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AI-Driven Chatbot Applications in Language Learning Environments: A Bibliographic Review

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Abstract

There is an abundance of intelligent teaching systems and language-learning support platforms as a result of the quick advances in artificial intelligence (AI), especially in the fields of machine learning and natural language processing (NLP). There has been a lot of interest in the potential for AI-driven chatbots, which include a range of sophisticated AI capabilities, to provide individualized and engaging language learning experiences. Conducting a bibliometric study of publications from 2004 to 2024 using the Scopus database is the aim of this research project in order to evaluate the current state of the art and emerging trends in AI applications inside chatbots. The three primary contributions of the study are as follows: (i) a comprehensive review of the literature on AI-based chatbot applications, with a focus on the leading countries, publications, and authors in the field; (ii) a theme analysis of chatbot deployment and application-related trends; and (iii) strategic recommendations for future directions in chatbot research. Researchers, teachers, tech developers, legislators, and other stakeholders interested in the application of AI chatbots in language learning environments will find great value in the study's findings.

Keywords: Artificial Intelligence, Chatbot, Natural Language Processing(NLP)
JEL Code:

Introduction

There has been an explosion of language-learning and intelligent teaching systems support platforms due to the quick advances in artificial intelligence (AI), especially in the area of machine learning and natural language processing (NLP). AI-driven chatbots, in particular, have emerged as a notable technological innovation in this area, offering significant potential to transform the landscape of language education (Michael et al., 2023). There has been ample interest in the futurel for AI-driven chatbots, which include a range of sophisticated AI capabilities, to provide individualised and engaging language learning experiences. As conversational agents, these chatbots provide dynamic, turn-by-turn exchanges that actively include consumers in insightful conversations(Gua et al., 2022). Since the release of Open AI's Chat GPT in November 2022, educators and other professionals have been more aware of the possibilities for AI-powered learning tools to improve language instruction in the post-COVID-19 e-learning environment (Caldarini et al., 2022).

According to some studies there are basically two types of chatbot we use in day to day life (Mnasri, 2019). The first type is known as transactional chatbots, or task-oriented chatbots. These chatbots are designed with a singular focus: to perform or automate specific functions. They primarily rely on predefined rules, natural language processing (NLP), and a minimal integration of machine learning (ML) (Hiristidis, 2018). Training was provided on structured data, transactional chatbots are built to offer users a predefined choice, guiding them to complete tasks or resolve specific issues efficiently (L. Xu et al., 2019). The transactional chatbot provides more options once the user selects one, assisting them throughout the process until the problem is completely fixed. In contrast, the second type of chatbot, known as the conversational chatbot, represents a more advanced and interactive AI system tailored for personalized interactions. These chatbots employ conversational AI to accurately interpret the intent behind user inputs and deliver responses that mimic human communication. The underlying system architectures of both transactional and conversational chatbots follow a similar sequence of processes, generally categorized into three main stages: pre-processing, processing, and response generation

(F. Mctear & Callejas, 2016). Conversational chatbots are distinguished by their context-awareness and growing sophistication, as they integrate natural language understanding (NLU), natural language processing (NLP), and machine learning (ML) to continually improve their capabilities(Maroengist et al., 2019). Key technologies driving chatbot development include AI and data (Lin et al., 2020). While AI and data have significantly contributed to the development of chatbots, they also impose certain limitations. AI excels at automating monotonous and repetitive tasks, making chatbots particularly effective in handling such functions. However, when the volume of incoming requests exceeds manageable levels or tasks become overly complex, chatbots may struggle to respond effectively. This can lead to inefficiencies and potentially adverse outcomes for both businesses and customers(B. Xu & Zhuang, 2020).

The research objective is to conduct a bibliometric analysis of papers from the Scopus database, spanning the years 2004 to 2024, to evaluate the most recent advancements and state of the art in AI applications inside chatbots. The study makes three main contributions: (i) a thorough analysis of the literature on AI-based chatbots, emphasising the most important nations, publications, and authors in the field; (ii) a thorough examination of thematic trends pertaining to the deployment and application of chatbots; and (iii) strategic suggestions for future avenues of inquiry into chatbot development. The outcome of this study will give academics a comprehensive grasp of the state of the field and the most recent developments in AI-driven chatbots, laying a solid platform for more research in this area.

The structure of this article will be presented as follows: First, we offer a thorough review of the existing literature on the application of AI chatbots in language education. Next, we detail the bibliometric research methods applied for literature grouping and visualization. Finally, we assess the data to address the research questions and explore the larger implications of this study for future research and practice. The insights gained from this comprehensive bibliometric analysis are anticipated to be of significant value to researchers, educators, technology developers, policymakers, and other stakeholders with an interest in the integration of AI chatbots within language education settings.

1. Literature Review

Human-Computer Interaction (HCI) concepts are added to the theoretical framework of this study report, which is based on two learning theories: constructivism and connectivism. A comprehensive grasp of the learning processes involved, how learners interact with AI chatbots, and the crucial design factors for creating successful chatbot models are made possible by this multidisciplinary approach. Connectivism, in particular, is a learning paradigm that has been modified for the digital age. (Simenes, 2005). According to connectivism, learning is the process of making connections—often via the use of technology—between various information sources. When applied to AI chatbots, which may adjust to students' ability levels, give prompt feedback, and promote student autonomy and self-correction, it emphasises the value of networked learning and the critical role that technology plays in supporting dynamic language exchanges.. In language instruction, these exchanges improve the connectivist learning process. Contrarily, constructivism asserts that learning is a dynamic, fruitful process in which pupils build new knowledge on top of their existing knowledge (Bereiter, 1994). Constructivism promotes the creation of AI chatbots that provide interactive, hands-on learning opportunities by highlighting the importance of experiences and reflection in the learning process. These chances could involve having meaningful conversations with students and putting them in circumstances where they have to solve problems in order to actively create their language knowledge (Tam, 2000). In the meantime, Human-Computer Interaction (HCI) offers fundamental guidelines for developing efficient, approachable, and captivating computer systems. It concentrates on the design and application of computer technology (Dix, 2004).These guidelines can be used to create chatbot models that have a thorough awareness of user requirements, preferences, and behaviours, improving language learning experiences in general.

Businesses are realising more and more that implementing AI technologies may significantly improve consumer interactions and present a big revenue opportunity. The widespread deployment of chatbots is proving advantageous across various industries, offering companies the potential to deliver personalized services to a diverse customer base (Fadhil & Gabrielli, 2017). AI chatbots are used by online retailers in the e-commerce and retail industries as customer support representatives to provide product details, provide tailored recommendations, and handle order and return requests (Tran et al., 2021). Chatbots are intelligent agents that banks and credit unions use to answer consumer questions, give account balances and billing details, streamline simple transactions, and give advice on investments and savings (Kulkarni et al., n.d.). Likewise, chatbots in clinics and hospitals can be used to book appointments, give medication information, and direct people to the closest medical facility (Lokman & Zain, 2007). Chatbots function as virtual agents and advisors in the insurance sector, handling mundane activities like claim processing and status updates while freeing up employees to handle more difficult assignments (Nuruzzaman & Hussain, 2020). Furthermore, chatbots can help factories with activities including managing suppliers, teamwork, workplace upkeep, product recalls, and HR duties (J. Chen et al., 2021). As a result, AI-driven chatbots provide significant returns on investment with little work, freeing up human workers to focus on more important client engagements (Pakanati et al., 2020).

2. Methods

A research work's literature review is one of its most crucial components. Its goal is to map and evaluate pertinent material in order to pinpoint potential research gaps that could be filled to advance the body of knowledge (Tranfield et al., 2003). Bibliometric analysis is one of the most often used methods for assessing literature reviews, which has recently gained popularity as a standard tool for research management and scientific policy (Daim et al., 2006). Publication and citation data, together with other more advanced bibliometric methodologies, are crucial to all major difficulties of science indices (Dix, 2004). Bibliometric analysis was used in this work to provide a comprehensive overview of AI based applications in chatbots**.**

3.1 Database and Search Strategy

Papers with a period frame of 2004–2024 that particularly addressed AI-based chatbots were the focus of our investigation. These papers were found using a search on Scopus, an online scientific citation indexing site that requires a subscription and offers a thorough citation search. Additionally, each document has to export complete records and references for bibliometric analysis, and Scopus offers strong data support technology. As a result, Scopus was chosen as the original data source database. Chatbot and AI were the query terms that were used. As seen in Table 1, several deformations were created using these two keywords. We made an effort to completely capture the characteristics of both an AI application and a chatbot while choosing keywords.

Chatbot	AI
"chatbot*" OR "chat bot*" OR "virtual assistant*" OR chatterbot* OR "conversational agent*" OR "natural language interface*" OR talk bot* OR "talk bot*"	"AI OR "artificial intelligence" OR "machine learning" OR "natural language processing" OR "knowledge representation" OR "computer vision" OR "automated reasoning" OR "neural networks"

Table 1 : Search Terms

2.2 Filtering Search Results

We utilized the Scopus database to gather articles. Using a topic query, the aforementioned terms were looked up in advanced search. There were 12093 items found in the first search.
The outcomes were then stored in TXT format and accommodate all pertinent article data, such as the affiliations, keywords, references, source, abstract, title, and names of the writers.

2.3 Refining Search Results

A time filter, which covers the years 2004 through 2024, was applied to further refine the search results. After that, "articles" were chosen as the source data for the analysis that followed. For additional analysis, only English was allowed. To manually review and eliminate incomplete elements from entire records, Microsoft Excel 2016 was used. After using the aforementioned retrieval and filtering technique, 1320 documents were eventually found. Additionally, subjects in business, management, accounting, social science, and the arts and humanities are chosen.

2.4 Data Processing Procedure

Olle Persson created BibExcel, a flexible set of bibliometric tools. BibExcel can perform nearly all bibliometric analysis and is strong and flexible enough to handle the initial data in several forms (Persson et al., 2009). For each manuscript, all relevant bibliographic data has been put into BibExcel in RIS format. In our study, we primarily pay attention to the author details, title, journal, publication year, keywords, affiliations, and references.

In the beginning of 2004, Cite space software was designed by Professor Chaomei Chen. Its definitions cover co-citation networks of cited authors, cited references, and cited journals in addition to co-occurrence network maps of authors, keywords, institutions, nations, and subject categories. (LiuZhigao et al., 2015). It focuses on identifying turning and key points, particularly intellectual ones, in the evolution of a topic or domain. In addition, Cite space offers a number of features that make it easier to comprehend and analyse historical patterns as well as network patterns. These features include the ability to pinpoint rapidly expanding topics, locate publication hotspots, break down a network into clusters,

and automatically label clusters with terms from cited articles (C. Chen, 2004). The data that is entered into Cite space is in TXT format. After selecting the type of information to cluster (author, keywords, and references), we may view complete records and cited references. In this article, the bibliometric analysis was mostly conducted using BibExcel and Cite space, with the usage of Excel where needed.

Region	Freq.
USA	1173
CHINA	560
INDIA	388
UK	347
AUSTRALIA	200
SOUTH KOREA	189
GERMANY	160
ITALY	160
SPAIN	149
CANADA	105

Table 2: Top ten contributing Countries

3. Bibliometric Results

4.1AI Chatbot Evolution

To track the development of AI application in chatbots, the saved text file was opened in BibExcel, converted to ".doc" format for recognition, and then sorted by year and nation. The table presents the regional distribution of publications in a bibliometric analysis. The USA dominates with 1,173 publications, followed by China (560) and India (388), highlighting their leading roles in research output. The UK, Australia, and South Korea contribute moderately, while Germany, Italy, and Spain show notable but lower output. Canada has the least representation with 105 publications. This reflects a concentration of research activity in North America, Asia, and select European regions. Fig. 1 depicts that China and the United States are the top two countries in terms of papers published, but other nations are also contributing to the increasing trend, especially after 2020. This upsurge may be related to newly popular subjects or world events that have sparked interest in study recently.

3.2 Journals and Authors

Using BibExcel, the author, institute, and journal influence was examined. The relevant fields related to author, institute, and journal were extracted from the RIS data file. It was noted how frequently these materials surfaced.

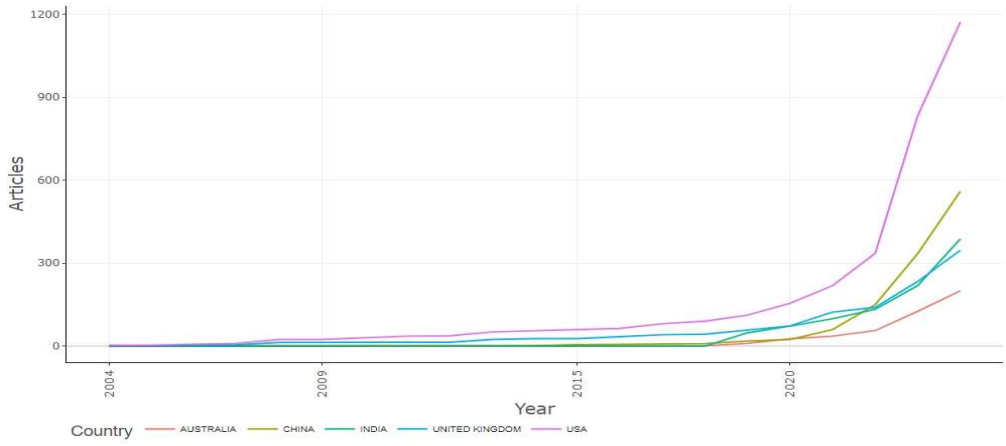

Fig. 1 Country wise Productivity

Table 3 displays the total number of articles as well as the top 10 contributing journals. By examining the journals' performance, we may ascertain which one has published the most papers and attracted the most attention. The distribution

of articles published in different scholarly journals is shown in the table. The "International Journal of Human-Computer Interaction" contributed the most articles (39), suggesting a strong emphasis on this area of study. With 32 papers, "Education and Information Technologies" follows, demonstrating a keen interest in the field's current research at the nexus of education and technology. As a reflection of the shifting objectives of academia in tackling technological and societal developments, this distribution of publications implies that current research trends highlight human-computer interaction, AI's impact on education and society, and sustainability.

Sources	Articles
INTERNATIONAL JOURNAL OF HUMAN-COMPUTER INTERACTION	39
EDUCATION AND INFORMATION TECHNOLOGIES	32
JOURNAL OF RETAILING AND CONSUMER SERVICES	25
COMPUTERS IN HUMAN BEHAVIOR	23
AI AND SOCIETY	21
JMIR MEDICAL EDUCATION	21
COMPUTERS AND EDUCATION: ARTIFICIAL INTELLIGENCE	20
PROCEEDINGS OF THE ACM ON HUMAN-COMPUTER INTERACTION	20
SUSTAINABILITY (SWITZERLAND)	20
JOURNAL OF BUSINESS RESEARCH	16

Table 3. Top 10 Contributing Journal.

In Table 4 top referenced references across all 1599 publications. Including their Digital Object Identifiers (DOIs), total citations, and citations per year (TC per year), the table lists highly cited academic works. With 1,163 citations and an impressive citation rate of 581.50 per year, Dwivedi et al. (2023) in the International Journal of Information Management is in the lead. The JMIR Medical Education article by Gilson et al. (2023) comes next with 699 citations and a TC per year of 349.50. Other noteworthy works with high citation counts and TC per year rates are Luo (2019) in Marketing Science and Hill (2015) in Computers in Human Behavior. This information showcases important studies conducted in domains like marketing, human behaviour, information management, and education.

Paper	DOI	Total Citations	TC per Year
DWIVEDI YK, 2023, INT J INF MANAGE	10.1016/j.ijinfomgt.2023.102642	1163	581.50
GILSON A, 2023, JMIR MED EDUC	10.2196/45312	699	349.50
LUO X, 2019, MARK SCI	10.1287/mksc.2019.1192	548	91.33
HILL J, 2015, COMPUT HUM BEHAV	10.1016/j.chb.2015.02.026	518	51.80
TLILI A, 2023, SMART LEARN ENVIRON	10.1186/s40561-023-00237-x	503	251.50
RUDOLPH J, 2023, J APPL LEARN TEACH-a	10.37074/jalt.2023.6.1.9	497	248.50
ADAM M, 2021, ELECTRON MARK	10.1007/s12525-020-00414-7	433	108.25
HOYER WD, 2020, J INTERACT MARK	10.1016/j.intmar.2020.04.001	429	85.80
ASHFAQ M, 2020, TELEMATICS INF	10.1016/j.tele.2020.101473	413	82.60
PUNTONI S, 2021, J MARK	10.1177/0022242920953847	388	97.00

Table 4. Highly Referenced Authors

The number of publications and top-performing institutes are displayed in Table 5. The University of Hong Kong leads the pack with 32 publications published among the universities shown in the table. Sungkyunkwan University (29 articles) and The University of Florida (31 articles) come next. With 22 publications, Monash University is ranked fourth, while the Chinese University of Hong Kong, University of California, and Queensland University of Technology are tied for second place with 20 articles each.

Affiliation	Articles
THE UNIVERSITY OF HONG KONG	32
UNIVERSITY OF FLORIDA	31
SUNGKYUNKWAN UNIVERSITY	29
MONASH UNIVERSITY	22
QUEENSLAND UNIVERSITY OF TECHNOLOGY	20
THE CHINESE UNIVERSITY OF HONG KONG	20
UNIVERSITY OF CALIFORNIA	20
UNIVERSITY OF CENTRAL FLORIDA	19
HAINAN UNIVERSITY	18
NANYANG TECHNOLOGICAL UNIVERSITY	18

Table 5. Top ten Contributing institutes

The top 10 contributing authors are shown in Table 6. With 16 publications, LEE S has garnered much more attention than other authors, far surpassing their contributions, according to an examination of the most prolific writers in terms of publishing output. This suggests that LEE S plays a prominent position in the field of research. JEON J, LI Y, WANG X, and ZHANG Y are among the nine authors in the cluster, which suggests a highly competitive group of influential researchers.

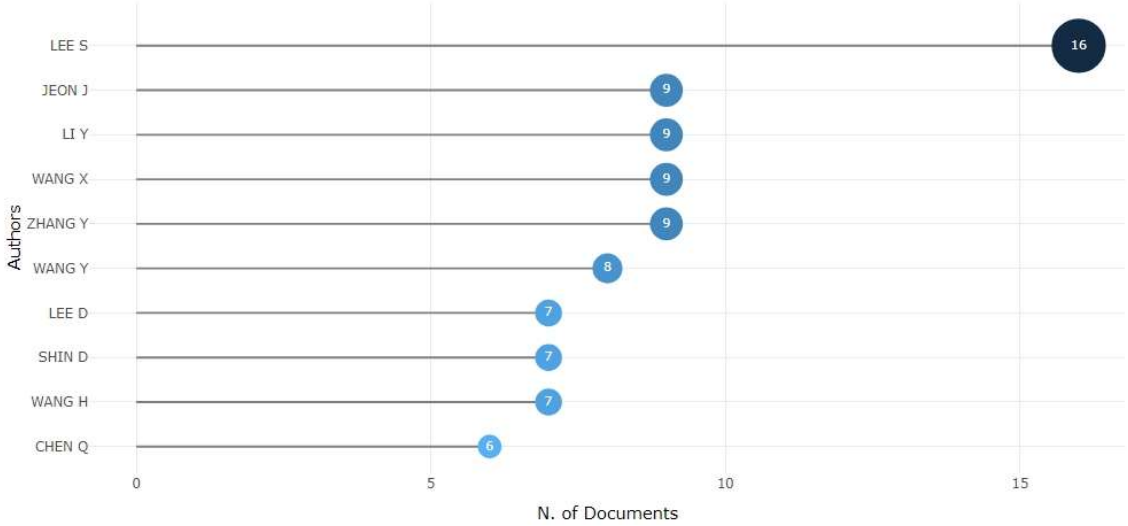

Table 6. Top ten contributing Authors

3.3 Keywords Analysis

Table 7 underwent a similar analysis to try and determine which words were most frequently used in the article titles. It shows that the majority of the terms in the list correspond to the search terms we selected for this investigation. It should be mentioned that certain new terms have been added to the list, like user and human, indicating the importance of user-related study in chatbot research.

Words	Occurrences
artificial intelligence	279
chatbots	249
natural language processing systems	108
conversational agents	83
students	66
chatgpt	64
human	60
humans	47
human computer interaction	44
learning systems	38

Table 6. Mostly used keywords

3.4 Co- citation Analysis

To examine the frequency of citation on a certain publication, citation analysis is carried out (Garfield, 1972). A scientific journal's total number of citations reveals its importance in that field of study. The frequency with which two documents are mentioned jointly by other documents is known as co-citation (Small, 1978). Two documents are deemed co-cited if they are cited in at least one additional document. Two papers' co-citation strength increases with the number of co-citations they receive, increasing the likelihood that they are semantically connected (Small, 1978). To provide light on the linkages between these categories, co-citation analysis looks at the relationships between authorship, subjects, journals, or keywords (C. Chen, 2005). We are able to determine which literature is closely related by using reference co-citation analysis. The definition of intimate link is that the literature frequently appears together in later published multiple works of literature, implying that it is frequently cited alongside the cited references. They share a common citation style and are of similar substance.

As a result, articles that regularly appear together in references will have higher co-citation strengths. VOS viewer is a popular tool for visualizing bibliometric networks, such as co-authorship, co-occurrence, or citation networks. The program makes it possible to see relationships between terms or keywords that are taken from scholarly papers graphically. This VOS viewer visualization shows a co-occurrence network of keywords related to artificial intelligence (AI) and chatbots. The nodes for AI and Chatbots are at the centre of the network, indicating that these are the most frequently occurring and related topics in the field. Notable subfields that represent current technological trends include ChatGPT, Conversational Agents, and Natural Language Processing (NLP). Fig. 2 shows a strong connection between AI and applications like virtual assistants, education, and human-computer interaction, indicating a wide range of applications. Furthermore, keywords like Trust, Sentiment Analysis, and Customer Satisfaction indicate a focus on the efficacy of these technologies in user-centered applications. The network is separated into clusters, each of which represents a distinct thematic area within AI research, such as customer service or educational technology.

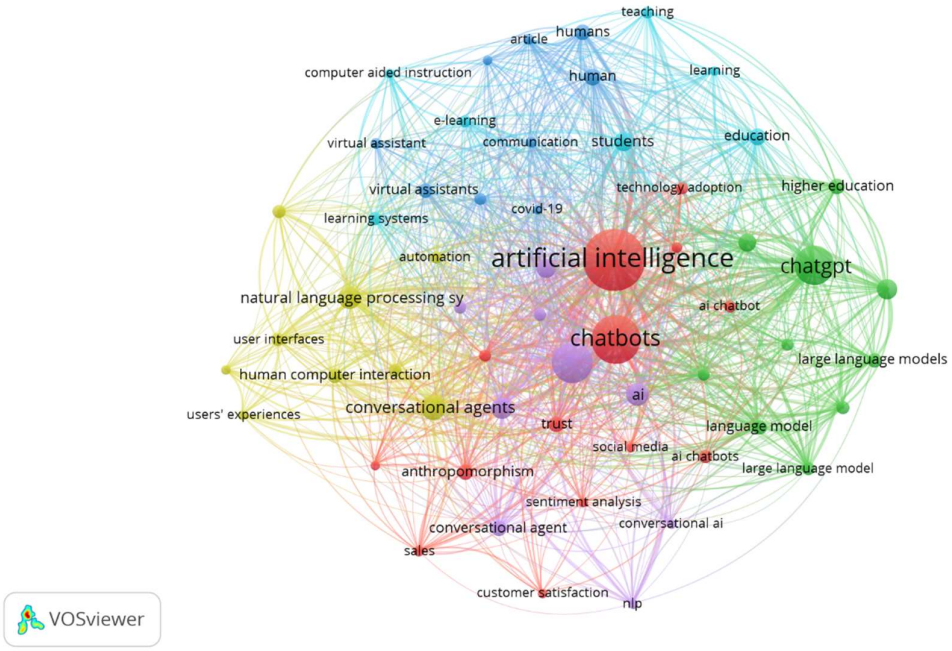

Fig. 2 Keyword Analysis

3.5 Co-authorship network

Co-authorship network in which authors are represented by nodes (circles) and collaboration ties are shown by linkages between them. A co-authorship network is depicted in the VOS viewer visualization, with each node representing an author and the links between nodes signifying collaborative affiliations in publications. Each node's size indicates how important the author is in terms of citations or publications. In Fig. 3 time dimension is shown by the colour gradient from dark blue to yellow, where blue denotes earlier studies (2020) and yellow more recent partnerships (2024). Strong collaborative networks are indicated by clusters of authors grouped tightly together, such as Ali M.Y., Naeem S.B., and Bhatti R. Conversely, authors clustered farther apart, like Jones V.K. and Jeon J., may represent distinct research groups with less shared relationships. This network identifies important contributions to the study domain that is shown, as well as historical and contemporary cooperation trends.

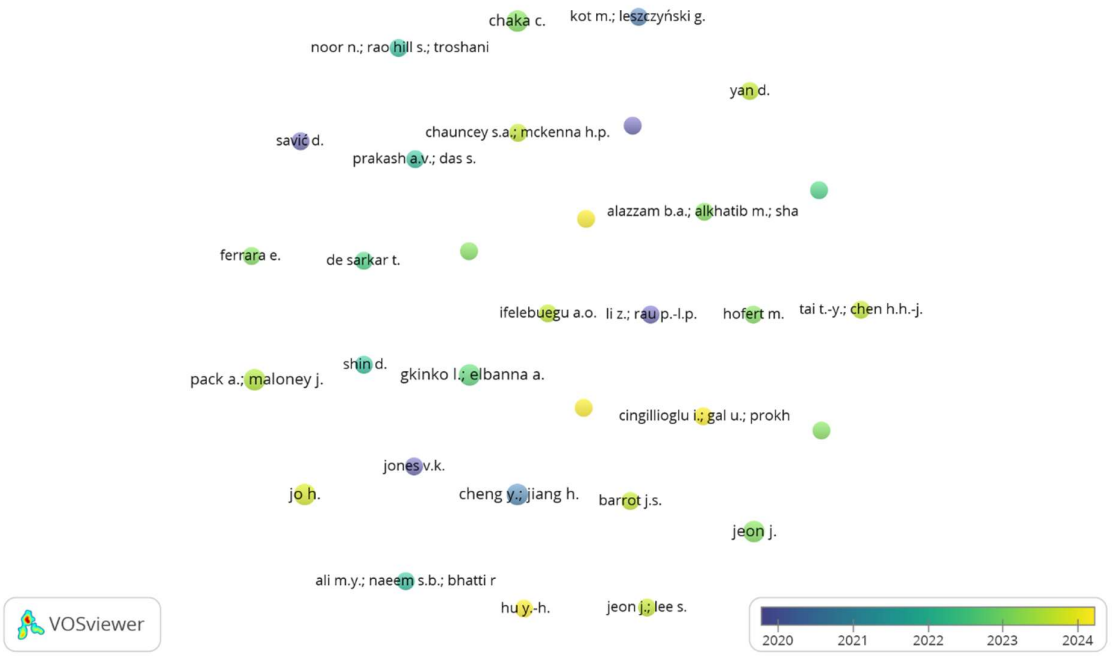

Fig. 3 Co- authorship network

3.6 Thematic Analysis

Thematic analysis is a method for locating, analysing, and interpreting patterns, or themes, in qualitative data. In Fig. 4 following themes are found. Motor Themes (Top-Right Quadrant): In the research domain, highly developed and key themes are crucial, such as natural language processing systems and learning systems. Basic topics (Bottom-Right Quadrant): Even if they are fundamental and developing, less advanced subjects like conversational agents and chatbots still require development.

Niche Themes (Top-Left Quadrant): These well-developed yet stand-alone themes, such as "human" and "article," are less essential to the overall domain and more specialized. Themes in the Bottom-Left Quadrant: Those that are either in the early stages of development or are becoming less relevant in the current context are themes like technology adoption and electronic commerce.

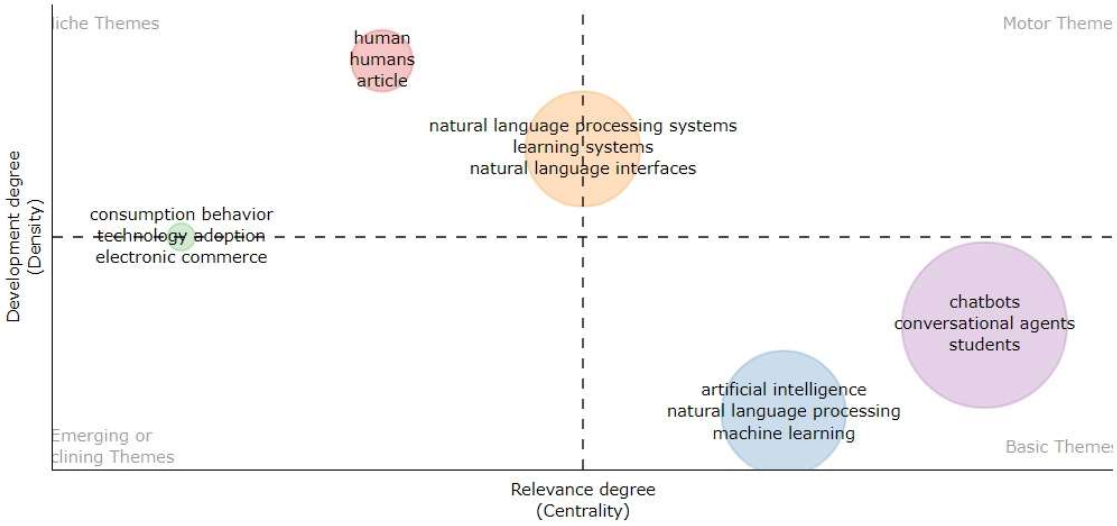

Fig. 4 Thematic Analysis

Conclusion

In summary, the swift progress in artificial intelligence (AI) has resulted in the spread of intelligent education systems and language-learning support systems, especially in the fields of natural language processing (NLP) and machine learning. With OpenAI's November 2022 introduction of ChatGPT, AI-driven chatbots have become a noteworthy technological innovation with enormous potential to change the face of language instruction. As conversational agents, these chatbots facilitate dynamic, turn-by-turn exchanges that actively include users in insightful conversations and provide individualized, dynamic language learning experiences. The potential of AI-powered learning technologies to enhance language education in the post-COVID-19 e-learning environment is becoming more recognised by professionals and educators. By highlighting the most significant countries, journals, and authors in the field, the bibliometric analysis of papers from the Scopus database, covering the years 2004 to 2024, has given essential insights into the state of the art and recent advancements in AI applications inside chatbots. With its strategic recommendations for future lines of inquiry into chatbot development, this thorough analysis is expected to be extremely valuable to researchers, educators, technology developers, policymakers, and other stakeholders interested in the use of AI chatbots in language education settings. Natural language processing systems and learning systems are two highly developed and important topics that thematic analysis has uncovered. These themes indicate crucial avenues for further field study and growth.

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