Review Article

Robo academic advisor: Can chatbots and artificial intelligence replace human interaction?

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ARTICLE INFO	ABSTRACT
	Purpose: Chatbots and artificial intelligence (AI) have the potential to alleviate some of the challenges faced by humans. Faculties frequently swamped with teaching and research may find it difficult to act in a parental role for students by offering them individualized advice. Hence, the primary purpose of this study is to review the literature on chatbots and AI in light of their role in auto-advising systems. The authors aimed to gain insights into the most pertinent topics and concerns related to robo academic advisor and identify any gaps in the literature that could serve as potential avenues for further research. **Design/methodology/approach:** The research employs a systematic literature review and bibliometric techniques to find 67 primary papers that have been published between 1984 and 2023. Using the Scopus database, the researchers built a summary of the literature on chatbots and AI in academic advice. **Findings:** Chatbot applications can be a promising approach to address the challenges of balancing personalized student advising with automation. More empirical research is required, especially on chatbots and other AI-based advising systems, to understand their effectiveness and how they can be integrated into educational settings. **Research limitations/implications:** This research's sample size may restrict its findings' generalizability. Furthermore, the study's focus on chatbots may overlook the potential benefits of other AI technologies in enhancing robo academic advising systems. Future research could explore the impact of robo academic advisors in diverse societal backgrounds to gain a more comprehensive understanding of their implications. **Practical implications:** Higher educational institutions (HEIs) should establish a robo academic advising system that serves various stakeholders. The system's chatbots and AI features must be user-friendly, considering the customers' familiarity with robots. **Originality/value:** This study contributes to a better understanding of HEIs' perceptions of the adoption of chatbots and AI in academic advising by providing insightful information about the main forces behind robo academic advising, illuminating the most frequently studied uses of chatbots and AI in academic advising. **Keywords:** artificial intelligence, chatbots, robo, academic advisor, human interaction

INTRODUCTION

Poor academic advising can have a negative impact on a student's emotional health and motivation, make it challenging for them to complete degree requirements, and cause them to miss out on significant opportunities. Faculties must balance their research and academic workload with their students' advisory

responsibilities while performing their position as advisors. This poses a significant challenge because it prevents them from responding quickly to stakeholder issues (Gnana Rajesh et al., 2023). While traditional advising systems centered on specific responsibilities like advising to choose the right courses, presently, chatbots-based advising systems have developed to offer scenario-based advising (Kuhail et al., 2022a). However, it is important to recognize the limitations of ChatGPT, which can occasionally deliver false or misleading information (Alneyadi & Wardat, 2023). Despite this, academic advising has been frequently ignored by academic support systems, and higher educational institutions (HEIs) primarily give academic advisors access only to basic descriptive statistics and technical assistance (Gutiérrez et al., 2020).

Lack of proper training for academic advisors, inadequate knowledge about advising policies, improper communication systems, difficulties with time management, and issues linked to assessing the results of academic advising are considered crucial problems that HEIs are currently dealing with (Chan et al., 2019). When looking for courses to register for an academic semester, students or academic advisees invest enormous effort. However, because of a lack of adequate academic information, decision-making could be complicated, which leads students to depend on their senior students' opinions rather than academic advisors. Hence, it is essential to consider the preferences and interests of the students, such as preferred professors, easy courses, particular course material, and easy courses (Esteban et al., 2020). The lack of emphasis on giving students the necessary knowledge and resources to make informed academic decisions is a significant problem in higher education. While advisors and professors have access to a wide range of dashboards and tools, the requirements of students themselves have received very little attention (Hilliger et al., 2020). Both public and private HEIs face challenges in a highly competitive market, including student retention and completion rates, which directly impact the quality of advising and services provided, requiring efforts to enhance support for students to succeed academically (Loucif et al., 2020). Conventional advising practices among HEIs were too rigid for adult learners, who may require more flexibility and autonomy in their academic pursuits (Roessger et al., 2019).

Artificial intelligence (AI), robots, and chatbots can improve efficiency and accuracy by performing difficult and time-consuming mundane tasks. Additionally, AI can automate laborious, repetitive, and time-consuming tasks and procedures requiring expertise or specialization (Haluza & Jungwirth, 2023). The student to advisor ratio is relatively high in the Arab region, with each faculty member advising 25-30 students each term. As a result, advisors might struggle to give each advisee the time and attention they need to address their concerns and inform them of pertinent college policies regarding registration, classes, prerequisites, and other related issues, as well as address their questions and concerns (Bilquise et al., 2022). According to Lim et al. (2021), it appears to concentrate on creating an academic advisor chatbot that uses a prediction model to identify students who might require academic counseling.

However, several possible study gaps might be further investigated, including evaluating the prediction model's accuracy, user acceptance, social issues, and integration with current academic support systems using chatbots and AI in the academic advising system.

According to the author's limited knowledge, little study has been done on applying chatbots and AI for robotic academic advising in HEIs. The current study makes a ground-breaking novel contribution to students' success in receiving proper advice and landing a job by revealing AI chatbots as important academic mentors at HEIs. For instance, Lin and Yu (2023) have conducted a bibliometric analysis of chatbots that use AI in educational contexts. They seek to make creating AI chatbot applications for educational contexts easier. Hwang et al. (2020) have studied AI's goals, issues, potential applications, and research concerns in education. A bilingual AI-driven chatbot for academic advising was proposed by Bilquise et al. (2022) in which data was gathered from students.

In contrast, Okonkwo and Ade-Ibijola (2021) conducted a thorough review of prior research on using chatbots in education using a systematic review method to examine 53 articles from recognized databases. Hence, the primary purpose of this study is to review the literature on chatbots and AI in light of their role in auto-advising systems. The authors aimed to gain insights into the most pertinent topics and concerns related to robo academic advisor and identify any gaps in the literature that could serve as potential avenues for further research.

A comprehensive global review to develop strategies to promote a robo academic advising system in HEIs requires empirical evidence. This study aims to address this issue by exploring the following research questions.

Research Questions

RQ1. What is the main area of focus in current research on robo academic advising with regard to chatbots and AI?

RQ2. What are the most commonly studied chatbots and AI applications in academic advising?

RQ3. What are the current research gaps and future directions for research on chatbots and AI in academic advising?

REVIEW OF LITERATURE

The current study has reviewed journal papers from the Scopus database, concentrating on the most recently cited local sources, particularly studies from 2022 and 2023. The literature review pertinent to the current study's subject by key themes or topics relevant to research questions are summarized in **Table 1**.

Table 1. Summary of review of literature: Robo academic advising with regard to chatbots & AI (Results from bibliometrix software, table by authors)

Authors	Title	Review of literature	Year	LC	GC	LC/GC (%)	NLC	NGC
Bilquise and Shaalan (2022)	AI-based academic advising framework: A knowledge management perspective	Academic advising has become a crucial component of students' success & is enhanced by fact that universities provide a wide range of programs & courses in their curricula. It is a student-driven project. Encourages a student's commitment to university by supporting them in their academic growth & career objectives. Managing knowledge involved in advising process is critical to ensuring that it is available to those who require it & used effectively to make excellent advising judgments that benefit student persistence & success. Introducing AI-based solutions improves advising process by lowering advisor burden & offering better decision support tools to enhance advising practice. From a knowledge management standpoint, their paper investigated issues connected with existing advising system.	2022	0	0	0.00	0.00	0.00
Hagemann et al. (2023)	Visual module exploration: A live-user evaluation	It might be challenging for students to choose a course & understand how it will help them reach their educational objectives because modern colleges provide various course alternatives. That was made worse when students were doubtful of their objectives or, as is frequently case, when information regarding course selections is scarce, leaving many students with options available to their classmates. Principal contribution of their study is description of a course counseling & recommendation system to aid learners in higher education in better understanding their course options & effects of their choices. Finally, they outline a system that builds detailed & related representations of models using text-mining techniques on metamodel descriptions.	2023	0	0	0.00	0.00	0.00
Kuhail et al. (2022a)	Engaging students with a chatbot-based academic advising system	Academic advising contributes significantly to mission of HEIs. Academic advisor's primary responsibility is to recommend courses for course planning. Students' unique circumstances must be analyzed with knowledge of study plans & programs. Large number of students & limited time make this task overwhelming. Thus, data-driven decision-support tools have been developed to facilitate term planning. A wide range of studies have been conducted on effects of these tools on students. But advisors' perspective remains largely unexplored. Authors examined how grade prediction tools affect academic advisors' approach to course recommendation.	2022	1	3	33.33	7.00	3.00

Table 1 (Continued). Summary of review of literature: Robo academic advising with regard to chatbots & AI (Results from bibliometrix software, table by authors)

Authors	Title	Review of literature	Year	LC	GC	LC/GC (%)	NLC	NGC
Lizarraga et al. (2022)	A new proposal for virtual academic advisories using chatbots	To strengthen peer advisors program, authors suggested introducing chatbots as a novel idea to perform virtual academic advice within institutional tutoring program. A Google Form instrument was created & assessed to ascertain opinions of faculty of computer science before it was developed.	2023	0	0	0.00	0.00	0.00
Nelekar et al. (2022)	Effectiveness of embodied conversational agents for managing academic stress at an Indian university (ARU) during COVID-19	Students of all ages were seeing increased mental health-related concerns due to stress, which has led to tragic personal tragedies like suicide. Particularly in developing nations, where education is highly seen as a crucial enabler, there is a lot of social & parental pressure to achieve. Demand for online intelligent virtual advisors has increased as a means of stress management during COVID-19 pandemic. As a result, there is a critical need for customized explanation that is culturally sensitive to user's context to increase user's understanding of & faith in suggestions made by virtual advisor. It introduced embodied conversational agent for managing university students. It has been modified from an explainable agent that was shown to provide study advice with justifications on student's values & aspirations, which helped Western students lessen their stress. According to trial findings, stress levels decreased in all student groups who received various justifications. Students also showed trust in conversational agent, a strong working relationship with them, & a desire to alter their behavior in response to all kinds of explanations. But it was found that user's context significantly influenced behavior modification.	2022	0	3	0.00	0.00	3.00

Note. LC: Local citations; GC: Global citations; NLC: Normalized local citations; & NGC: Normalized global citations

Table 1 includes the authors' names, the titles of their articles, local and global citation counts, local/global citation ratios, and normalized local/global citation counts. An article is considered necessary in the larger body of literature on the subject when it has broader local citations (Goyal & Kumar, 2021). As such, during the literature review in this study, the authors centered on the most locally cited documents.

Table 2 shows the most studied application of chatbots and AI in academic advising.

Current Research on Robo Academic Advising with Regard to Chatbots & Artificial Intelligence

To summarize, the literature review covers various studies on using chatbots and AI-based solutions to improve academic advising services for students in HEIs. Several papers suggest using chatbots to provide virtual academic advice, which can help students choose courses that align with their educational goals and support career planning. The review also highlights the importance of considering the advisors' perspectives when designing such systems. Studies have shown that using AI-based tools can help advisors make course recommendations and facilitate term planning. The review also discusses the importance of personalized education, project-oriented training, and the need for a specialized course for advisors. The paper concludes by emphasizing the need for culturally sensitive chatbots that can provide customized explanations to increase students' understanding and trust in the recommendations made by the virtual advisor.

RESEARCH METHODOLOGY

Method

Bibliometric methods and systematic literature reviews (SLRs) are becoming increasingly popular across various academic disciplines (Pattnaik et al., 2020; Thottoli et al., 2022). An approach to synthesizing knowledge on a particular subject or research question known as an SLR involves methodically reviewing

Table 2. Summary of review of literature: Most studied application of chatbots & AI in academic advising (Results from bibliometrix software, table by authors)

Authors	Title	Review of literature	Year	LC	GC	LC/GC (%)	NLC	NGC
Bilquise et al. (2022)	Bilingual AI-driven chatbot for academic advising	Students' expectations for prompt responses & constant availability are rising due to conversational technologies revolution in business communications. Inquiries from students regarding academic & institutional policies & practices, academic progress, extracurricular activities, & other topics are expected. There is a lack of satisfaction with services because academic advisors & student services team are overloaded with inquiries & unable to respond immediately. People's expectations for prompt responses & constant availability are rising due to conversational technologies revolution in business communications. Questions from students regarding academic & institutional policies & practices, academic progress, extracurricular activities, & other topics are expected. There is a lack of satisfaction with services because academic advisors & student services team are overloaded with inquiries & unable to respond immediately. Finally, a bilingual chatbot was developed, which converses with students in both English & Arabic using AI & natural language processing (NLP) technologies.	2022	0	0	0.00	0.00	0.00
Kuhail et al. (2022b)	Interacting with a chatbot-based advising system: Understanding the effect of chatbot personality and user gender on behavior	It has been shown that chatbots with personalities impact user satisfaction & engagement. But rather than emphasizing interpersonal communication, most chatbot designs emphasize accuracy & functionality. Studies that have already been done on chatbots that have personality have mainly measured how nature of chatbot affects user preference & satisfaction. They provided following to help close gaps: A thorough design of a chatbot with personality used for academic counseling & empirical results of a study in which students interacted with three different chatbot iterations.	2022	0	1	0.00	0.00	1.00
Shavetov et al. (2022)	Student advising services in control systems and robotics	It outlines general concept of establishing student advising services at ITMO University for control systems & robotics majors. Personalized education, project-oriented training, & curriculum design & redesign are among topics covered in their study. Expected duties of advisors & their role in professional career planning are discussed in detail. Their paper depicted how advisors can be recruited & trained through a special course of extra professional education.	2022	0	0	0.00	0.00	0.00

Note. LC: Local citations; GC: Global citations; NLC: Normalized local citations; & NGC: Normalized global citations

pertinent research using a specific research technique. While minimizing potential biases during the review of research data, SLR seeks to improve the clarity, validity, and reliability of pertinent studies in the field.

SLR overviews the reviewed documents by outlining the structure, document methods, and search process. Additionally, SLR aids in eradicating possible biases like selection and publishing bias (Bihari et al., 2022). The transparency and reproducibility of this type of study are frequently compromised by insufficient disclosure of the methods for data collection, processing, and analysis. The author of this study intended to present a novel, transparent, and repeatable methodology that academics could readily use in their future research. A model for summarizing and evaluating literature is investigated through SLR to enhance future research agenda. SLR acts as a common road map for locating possible documents (Young et al., 2018).

A bibliometric analysis of R software was also employed in this study (Aria & Cuccurullo, 2017). In addition to gaining a deeper understanding of chatbots and AI in light of their role in auto-advising systems, the Scopus database was taken into consideration to identify the broad research trends related to the current research in the field of robo academic advising from 1984 to 2023. The authors sought to fill any knowledge gaps that might open up new directions for future study and obtain insight into the most pertinent topics and issues
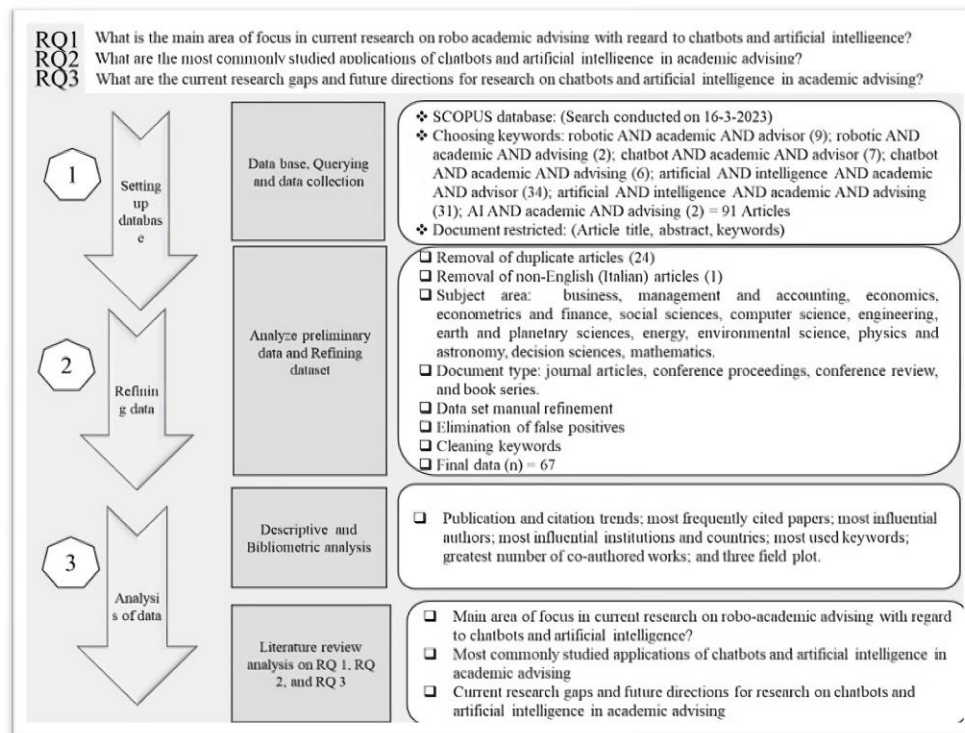
Figure 1. Research etiquette (adapted from Nanibaa' et al., 2016 & Thottoli et al., 2022)

relating to the robo academic advisor. This study has used qualitative and quantitative bibliometric techniques to analyze data and track published research papers. The bibliometric approach has the potential to enhance review quality by providing a thorough, broad, and consistent review procedure. Bibliometric methods are beneficial when examining literature. The most significant publications are recommended to the scholars even before they begin reading, and the study areas are objectively mapped (Zupic & Cater, 2015).

The choice of research publications is essential for bibliometric research analysis to be reliable and consistent. Only articles focusing on the business management discipline and their contribution to the subject of trending technology hashtags in the accounting field were included in the selection process. **Figure 1** illustrates a three-step procedure (setting up the database, refining data, and data analysis) for selecting research publications and interpreting the results (adapted from Nanibaa' et al., 2016; Thottoli et al., 2022). The researchers first looked for a database with bibliometric information before filtering the primary document collection. To review the literature on chatbots and AI in light of their function in auto-advising systems, data was collected only in the Scopus database on March 16, 2023. The authors wanted to learn more about the most important issues and problems concerning the robo academic advisor. Also, tried to find any gaps in the literature that might suggest future directions for study.

Collection of Data

A broad study query was used to search the Scopus database. There is a lot of coverage for peer-reviewed papers in the well-known Scopus database. Due to extensive and high-impact data collection, the Scopus database is regarded as the most reliable database for bibliometric studies (Meho & Yang, 2007).

The final query was the outcome of several iterations designed to define a research question broadly enough to include all relevant articles. The query was included through Boolean search as "robotic" AND "academic" AND "advisor" OR "robotic" AND "academic" AND "advising" AND "chatbot" AND "academic" AND "advisor" OR "chatbot" AND "academic" AND "advising" AND "artificial" AND "intelligence" AND "academic" AND "advisor" OR "artificial" AND "intelligence" AND "academic" AND "advising" OR "AI" AND "academic" AND "advising."

Using the predetermined keywords, the researchers conducted individual Scopus searches. The scope of the thorough search was limited to research papers' titles, abstracts, and keywords. A total of 91 articles were

Table 3. Main information (Results from bibliometrix software, table by authors)

Variable	Value	Percentage (%)
Timespan	1984:2023	
Sources (journals, books, etc.)	56	
Documents	67	
Annual growth rate (%)	0	
Document average age	9.75	
Average citations per document	5.94	
References	1,367	
Document contents		
Keywords plus (ID)	500	
Author's keywords (DE)	170	
Authors		
Authors of single-authored docs	16	8.04
Authors of multiple-authored docs	183	91.96
Total	199	100
Authors collaboration		
Single-authored documents	18	
Co-authors per document	2.81	
International co-authorships (%)	14.93	
Document types		
Article	28	41.79
Book chapter	1	1.49
Conference paper	35	52.24
Conference review	3	4.48
Total (n)	67	100

generated during the initial search procedure. The authors then used inclusion and exclusion criteria to screen and choose only the pertinent articles. The following outlines the criteria for inclusion and exclusion.

Inclusion & exclusion criteria

The articles considered in this SLR were required to meet certain inclusion criteria. They needed to be written in English and published in peer-reviewed academic journals indexed only in the Scopus database. Furthermore, the articles had to have been published between 1984 and 2023, and the search date was March 16, 2023. We considered any discussion of chatbots and AI in the context of their role in auto-advising systems.

The subject area was restricted to business, management and accounting, economics, econometrics and finance, social sciences, computer science, engineering, earth and planetary sciences, energy, environmental science, physics and astronomy, decision sciences, and mathematics. The document type was restricted to journal articles, conference proceedings, conference review, and book series. Articles were excluded if they failed to satisfy the inclusion or exclusion criteria mentioned above, their links were broken, or their content was unavailable. The authors observed that 24 duplicate articles were removed from the initial search results (91-24=67). Therefore, 67 articles were included in the analysis. According to the authors, the limited sample size was attained because they used the authors' own keywords to focus on a particular research area since there have not been many studies on those keywords in recent years. The study's primary focal area will be strengthened with the right and relevant selection of articles. Rogers et al. (2020) argued that it might be an analytical minimum. But smaller samples might be acceptable for qualitative analysis. Yet, such samples might be perplexed by a dearth of "highly cited" papers in smaller research-intensive units in bibliometric analysis.

Analysis

Table 3 provides information on a research project spanning the time span of 1984 to 2023. The data was gathered from 56 sources, including journals, books, and other documents. In total, 67 documents were analyzed, with an annual growth rate of 0.00%. The average age of the documents was 9.75 years old, and they received an average of 5.94 citations per document. The contents of the documents included 500 keywords plus (ID) and 170 author's keywords (DE). There were 199 authors involved in the research, with 16 of them contributing to single-authored documents and 183 of them contributing to multiple-authored documents. The collaboration between authors was also analyzed, with 18 single-authored documents and
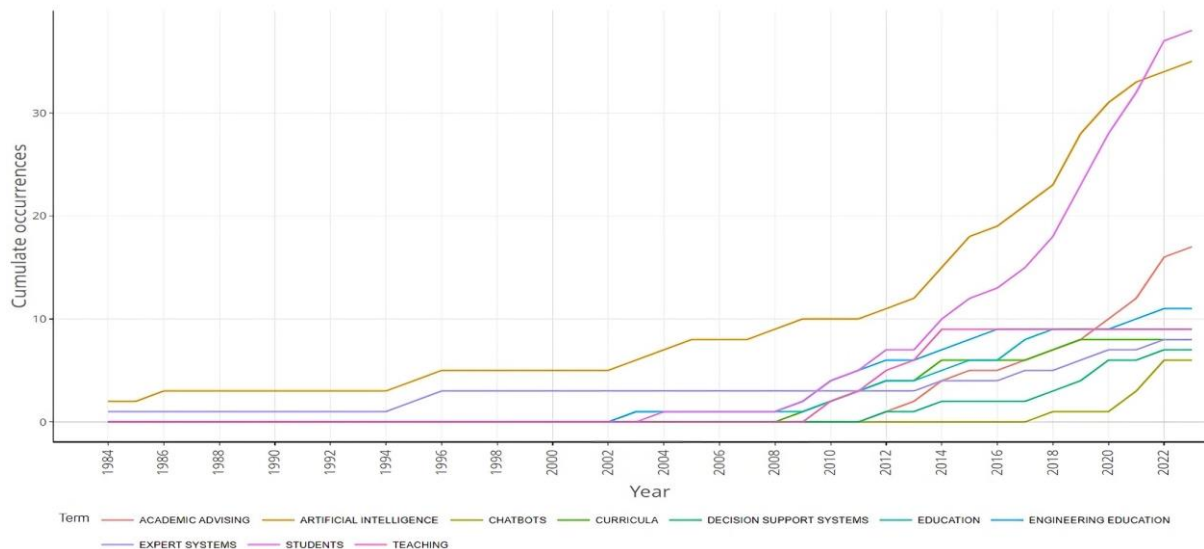
Figure 2. Words' frequency over time (Results from bibliometrix software, figure by authors)

an average of 2.81 co-authors per document. International co-authorships accounted for 14.93% of the collaborations. The document types were categorized, as follows: 28 articles (41.79%), one book chapter (1.49%), 35 conference papers (52.24%), and three conference reviews (4.48%).

RESULTS & DISCUSSION

Current Research Areas on Robo Academic Advising with Regard to Chatbots & Artificial Intelligence

Understanding current study themes on robo academic advice with reference to chatbots and AI is aided by bibliometric results such as words' frequency over time, word cloud, and trend topics. Those bibliometric results assist in examining the study's first research question of current study themes (Al Mazroui et al., 2023).

Words' frequency over time

The first research question, "**RQ1.** What is the main area of focus in current research on robo academic advising with regard to chatbots and AI?" is the one that this section aims to address. The primary area of focus in the current study on robo academic advising was identified by the researchers for this analysis using words' frequency over time. The most popular words, which have been used in various research disciplines, can often be used to identify research trends (Falagas et al., 2006; Zheng et al., 2017).

Figure 2 shows the frequency of particular words from 1984 to 2023 in research articles. The identified words are students, AI, academic advising, engineering education, education, teaching, curricula, expert systems, decision support systems, and chatbots. The numbers in each cell indicate how many articles that contained the corresponding word had been published that year. It has been noted some research areas have been seen to have a growing tendency throughout the study. Since 1980, and especially in the 2010s, the term "artificial intelligence" has become increasingly popular.

Similarly, since dropping out of popularity, "expert systems" found significant popularity in the 1990s. Another extremely important word is "chatbots," which has shown a growing trend over the past ten years. Although words like "academic advising" and others have shifted over time, their importance has remained unchanged. Hence, some words, particularly 'AI and chatbots,' appear more frequently, showing increasing interest and research in academic advising.

Word cloud

Unstructured text, such as books, papers, speeches, or poems, can be explored using a word tree, a visual search tool, and users can discover all the various contexts in which a word or phrase occurs by selecting it (Bogicevic et al., 2013). The word cloud in **Figure 3** precisely reflected the frequency of terms related to

Figure 3. Word cloud (Results from bibliometrix software, figure by authors)

Table 4. Trend topics (Results from bibliometrix software, table by authors)

Item	freq	year_q1	year_med	year_q3
Engineering education	11	2010	2012	2016
Teaching	9	2011	2012	2014
Curricula	8	2011	2013	2015
Education	9	2011	2014	2017
Artificial intelligence	35	2008	2015	2019
Expert systems	8	1996	2016	2019
Students	38	2014	2019	2021
Decision support systems	7	2016	2019	2020
Decision making	5	2008	2019	2020
Academic advising	17	2015	2020	2022
NLP systems	6	2016	2020	2021
Chatbots	6	2021	2022	2022

academic advising using chatbots and AI in the underlying data set. The most frequent word is artificial intelligence (11), followed by chatbot (five), expert system (four), machine learning (four), decision support system (three), higher education (three), NLP (three), and natural networks (three).

The terms "humanoid robots," "fiber optics," "engagement," and "explainability" refer to recent developments in the field of AI applications research.

Trend topics

The trend topics in **Table 4** related to robo academic advisors and the possibility of chatbots and AI replacing human interaction include expert systems, NLP systems, chatbots, and AI. Understanding the dynamics of trending subjects allows us to classify them as either positive or negative trends (Saquib & Ali, 2017). Chatbots appear to be the recent trend (the year 2022), and NLP systems have appeared six times each, implying the prominence of using AI and related technologies to improve the academic advising system among institutions. The word "artificial intelligence" appears 35 times, implying extensive relevance in using AI technologies in academic advising systems. This calls into question how to balance personalized student advising with automation in educational settings and emphasizes the need for more study and discussions in this field. In light of the fact that chatbots, expert systems, and NLP systems are hot subjects in current research, this suggests that using AI technologies in academic advising systems is highly relevant.

Table 5. Applications of chatbots & artificial intelligence in academic advising (Results from bibliometrix software, table by authors)

Authors	Applications of chatbots & AI in academic advising	TC	TCY	NTC
Engin et al. (2014)	AI-based educational expert systems can recommend courses using Oracle policy automation software.	39	3.90	3.12
Ho et al. (2018)	Outlined a conversational agent, called EASElective, an academic advising chatbot that uses AI & NLP to facilitate discussions about course selection & student feedback.	35	5.83	2.08
Zhao et al. (2018)	Through applications, a time-aware advisor-advisee relationship mining model employs AI to find advisor-advisee relationships.	24	4.00	1.43
Alblawi and Alhamed (2017)	Suggested AI-based learning analytics & NLP.	20	3.33	1.19
Golumbic et al. (1986)	Academic planning environment expert system makes course recommendations based on student interests.	19	0.50	1.00
Biletskiy et al. (2009)	A database compiled using web mining, NLP, & pattern recognition methods applied to HTML course outlines may automate the course credit transfer procedure.	18	1.20	1.89
Aly et al. (2017)	Smartphone apps with intelligent algorithm-based experts can improve academic advising by giving students appropriate choices with less time and effort.	12	1.71	1.33
Fayoumi and Hajjar (2020)	A decision support system built on artificial neural networks can help with academic planning and counseling. It incorporates input from academic data sources for precise academic performance projection.	12	3.00	2.18
Asakiewicz et al. (2017)	University-related queries can be addressed by a cognitive advisory system that uses IBM Watson's intelligence.	7	1.00	0.78
Almutawah (2014)	By combining diverse information sources & sophisticated data mining techniques, it is believed that use of AI will increase efficacy of student counseling.	7	0.70	0.56
Kuhail et al. (2022a)	Systems for academic advice that use chatbots automate course selection & offer scenario-based guidance. MyAdvisor is a system that prioritizes needs of its users & is built on actual advising circumstances.	3	1.50	3.00
Nam and Samson (2019)	AI can include behavioral data and student profiles to forecast success in science, technology, engineering, and mathematics courses in higher education.	3	0.60	1.88
Lim et al. (2021)	To provide early assistance & lighten load on lecturers, an academic adviser chatbot forecasts student achievement based on attendance & formative assessment results.	2	0.67	2.80
Castellano et al. (2008)	OrieB is a collaborative recommender system based on fuzzy linguistics that suggests academic options using student grades in academic orientation domain.	1	0.06	1.00
Kuhail et al. (2022b)	It was suggested to create a chatbot with personality for academic guidance and analyze how it affects user trust, engagement, authenticity, and use intention.	1	0.50	1.00
Ismail et al. (2021)	The academic adviser chatbot can respond to a lot of questions sent through online communication channels and is designed to be linked with Microsoft Teams.	1	0.33	1.40
Lizarraga et al. (2022)	To empower peer advisors, the article advocates deploying chatbots for virtual academic advising inside the institutional tutoring program.	0	0.00	0.00
Bilquise et al. (2022)	Using a bilingual chatbot that communicates with students and uses NLP processing and a purpose-built knowledge base, AI is applied to academic advice.	0	0.00	0.00
Lee et al. (2021)	Employing chatbots to provide academic and career advising services, helping students select majors and find related careers.	0	0.00	0.00
Abdelhamid and Alotaibi (2021)	A multi-agent, integrated ecosystem that automates academic advising using machine learning methods. A smart advisor agent controls communication while giving advice.	0	0.00	0.00

Note. TC: Total citations; TCY: Total citations per year; & NTC: Normalized total citations

Most Commonly Studied Applications of Chatbots & AI in Academic Advising

The second research question, "**RQ2.** What are the most commonly studied applications of chatbots and AI in academic advising?" is the one that this section aims to address. **Table 5** outlines the various uses of chatbots and AI in academic advising.

CONCLUSIONS

This study is to review the literature on chatbots and AI in light of their role in auto-advising systems and to gain insights into the most pertinent topics and concerns related to the robo academic advisor, as well as to identify any gaps in the literature that could serve as potential avenues for further research using bibliometric analysis. Chatbot and AI-based robo academic advising technology uses bibliometric analysis to analyze the main area of focus in current research on robo academic advising and explore the most commonly studied applications of chatbots and AI in academic advising. Data was taken from 1984 and 2023
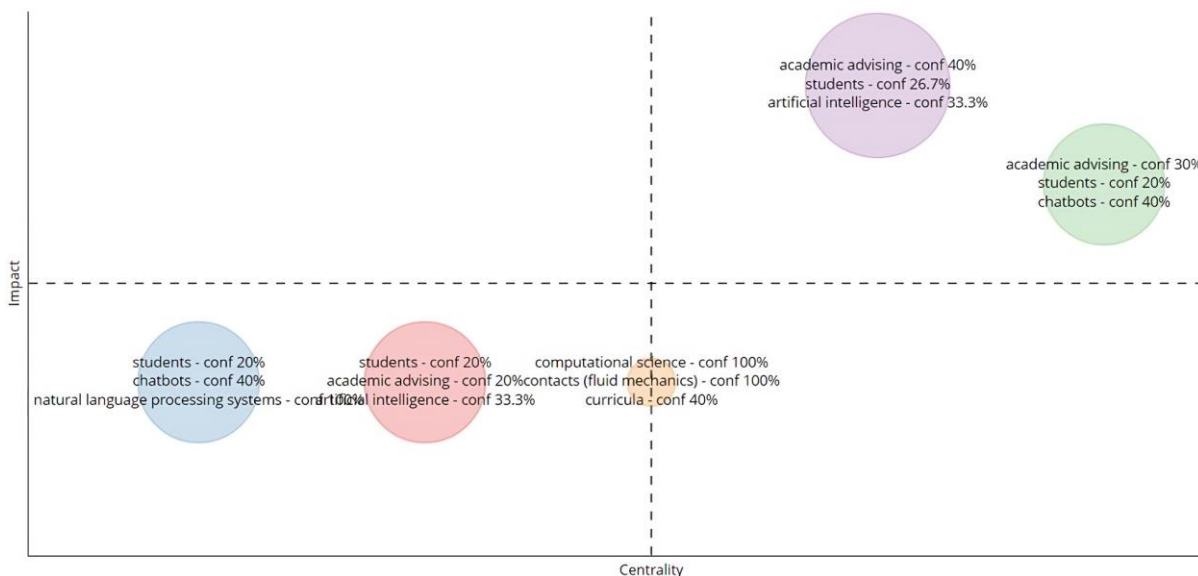
Figure 4. Clustering by coupling (Results from bibliometrix software, figure by authors)

Table 6. Clustering by coupling (Results from bibliometrix software, table by authors)

Label	Group	Freq	Centrality	Impact	Color
Students-conf 20.00% academic advising-conf 20.00% AI-conf 33.30%	1	4	4.787651	1.000000	Purple
Students-conf 20.00% chatbots-conf 40.00% NLP systems-conf 100%	2	4	3.058517	1.000000	Blue
Academic advising-conf 30.00% students-conf 20% chatbots-conf 40.00%	3	4	6.797411	1.555556	Green
Academic advising-conf 40.00% students-conf 26.70% AI-conf 33.30%	4	5	6.179874	1.916667	Red
Computational science-conf 100% contacts (fluid mechanics)-conf 100% curricula-conf 40.00%	5	2	5.263158	1.000000	Orange

from the Scopus database. Chatbots, expert systems, and NLP systems are hot subjects in current research; this suggests that using AI technologies in academic advising systems is highly relevant. According to the literature review and bibliometric analysis findings, there has not been much research on chatbot applications in academic advising. But previous studies identified several AI applications of AI in academic advising (as per **Table 4**). Thus, it can be concluded that chatbots and AI can replace human interaction by properly adopting robo academic advisors in HEIs. Berse et al. (2023) noted that ChatGPT and AI might help raise knowledge and skill levels, deliver timely correct information, and enhance time management. Due to chatbots' weakness in emotional communication, possible hazards and limits of employing AI chatbots may have a detrimental influence on user relationships and concerns around chatbots offering false or biased information.

Future Research directions

In this section, the researchers discuss the third research question, "**RQ3.** What are the current research gaps and future directions for research on chatbots and AI academic advising?," which examines the existing knowledge gaps and possible future directions in investigating chatbots and AI academic advising. Bibliometric clustering results by coupling might assist researchers in understanding existing research gaps and future directions in robo academic advising regarding chatbots and AI. Kessler (1963) developed the bibliographic coupling approach, which is used to map current research trends and find the cluster of underlying research.

Clustering by Coupling

Researchers can identify developing patterns and prospective areas for further inquiry within a specific discipline by grouping related publications on their bibliographic coupling (Fu et al., 2016). In the current study, the researchers considered clustering by coupling, and results are shown in **Figure 4** and **Table 6**.

The first cluster consists of data points related to "students," "academic advising," and "artificial intelligence," all of which have a 20.00-33.30% frequency at their respective conferences. This cluster has a label of one, a centrality of four, and an impact of 4.787651387, represented by purple. The second cluster

includes data points related to "students," "chatbots," and "natural language processing systems," with a 20.00-40.00% frequency at their respective conferences. This cluster has a label of two, a centrality of four, and an impact of 3.05851672, represented by blue. The third cluster includes data points related to "academic advising," "students," and "chatbots," with a 20.00-30.00% frequency at their respective conferences. This cluster has a label of three, a centrality of four, and an impact of 6.797410533, with a color of green. The fourth cluster includes data points related to "academic advising," "students," and "artificial intelligence," with a 26.70-40.00% frequency at their respective conferences. This cluster has a label of four, a centrality of five, and an impact of 6.17987393, represented by red. The fifth cluster includes data points related to "computational science," "contacts (fluid mechanics)," and "curricula," with a 40.00-100% frequency at their respective conferences. This cluster has a label of five, a centrality of two, and an impact of 5.263157895, represented by orange.

Academic advising, regarded as one of the most adopted strategies in HEIs for the current research purpose and research context, lacks clear demarcations despite the diversity of adoption of AI and chatbots in the educational sectors reported in current literature. Despite being in the same research area, distinct AI strategies and specifications have been adopted. Lin and Yu (2023) sought to make it easier to create AI chatbot applications for an educational context. A bilingual AI-driven chatbot for academic advising was proposed by Bilquise et al. (2022), which can lead to better use of chatbots and AI in HEIs' academic advising systems. It is required to evaluate the applicability of research techniques and criteria to thoroughly review the usage of chatbots in the education system through a systematic review (Okonkwo & Ade-Ibijola, 2021). Hence, future research will focus on adopting chatbots and AI technologies in academic advising research studies. Additionally, in the fourth industrial revolution (IR4.0), there is a growing concern about using technology to open up new possibilities for effective academic advising systems, and chatbot applications in a range of disciplines, including education, have been a recent hot topic.

However, so far, relatively little focus has been placed on systematically analyzing the impact of chatbots and AI adoption and implementation of robo academic advisors on academic research. Therefore, it is crucial to check whether the outcomes and conclusions reached at high levels of technology adoption are genuinely distinct from those reached by more conventional academic advising systems, which would be done in a way that is more efficient, where Bilquise et al. (2022) emphasized on advisors struggle to give each advisee the time and attention they need, as well as to address their concerns and inform them of pertinent college policies regarding registration, classes, prerequisites, and other related issues, as well as to address their questions and concerns (Bilquise et al., 2022). To fill in the gaps in the literature, the authors suggest that future research can focus on NLP and other chatbots to improve academic advising and auto-career guidance for students. Future research can also focus on AI-enabled advisors that help students select the best major by considering their unique passions and skills.

Implications & Limitations

Theoretical implications

According to Dini and Jevremov (2021), applying science mapping techniques to include visual and non-visual representations of topic traits and interactions might enhance scientific discourse and speed up information retrieval. Mariani et al. (2022) investigated the intellectual structure exhibited in the literature using various bibliometric techniques and network analysis. By conducting bibliometric analysis, including examining the most locally and globally cited documents, this study provides valuable insights into important journal articles with the highest citation rates and importance and an understanding of the applications of chatbots and AI in academic advising based on existing research. The most often referenced local and global cited documents lack a unifying topic, suggesting that there has not been much in-depth research on using chatbots and AI for robo academic advising at HEIs. To bridge the gap between virtual reality and education, Rojas-Sánchez et al. (2023) conducted a bibliometric review to identify and analyze the scientific literature and were able to determine the most frequently local or global cited articles, as well as the countries, where they were produced, to establish the knowledge base in the educational field. The current study results using most locally cited documents have helped with the analysis of **RQ1**, which seeks to identify the main area of focus in recent research on robo academic advising with regard to chatbots and AI, and **RQ2**, which seeks to identify

the most commonly studied applications of chatbots and AIin academic advising by using most global cited documents. The analysis also determines trending topics, clustering by coupling, the frequency of words over time, and important author keywords that have significantly contributed to the research on chatbots and AI in academic and educational fields. Based on these findings, the study recommends the automation of academic advising, which may be helpful for future research agendas on robo academic advising among HEIs.

The highlighted seminal components can be used as a starting point for future research by authors looking into how automation changes academic advising in HEIs. A computer program built as a conversational chatbot is created to respond to questions from students regarding academic guidance, clarification of college regulations, progression, going on to the next level, and specialization selection (Gnana et al., 2023). To improve the automation of academic advising by applying the most recent ideas in AI and chatbots, future studies could build on the complete analysis of the research area and develop research streams provided by the current study. These findings may help advance the field of academic advising as technology adoption across HEIs increases during IR4.0 era, which can replace human interaction to the greatest extent possible.

In current era of IR4.0, educational institutions are progressively using AI in educational sector and advising. Thus, robo academic advice employing chatbots must advance toward larger accomplishments. Directors of universities and colleges are under intense pressure to stay up with developments in AI and related technologies while enhancing their technology-enabled academic advising expertise. This is essential for effectively meeting students' demands and guaranteeing their total satisfaction as they study and obtain their degrees in the time frame, with minimal human interaction. This study offers faculties, academic staff, and software service providers valuable insights regarding the significance of research and important future research trends. They can use this information to emphasize subject and enable an efficient shift to digitalization in their academic advising operations. Generally speaking, theoretical generalizations are frequently simpler to formulate than empirical ones. Even if they are shown to be helpful, empirical generalizations are likely to only be short-term in nature if they are pursued (Sim, 1998). Due to its compatibility with IR4.0 trend towards performative technologies, using robo academic advice, including chatbots, expert and NLP systems, and other AI applications, has emerged as a prominent research area in education.

Practical implications

Due to its expertise in conducting performance analysis, bibliometric research appears to be a useful instrument for objectively evaluating research output and impact. In this research, several metrics are used to assess the productivity of research contributors. These metrics may include the most locally cited and globally cited documents, trending topics, clustering by coupling, word cloud, and word frequency over time. A comprehensive assessment of the content can conclude the clusters provided in the bibliographic coupling, which can be produced via bibliometric analysis (Omotehinwa, 2022). An article may frequently obtain more citations from other disciplines, which helps determine its influence using global citation (Agbo et al., 2021). Similarly, several metrics are used to assess the influence of research in the field, including total citations, total citations per year, and normalized total citations.

By reducing the advising workload, university and college faculties will have more time to dedicate to research and community service activities besides their teaching duties. The registration office is concerned with student retention rates and giving students the best possible course selection alternatives. They are concerned that students may not receive proper advising, which could increase retention rates. Therefore, an automated academic advising system that uses the most recent AI technology would be highly beneficial to the registration departments of universities and colleges. With the help of cutting-edge AI tools like chatbots, this study intends to promote the usage of such technologies in HEIs so that students and advisees can quickly decide the courses they want to take with little interaction from humans. Thus, a basis for closing the technology theory-practice gap in academic advising and education is desirable. However, AI and ChatGPT cannot successfully clear up misconceptions because it does not have a solid grasp of geometry (Wardat et al., 2023). Depending on the intricacy of the equation, the input data, and the directions supplied to ChatGPT, the solutions provided by ChatGPT may vary in accuracy and efficacy. To solve mathematical puzzles of ever-greater complexity, ChatGPT is anticipated to become more effective (Wardat et al., 2023).

Limitations

There are some limitations to the study that need to be pointed out. First of all, relying entirely on the Scopus database as a tool for evaluation might have produced biased results. Additionally, the study's sampling strategy was constrained because it depended on the choice of authors and international databases that might ignore articles published other than in the English language. It should have additionally considered language bias and technical difficulties, as Noruzi and Abdekhoda (2014) mentioned in the publication data. While the study concentrated on bibliometric analysis, it is essential to note that extended analyses have not been considered, as per Aria and Cuccurullo (2017), R-tool for complete science mapping analysis. The search was limited to article titles, abstracts, and keywords. Finally, the study might be broadened to cover specific challenges linked to academic advising from different perspectives since it only addressed the three research topics about robo advisors.

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