching in the past decade through literature research. The 5E instructional model has been found to have a promoting effect on mathematics education and teaching. Artun and Costu conducted an experimental study to explore the effectiveness of the 5E instructional model in English reading learning for middle school students. Through testing and analyzing the learning effectiveness of students, the study found that the use of the 5E instructional model in English reading teaching could improve the reading ability of middle school students (2013). The model was proposed based on traditional classroom teaching contexts. We took BSCS's 5 factors into account and reclassified them from the following perspectives: when, why, and how. In this study, we developed the model combining with artificial intelligent chatbots in current educational background, applying it as a frame of reference for analyzing the chatbot application principles in educational contexts.

Figure 1: A proposed theoretical framework of chatbot application principles in educational contexts



RESEARCH OBJECTIVES

1. To explore chatbot application principles in educational contexts from the perspective of teaching designs.
2. To conduct a bibliometric analysis through visualization and citation network analyses on the use of chatbots in education.
3. To identify key variables on chatbot application principle in the educational context.

RESEARCH QUESTIONS

1. Which keyword items, authors, organizations, and countries feature most prominently in studies on the use of chatbots in education?
2. What are the main contexts within education where chatbots are being applied?
3. What is the motivation for the application of chatbots in education?
4. What affordances can chatbots provide in an educational context?
5. How are chatbots applied to education?

RESEARCH METHODOLOGY**Literature Search and Results Analysis in WOS**

The related literatures were searched and downloaded from the Core Collection on Web of Science. The scope of sources was Science Citation Index Expanded (2013 to present), Social Sciences Citation Index (2006 to present), Arts & Humanities Citation Index (2008 to present), and Emerging Sources Citations Index (2017 to present), which were four high relevant research areas. The rest two in WOS, Current Chemical Reactions (1985 to present) and Index Chemicus (1993 to present), were excluded from the scope due to their irrelevance. The following search strategy was adopted: chatbot* OR chatgpt* OR conversational agent* (Topic) AND educat* OR teach* OR learn* OR writing* OR EFL OR ESL OR “English as a Second Language” OR “English as a Foreign Language” OR writing OR language class* OR speech OR spoken English OR oral English OR speak* (Topic) AND design* OR principle* OR strateg* OR pedagog* (Topic). From the “Analyze Results” on Web of Science, we could see year-based publication trend analysis, top categories as well as the most publication journals with remarkable clarity. Here, we gave the last 25 years publication trend as the limitation of this website.

Visualization and Citation Network Analysis

The literature searched from WOS was exported in the form of a full record and the cited references for visualization analysis and analyzed successively in two software of VOSviewer (Van Eck & Waltman, 2014) and CitNetExplorer (Van Eck & Waltman, 2010). We excluded the early-accessed publications due to the technological null point exception error in CitNetExplorer. VOSviewer had the

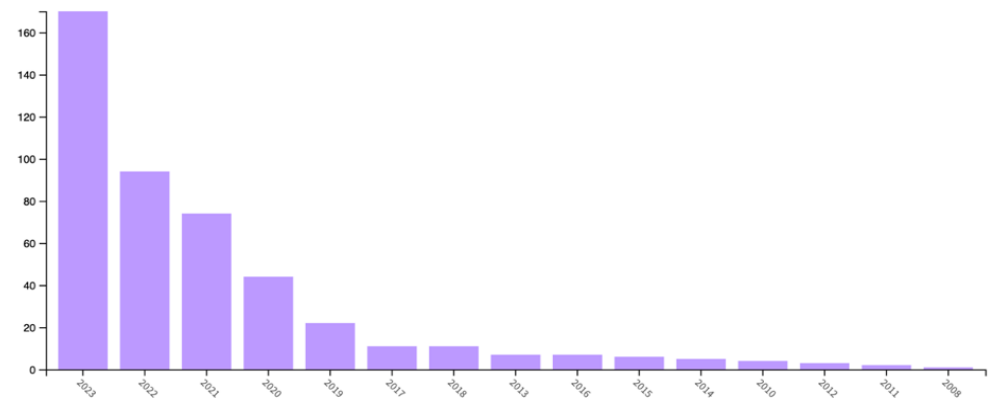
function of visualizing some basic information and connections of studies related to their authors, keywords, countries, and organizations. We searched for the most frequently occurring and highly cited items for each analytical category, while the software concurrently generated lists tallying citations and occurrences of authors, keywords, countries, and organizations. We compiled the 25 most prevalent keyword items based on their occurrences, as they effectively represent the prevalent issues and components of this topic. CitNetExplorer facilitated “clustering” analysis, grouping closely related studies within the same cluster.

DATA ANALYSIS

Literature Search Outcomes and Publication Tendencies

On November 15, 2023, we keyed topics and searched related literatures on WOS within the four research scopes. 520 publications were found, with 59 early-accessed papers included. Web of Science provided insights into the yearly publication trends for all these findings. As illustrated in Fig. 2, we chose to showcase the number of publications over the past 25 years, noting that studies prior to 2008 were too scarce to be included. At the time of data collection, 170 publications had been released this year, marking the current peak. The number of publications has doubled since approximately 2019. Subsequently, we delved into the Web of Science categories encompassing these results, identifying the ten most prolific categories as: Education Educational Research (N = 69, 14.967%), Computer Science Information Systems (N = 64, 13.883%), Computer Science Artificial Intelligence (N = 58, 12.581%), Health Care Sciences Services (N = 50, 10.846%), Medical Informatics (N = 42, 9.111%), Engineering Electrical Electronic (N = 35, 7.592%), Computer Science Cybernetics (N = 32, 6.941%), Computer Science Interdisciplinary Applications (N = 31, 6.725%), Physics Applied (N = 23, 4.989%), and Engineering Multidisciplinary (N = 22, 4.772%).

Fig 2: The trend in the number of yearly publications related to this topic



The top ten publication titles, i.e., journal names, were *JOURNAL OF MEDICAL INTERNET RESEARCH* (N=22, 4.772%), *APPLIED SCIENCES BASEL* (N= 15, 3.254%), *IEEE ACCESS* (N=11, 2.386%), *CUREUS JOURNAL OF MEDICAL SCIENCE* (N=10, 2.169%), *INTERNATIONAL JOURNAL OF HUMAN COMPUTER STUDIES* (N=10, 2.169%), *FRONTIERS IN PSYCHOLOGY* (N=8, 1.735%), *ELECTRONICS* (N=7, 1.518%), *HEALTHCARE* (N=7, 1.518%), *JOURNAL ON MULTIMODAL USER INTERFACES* (N=7, 1.518%), and *COMPUTER ASSISTED LANGUAGE LEARNING* (N=5, 1.085%). The relevant studies were widely dispersed across various journals, as evident from the low proportion of papers published in each individual journal.

Visualization Analysis and Most-Cited Items

VOSviewer visualized a total of 156 keyword items from the incorporated studies, and the top 25 keywords (along with their respective occurrences) were enumerated in Fig. 3.

Fig 3: Most-cited items by VOSviewer

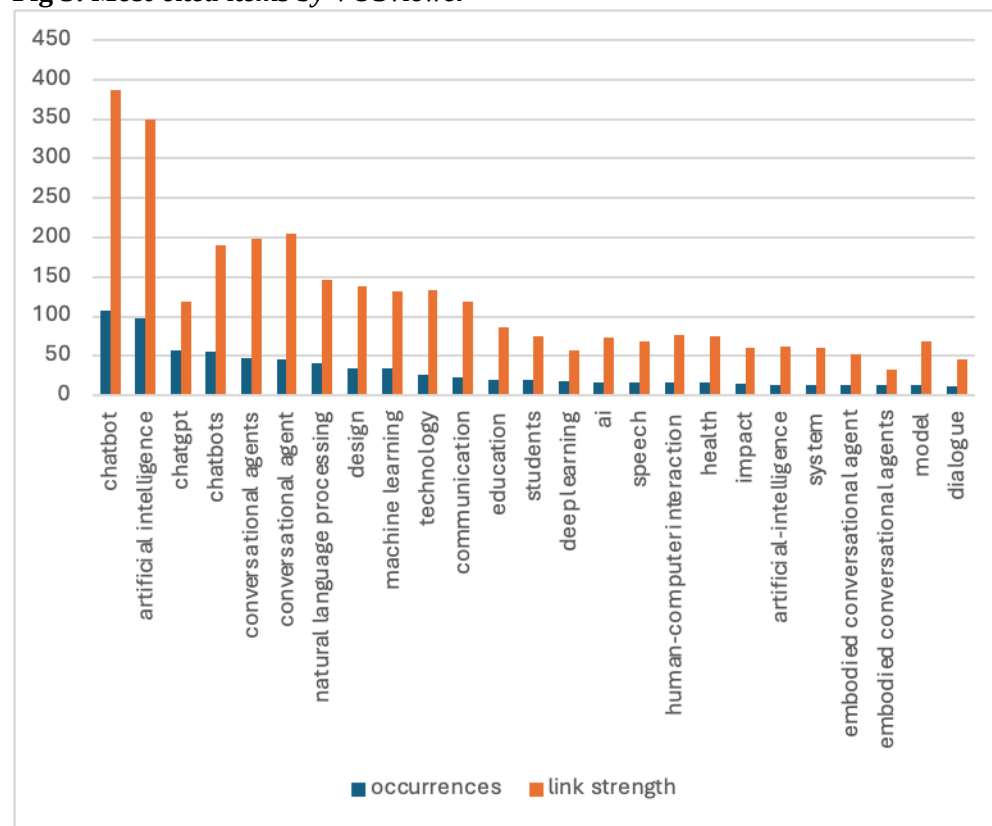
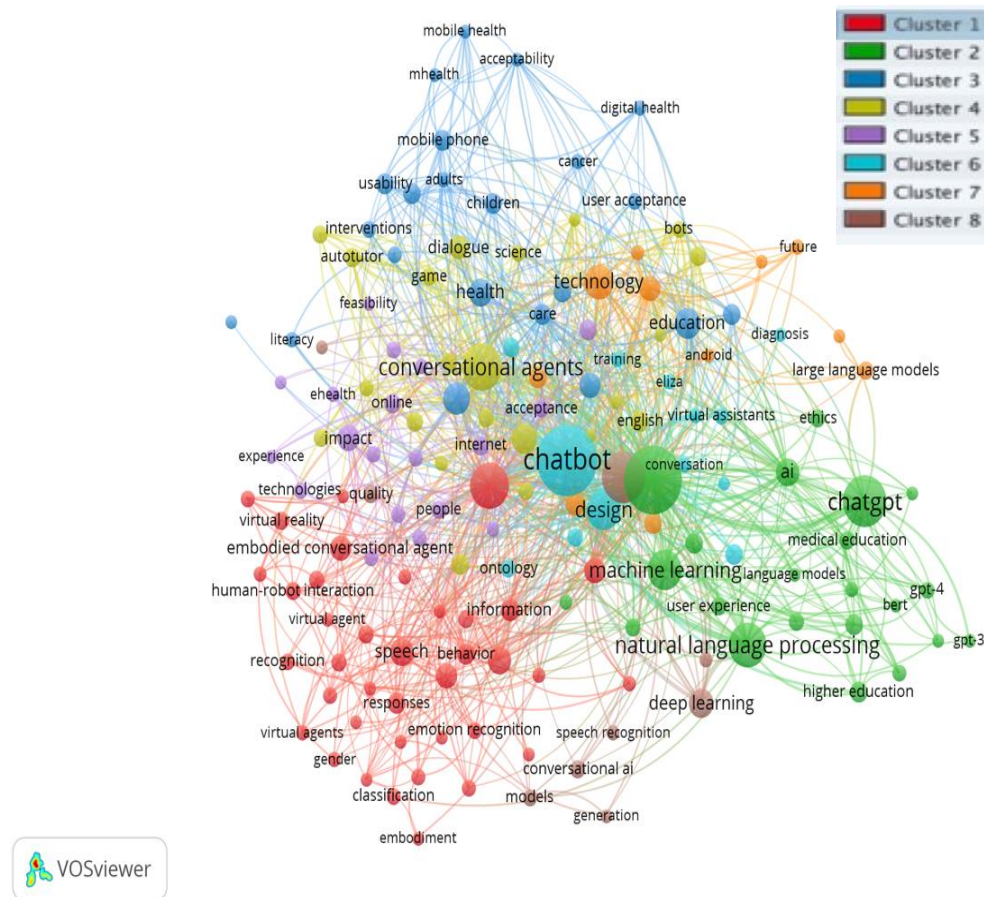


Fig 4: Keyword items clustering by VOSviewer

As shown by the distinct colors in Fig. 4, these keywords were organized into 8 clusters. Notably, cluster 6 (13 items, in cyan), cluster 2 (22 items, in green), and cluster 8 (9 items, in brown) occupied the central portion with larger nodes than the others, indicating a higher frequency of occurrence for these keyword items. Cluster 6 was characterized by keywords such as “chatbot”, “conversation”, and “design”. Cluster 2 was represented by “ai”, “chatgpt”, “language models” and “artificial intelligence”. Cluster 8 was represented by keywords such as “chatbots”, “deep learning”, “dialogue systems”, and “models”. Additionally, other prominent nodes signifying keyword items were “conversational agent” (cluster 1, in red), “communication” (cluster 3, in blue), “conversational agents” (cluster 4, in yellow), “impact” (cluster 5, in purple), and technology (cluster 7, in orange).

Furthermore, based on the citations of each item, we identified the ten most prominent authors, organizations, and countries in figure 5, 6, and 7.

Fig 5: The ten foremost authors created by VOSviewer

Name	Documents	Citations	Link Strength
Luke K. Fryer	4	216	2
Stefan Morana	2	188	0
Malik Sallam	3	173	10
Zoraida Callejas	8	153	11
Catherine Pelachaud	2	113	1
Dirk Heylen	2	108	2
Arthur C. Graesser	5	91	3
David Griol	9	84	12
Chloe Clavel	3	81	1
Khe Foon Hew	2	70	3

Fig 6: The ten foremost organizations created by VOSviewer

Organization	Documents	Citations	Link Strength
The University of Sydney	11	265	14
The University of Hong Kong	9	243	7
Technical University of Munich	4	208	2
Telecom ParisTech	4	189	3
The University of Jordan	4	181	3
University of Twente	7	178	4
Jordan University Hospital	3	173	3
Universidad de Granada	8	153	6
The University of Melbourne	5	127	2
Imperial College London	4	106	1

Fig 7: The ten foremost countries created by VOSviewer

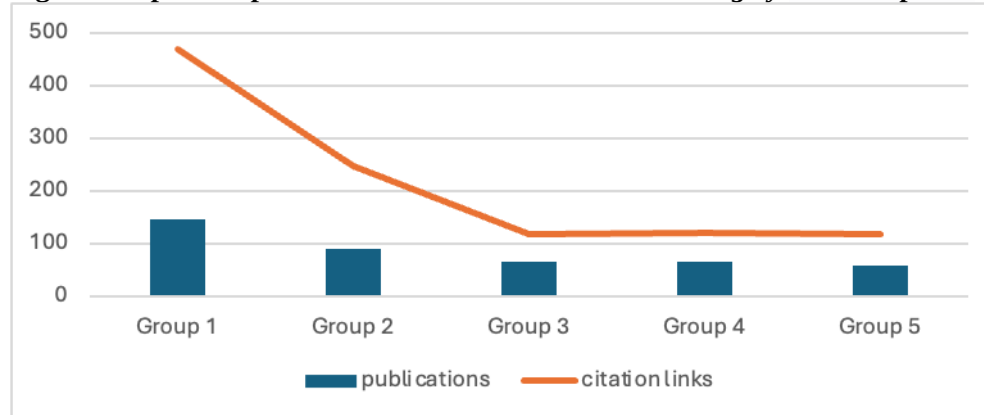
Organization	Documents	Citations	Link Strength
USA	97	838	63
Germany	28	684	34
People's Republic China	47	613	41
England	29	587	52
Australia	36	557	43
Netherlands	19	491	32
Spain	34	479	29
France	16	467	32
Switzerland	14	388	33
Singapore	11	339	26

Literature Clustering

Clustering Application Contexts in Education

To uncover the main application contexts of chatbots within education, we utilized CitNetExplorer to group the results. The clustering capability of the software relied on citation connections among the outcomes of the literature search. We included the publications totaling 529 with 1,372 citation links. The concrete results are shown in Fig. 8. Group 1 and Group 2 had the largest number of publications and citation links; Group 3 and Group 4 only had 2 publications with higher than 15 citation scores; Group 5 had 4 publications with higher than 15 citation scores. Given the significant volume of publications and citation connections, our analysis primarily concentrated on the first two groups.

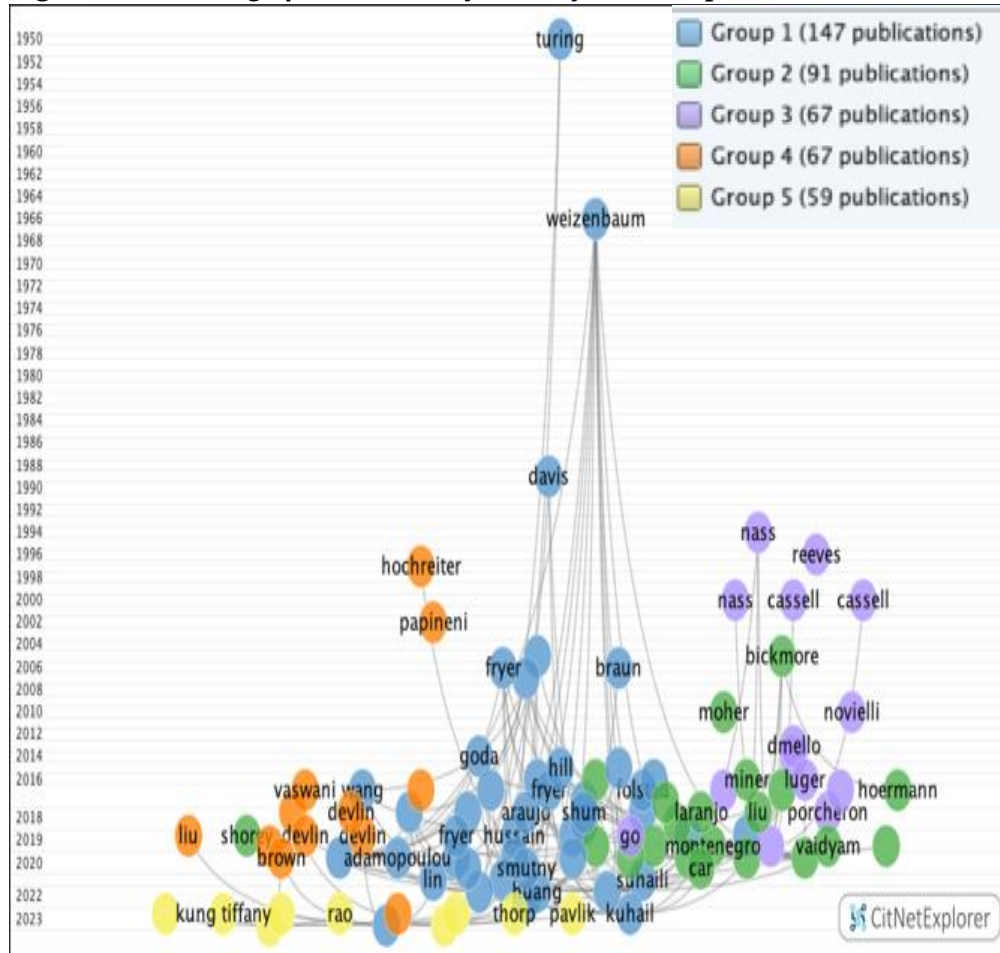
Fig 8: Group-based publications and citation links clustering by CitNetExplorer



The clustering outcomes of the literature highlighted two predominant usage contexts of chatbots in education: language learning and healthcare. Although there were some cross-disciplinary citations and potentially erroneous groupings by the software, every cluster showcased its dedication to distinct educational environments. According to the dominant research topics of the most cited and recent literature, we summarized the focus of each cluster. In cluster 1, studies fixed their focus on the contrast between human-human interactions and human-chatbot interactions (Hill, 2015; Fryer, 2019) as well as students' learning benefits and technology acceptance (Fryer et al., 2017). In addition, Nass et al. presented that users were easy to generate social responses to computers, and individuals' interactions with computers were fundamentally social (1994). Similarly, Go et al. concluded users' expectation for personal nature of chatbots could increase the frequency of interaction (2019). In a recent study, Hu et al. explored the interaction between human and acoustically emotion-aware conversational agents (CAs), getting the result that empathetic and emotional responses given by the CA could alleviate

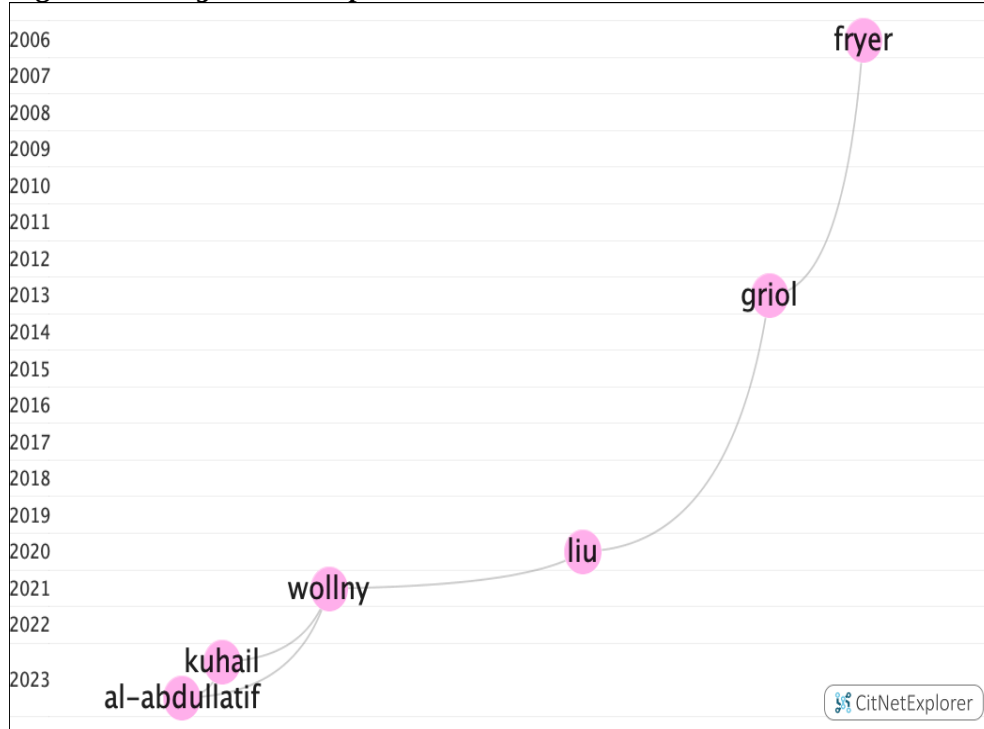
some participants' negative emotions (Hu et al., 2023). By contrast, cluster 2 had studies pertaining to various services of conversational agents in healthcare (Fitzpatrick et al., 2017), such as assisting patients and elderly individuals (Wolters et al., 2016).

Fig 9: The clustering of the literature yielded by CitNetExplorer

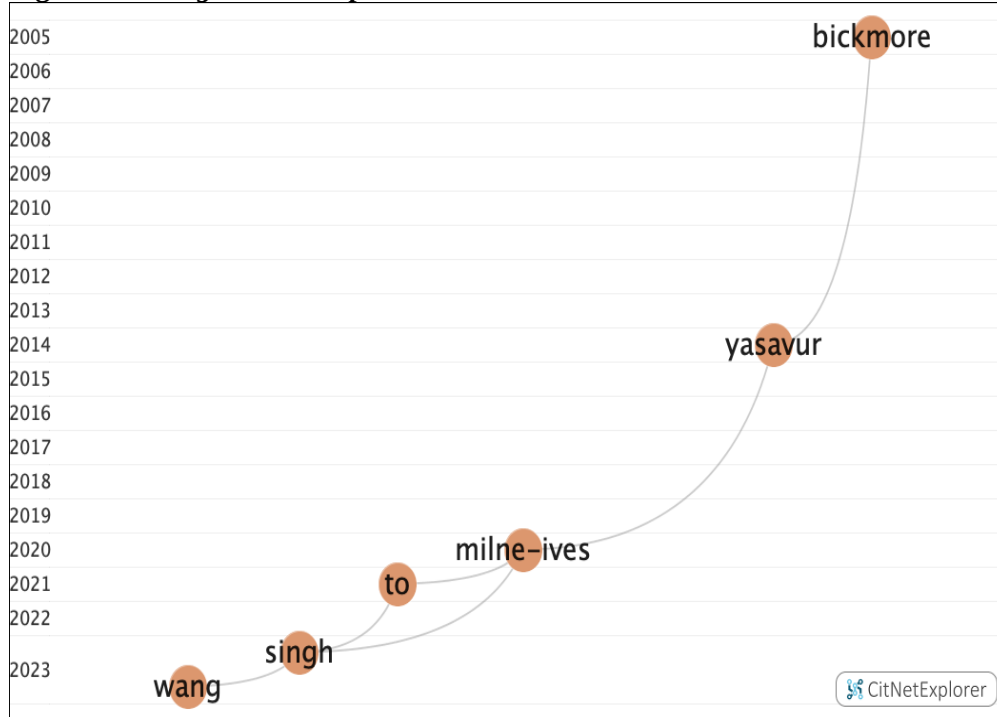


Recent Advancements in Chatbot

We traced the longest citation path in cluster 1. This was achieved by pinpointing one of the seminal works, namely Fryer and Carpenter's study from 2006, and following it through to a recent investigation by Al-abdullatif, published in 2023. Notably, this longest citation chain spanned five links. The longest path of citation length = 5.

Fig 10: The longest citation path in cluster 1

Along the longest citation path, Fryer and Carpenter suggested that chatbots could help students reduce shyness, making a great learning experience when involved in education (2006). Based on the advantages of chatbots in learning, Griol et al. provided a modular and scalable framework to develop educative chatbots, which was used to capture students' attention and stimulate their motivation for learning (2013). With the advances in mobile devices and conversational agents, there was an increasingly research on the design of chatbots for mobile learning. An agent-based conceptual architecture was designed and evaluated to develop a domain-specific chatbot for mobile learning (Liu et al., 2020). To delve deeper into the educational functions of chatbots, including their utilization as mentors and their capacity to tailor education to individual needs, Wollny et al. conducted a comprehensive review of the literature examining the various educational domains in which chatbots have been implemented (2021). Given the role of revolutionizing education, chatbots were analyzed from the following dimensions: the factors being considered to design educational chatbots, the different role of chatbots, styles for interaction, and limitations (Kuhail et al., 2023).

Fig 11: The longest citation path in cluster 2

For cluster 2, we also found one longest path of citation length = 5. As demonstrated in Fig. 4, Bickmore firstly employed some relational strategies that people use in face-to-face conversation to design, develop, and evaluate conversational agent that set up and keep a relationship with its users over time. The assessment revealed that maintaining a consistent engagement in a relational dialogue with a software agent can yield favorable effects on users' perceived connection with the agent. (2005). More and more studies on the design and application of chatbots were followed, such as conversational exchanges with smart virtual assistants in the healthcare domain. The positive results could be seen on task accomplishment, user-friendliness, and future intention to use the system (Yasavur, 2014). The growing capability and superior outcomes of conversational agents caused another review on the efficacy of AI-powered conversational agents in health care. Usability and satisfaction were tested to perform well (Milne-Ives et al., 2020). Apart from mental health, To et al. and Singh, et al. also proved health behavior change interventions of chatbots in physical activity, diet, and sleep (To et al., 2021; Singh et al., 2023). Due to the discovery of various research, Wang et al. discovered that an online intervention delivered via chatbot could enhance the acceptance of seasonal influenza vaccinations during the COVID-19 pandemic outbreak (Wang et al., 2023).

DISCUSSION

Publication Trends and Application Contexts of Chatbots in Language Education

Chatbots used in education have been a hot topic and developed rapidly in the past five years. The outbreak of COVID-19 was a turning point for chatbots' support in online learning during face-to-face class suspension (Kohnke, 2022). Concerning artificial intelligence chatbots, a good deal of researches on educational, technological, social, and psychological categories could be found (Lin et al., 2023). The subject on chatbots application principles in education still need to be explored and specified so as to find a suitable learning pattern for teachers and students. The finding was consistent with Hwang et al. (2021), the research on chatbots in education remained inadequate due to a scarcity of empirical investigations exploring effective learning designs or strategies in conjunction with chatbots. On the other hand, People's Republic China is the first three countries in this research area, with the representatives of the University of Hong Kong. Other organizations in China have insufficient research on chatbots application in education.

According to the clustering analysis, current studies on chatbots have been concentrated on language learning and healthcare. These application contexts showed the service function in language education, medical training, and educational information counselling (Lin & Yu, 2023). The longest path analysis of cluster 1 demonstrated a quick developmental path from discovery of advantages to explore the design of chatbots and analyzing the roles and purposes in language learning. Korsakova et al. proved chatbots could help students do preparation for examinations (2022). Casillo et al., designed HeriBot, an innovative chatbot-based system to support experiential tourism (2022). In cluster 2, we found a series of studies on the design strategies used to develop chatbots to facilitate the users' experience. Babington-Ashaye et al., designed an AI chatbot to help people with Haemophilia improve education and self-management in Senegal (2023).

Based on the above discussion, there is a lack of research on teaching and learning application principles of chatbots in education. The results obtained from keywords about "design", "principle", "strategy" and "pedagogy" are almost around the design of chatbots, rather than the using model or application principle in the process of education.

Motivation for the application of chatbots in education

Implementing chatbots in education aims to increase motivation, which is consistent with the result analysis in cluster 1. This answers one dimension in the framework of application principles, that is why we apply intelligent chatbots to education. Wollny et al., conclude that using chatbots in education can be divided into following

categories: skill improvement, efficiency of education, and students' motivation (Wollny et al., 2021). The frequent motivations for chatbot users are considered to be productivity, entertainment, social factors, and contact with novelty (Adamopoulou & Moussiades, 2020). This present study formulates and validates new scales for two key variables: perceived usefulness and perceived ease of use, postulated as fundamental factors influencing user acceptance (Davis, 1989). Chocarro et al., elucidates teachers' acceptance of chatbots through the lenses of the Technology Acceptance Model, its conversational design (incorporating the use of social language and proactiveness), as well as teachers' age and digital proficiency (2021). Regarding chatbots' features, the use of formal language by a chatbot enhances the intention to use them. These findings can guide chatbot design and communication decisions, fostering greater acceptance within the educational community (Chocarro et al., 2021).

Affordances of chatbots in education

Reflecting on when to use chatbots in language education, we need to identify affordances that chatbots can provide. The concept of affordance, originally coined by Gibson in 1986, refers to the potential actions that arise from the interaction between an individual and their surroundings. Later, different scholars have tailored the notion of affordance to fit their specific contexts. In the realm of language acquisition, experts have employed this term to denote the inherent opportunities for language learning present within a given learning setting. Chen also emphasized that the affordance perspective shed light on the more effective design of new technology (2020). To use chatbots properly and effectively, the presence of pedagogical, technological, and social affordances provided by chatbots should be taken into account (Jeon, 2022). When students are shy, embarrassed by a mistake, or feel pressure by a human partner, we may use chatbots to facilitate their learning.

Considerations for Chatbots Applied to Education

This is another dimension for the application principles model, that is how to apply chatbots to education. We can draw inspiration by summarizing the findings in the result. Chatbots should be constructed in such a manner that they simultaneously function as tools, toys, and friends (Brandtzaeg & Følstad, 2017). Nowadays, chatbots are perceived as mere assistants and established as amiable companions (Ferreira da Costa, 2018). The allure of social chatbots stems not just from their responsiveness to a wide range of user requests but also from their ability to forge an emotional bond with users (Shum, 2018). Nass examines a slew of experimental studies that underscore how individuals unconsciously apply social norms and anticipations to computers (2000). Go advocates for humanizing chatbots, arguing that identifying the agent as human elevates user expectations for interactivity (2019).

Furthermore, as artificial communication systems, chatbots are gaining increasing popularity, yet not all security concerns related to them have been unequivocally addressed. The level of trust a chatbot garners from its usage is contingent upon privacy and protection issues. Nevertheless, this widespread adoption poses additional security risks and gives rise to significant security challenges that must be tackled (Hasal et al., 2021). All those factors need to be considered when we think of how to apply chatbots to education. With the support of powerful technology and their strengths in education, artificial intelligence chatbots receive rising academic attention. By performing visualization and citation network analyses on this subject, this bibliometric analysis arrives at the following conclusions.

First, the application of chatbots in education is a growing research topic due to the support of technology and its advantages and strengths in education in recent 5 years. Second, the hot issues on this topic include strategies for designing chatbots, users' expectation, comparison between human and chatbot partners, affordance, and motivations. Third, current results on this topic are mainly about the design of framing chatbots, and there is a lack of design on chatbots application principles in education. This provides a solid foundation for following researchers to carry out the empirical study on educational design.

We must recognize that this investigation has certain constraints. Firstly, the literature review was centered on the core collection of the Web of Science, excluding some relevant research. Secondly, only English-language studies were encompassed in this bibliometric analysis, while studies conducted in other languages remained unaccounted for. Finally, the research model proposed by the authors are incomprehensive to cover all relevant factors pertaining to application principles. Nevertheless, this inquiry aimed to underscore its research significance by outlining crucial design considerations for such applications from a linguistic educational standpoint.

RECOMMENDATIONS

Our results hold potential theoretical and applied significance for subsequent studies. Theoretically, future studies are needed to address and explore the teaching model about chatbots application in education whereby variables related to motivation, relationship between human and chatbots, expectations for chatbots, etc. Besides, it could give rise to the development of teaching and learning theories to enable a better education.

This study also has some applied implications. In this study, the findings are mainly English education in the use of chatbots, other languages teaching and learning, such as Chinese, are rarely discussed and researched. It may encourage researchers and

instructors to adapt chatbots to various language teaching. The exploration of chatbots application principles will promote the change of teaching practice to improve learning outcomes.

CONFLICT OF INTEREST

This study extends Lin and Yu's (2023) review entitled "A Bibliometric Analysis of Artificial Intelligence Chatbots in Educational Contexts". I have obtained substantial assistance from the authors, while this article contains no conflict of interest related to its content and authorship.

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