

CAN CHATBOTS IMPROVE SCIENTIFIC RESEARCH SKILLS?

Ahmad, Samah Zakareya

Department of English Language, College of Science and Humanities-Jubail, Imam Abdulrahman Bin Faisal University, Dammam, KSA.

Received: 19 July. 2025, Revised: 7 Aug. 2025, Accepted: 20 Sep 2025.

Published online: Sep 2025.

Abstract: The integration of chatbots in higher education has shown promising potential to support the development of students' scientific research skills. This study aimed to evaluate the effectiveness of an AI chatbot intervention designed to enhance college students' scientific research skills. A quasi-experimental research design was employed involving 41 college students enrolled in Research Methodology at College of Science and Humanities, Imam Abdulrahman Bin Faisal University, KSA. Participants completed a standardized scientific research skills test before and after an 11-week intervention using Perplexity. Using pretest-posttest measures complemented by systematic observational data, the study identified significant improvements in research capabilities post-intervention ($t = 21.8$, $p < .001$). Observations highlighted challenges such as formulating precise queries and over-reliance on chatbot responses, which diminished over the intervention period, indicating growing learner autonomy. The chatbot facilitated critical research processes, including literature searching, hypothesis formulation, and data analysis, contributing to improved student confidence and engagement. These findings underscore AI chatbots' potential as effective educational tools that scaffold complex analytical skills. The study recommends further development of chatbot functionalities and user training to mitigate observed challenges and maximize research skills development within academic curricula.

Keywords: AI chatbots, scientific research skills, college students, higher education, research skills development, artificial intelligence in education

Introduction

Research skills are fundamental to academic and professional success fostering critical thinking, creativity, and problem-solving, which are essential in today's dynamic and information-rich world (Booth et al., 2016). Research skills also enhance lifelong learning, allowing individuals to adapt to new challenges and continuously expand their knowledge base (Leedy & Ormrod, 2020). In the context of education, teaching research skills is vital for developing intellectual independence. This process involves more than collecting data; it requires students to critically evaluate sources, interpret findings, and present results in meaningful ways. Enhancing these abilities not only prepares students for academic success but also equips them for informed decision-making in their personal and professional lives (Creswell & Creswell, 2018). Furthermore, embedding research skills into curricula promotes collaboration and communication, as students often engage in team-based projects to address real-world problems. These activities cultivate the ability to articulate ideas effectively and adaptively—a crucial competency in interdisciplinary and multicultural settings (Bryman, 2015).

Students often face significant challenges in developing scientific research skills, as these competencies demand advanced abilities such as critical analysis, synthesis of diverse sources, and the application of theoretical knowledge to practical contexts. For instance, many students struggle to effectively design research methods or interpret data, primarily due to inadequate preparation in these areas during their earlier education (Thomas, 2017). Moreover, the abundance of online information has made it progressively challenging for students to identify reliable sources, often resulting in the use of low-quality or irrelevant data in their research (Graff & Birkenstein, 2021). Time management further complicates the process, with students frequently overwhelmed by the extensive nature of research activities (Rowley & Slack, 2004). These challenges are intensified by limited access to personalized feedback and guidance, which are essential for dealing with the complicated nature of research (Berg & Seeber, 2016).

Kingdom of Saudi Arabia places significant emphasis on promoting scientific research and developing students' research skills as part of its Vision 2030 framework, which aims to position the Kingdom as a global leader in innovation and knowledge (Cactus Global, 2025). The government supports numerous initiatives, including advanced data platforms and grants, to foster an environment conducive to research and skill acquisition among students (Future DC, 2025). However, Saudi students face several

*Corresponding author e-mail: szamohammed@iau.edu.sa

challenges in acquiring scientific research skills, which impact their academic and professional development. Research education in undergraduate programs often fails to meet students' needs for critical thinking, problem-solving, and research methodology skills (Al-Suhaibani et al., 2019). These deficiencies are compounded by a lack of exposure to practical research opportunities, limited guidance from faculty, and insufficient engagement with advanced research tools and technologies (Naji et al., 2017; Noorelahi et al., 2015). Additionally, cultural and language barriers create significant obstacles, especially for students navigating the complexities of academic writing in a second language (Qasem & Zayid, 2019). Female students, in particular, face additional challenges when moving between cultures, which further hinder their ability to seek and evaluate research information effectively (Binsahl et al., 2015). These barriers contribute to a lack of confidence in research skills, impacting students' overall academic performance (Kazim et al., 2024). Furthermore, the lack of a cohesive and competency-based research education system in Saudi higher education limits students' ability to develop essential research skills necessary for global competitiveness (Al-Mubarak, 2011; Al-Dighrir, 2018). Addressing this gap is crucial, as developing these skills is not only vital for academic success but also for preparing students to meet the demands of a rapidly evolving, knowledge-based economy. Therefore, the current study explores how AI-powered conversational agents (Chatbots) can bridge the gap between traditional teaching methods and the need for more interactive, adaptive, and skill-focused learning experiences in the context of scientific research.

Literature Review

Chatbots, also known as conversational agents, are software applications designed to simulate human-like interactions through text or speech, using artificial intelligence technologies (Adamopoulou & Moussiades, 2020). Chatbots represent a potential shift in how people interact with data and services online (Brandtzaeg & Følstad, 2017). The integration of chatbots into education has undergone significant evolution, reflecting advancements in artificial intelligence and their potential as educational tools. Initially, their use in education was limited to basic question-and-answer functionalities. However, with advancements in AI, chatbots now support personalized learning, real-time feedback, and student engagement across various disciplines (Winkler & Soellner, 2018). Recent studies emphasize their role in enhancing student motivation, accessibility, and learning outcomes by providing 24/7 support and fostering interactive learning environments (Hobert, 2019). These developments underline the transformative potential of chatbots in addressing educational challenges and meeting diverse learner needs, particularly in enhancing research and analytical skills (Bekkar & Chtouki, 2024).

The use of chatbots in education is supported by several theoretical frameworks. One of these frameworks is the Constructivist learning theory which emphasizes active student engagement in constructing knowledge through meaningful experiences and interactions. Chatbots align with this theory by facilitating personalized, inquiry-based learning environments where students interact dynamically with the technology to explore concepts and refine their understanding. By engaging learners in reflective and exploratory conversations, chatbots can operationalize fundamental tenets of constructivist learning, fostering deeper cognitive engagement and personal understanding (Holmes et al., 2019). This dynamic interaction supports the constructivist view of learning as a process of meaning-making through active dialogue and exploration. Another theoretical framework supporting the use of chatbots in education is the Cognitive Load theory which focuses on optimizing instructional design to minimize extraneous cognitive load and maximize relevant cognitive processes essential for learning. Chatbots contribute to this optimization by delivering just-in-time support, breaking down complex tasks, and streamlining access to resources. They can guide learners step-by-step, ensuring cognitive demands remain manageable without overwhelming working memory (Lademann et al., 2025). Research underscores how chatbots support effective knowledge acquisition while reducing the cognitive overload often associated with traditional learning environments (Mayer, 2020). Moreover, it shows how chatbot users experience less cognitive load and are more productivity (Schmidhuber et al., 2021). Scaffolding is another theoretical framework supporting the use of chatbots in education.

Scaffolding theory describes the process by which learners are provided with temporary support to achieve tasks beyond their independent capabilities (Verenikina, 2003). Chatbots exemplify this by offering dynamic, context-sensitive assistance tailored to individual learner needs. They can act as virtual mentors, guiding students through complex problem-solving or research processes (Ravi & Vedapradha, 2025). Vygotsky's concept of the "Zone of Proximal Development" (ZPD) finds a direct application here, as chatbots enable learners to transition from dependence to autonomy (Sharma et al., 2021).

Chatbots such as Bard, ChatGPT, Ada, Replika, Socratic, Habitica, and Piazza offer diverse educational support by generating content, personalizing tutoring, providing emotional support, facilitating concept learning, gamifying tasks, and fostering collaboration (Labadze et al., 2023). They serve as virtual tutors delivering instant feedback and promoting self-directed learning in subjects like language, math, and coding (Schei et al., 2024). Additionally, chatbots assist with administrative and pedagogical tasks in higher education by managing student inquiries, integrating with learning management systems, and enhancing accessibility (Gokcearslan et al., 2023; Okonkwo & Ade-Ibijola, 2021). They also encourage collaborative learning and improve academic skills, with students reporting increased motivation and productivity when chatbots support writing and research activities (Tang et al., 2023; Schei et al., 2024). Chatbots support the development of research skills by providing personalized guidance on various research methodologies, helping structure studies through steps like hypothesis formulation and data analysis, and identifying knowledge gaps to align research goals (Huang & Tan, 2023; Khalifa & Albadaawy, 2024). They also enhance academic writing by improving grammar, style, and coherence while emphasizing ethical usage to avoid plagiarism and maintain originality (Dergaa et al., 2023). Additionally, AI facilitates the literature review process through semantic search, automatic summarization, and efficient citation management with platforms like Zotero, Mendeley, and EndNote, allowing researchers to comprehensively navigate and synthesize relevant academic work (Khalifa & Albadaawy, 2024).

Several studies emphasized the potential of AI-powered chatbots to improve students' scientific research skills by providing personalized support and enhancing engagement. Kooli (2023) highlighted chatbots' ability to deliver timely, individualized feedback while addressing ethical challenges in research processes. Wang et al. (2024) presented SurveyAgent, a system that aids literature reviews by organizing materials and discovering relevant papers, thereby streamlining research. Vanichvasin (2021) demonstrates that chatbot use significantly improves students' research knowledge based on pre- and post-test comparisons. Labadze et al. (2023) systematically reviewed the educational impact of chatbots, noting their benefits in personalized learning and skill development alongside concerns about reliability and ethics, underscoring their transformative potential in scientific research education. Therefore, the current study aims to investigate the effectiveness of chatbots in improving college students' scientific research skills.

Study hypothesis

The researcher proposed that there would be no statistically significant difference in research skills scores between the pretest and posttest.

Methodology

Design

The study used a quantitative quasi-experimental research design to assess the effectiveness of AI chatbots in improving students' scientific research skills. This design allowed comparison of outcomes before and after chatbot use within the same participant group.

Variables

The current study includes one independent variable, chatbots, operationally defined as AI-driven conversational agents designed to interact with users in natural language, providing personalized, real-time support to enhance skills such as scientific research through dynamic dialogue and information retrieval. It also includes a dependent variable, research skills, operationally defined as the capabilities

to write and showcase a research project. These capabilities can be divided into: problem identification, information management, hypothesis formulation, data analysis, and communication of findings.

Participants

A sample of 41 college students enrolled in the Research Methodology course were recruited using purposive sampling. Participants had varied initial familiarity with AI chatbots to ensure generalizability.

Instrument

The Research Skills Questionnaire developed and validated by Daryanes et al. (2024). It is a 22-item instrument structured around four dimensions: Embark & Clarify, Find & Manage, Identify & Generate, and Evaluate & Communicate. It underwent rigorous validation using both Exploratory Factor Analysis and Confirmatory Factor Analysis. The questionnaire employs a five-point Likert scale to assess various aspects of scientific research skills, including problem identification, information management, hypothesis formulation, data analysis, and communication of findings. The validation results demonstrated strong construct validity and internal consistency, indicating that this instrument reliably measures the multifaceted nature of research skills and is suitable for evaluating students' competencies in scientific research. This tool offers a comprehensive and psychometrically sound way to assess and develop research skills in educational contexts. Therefore, it was selected as the instrument for the present study and was administered before and after the intervention.

In addition to the Research Skills Questionnaire and chatbot intervention, a systematic observation methodology was implemented to supplement data collection in the experimental study. During the 11-week intervention, students' interactions with the AI chatbot Perplexity were observed in real-time sessions and through analysis of logged conversations. The observation focused on identifying key behavioral patterns, difficulties encountered in chatbot usage, and engagement levels during various stages of the research process. Particular attention was given to moments when students struggled to formulate research questions, navigate literature search, or apply chatbot guidance effectively. This observational data aimed to provide qualitative insights into the challenges and facilitative factors underpinning the quantitative improvements in research skills.

Procedures

Among the various AI-powered chatbots, Perplexity was selected for this study due to its advanced capabilities as an AI-powered research assistant that combines real-time internet search with sophisticated language models like GPT-4.1 and Claude 4.0. Its unique Deep Research feature enables the synthesis of information from hundreds of academic sources within minutes, providing detailed, well-organized, and citation-linked reports that support efficient literature review and data analysis. Additionally, Perplexity's emphasis on source transparency and the ability to tailor searches to scientific databases make it particularly suited for enhancing scientific research skills by delivering accurate, verifiable, and comprehensive information quickly, thus improving the research process for users.

The study was conducted over a 12-week period with 41 college students enrolled in the Research Methodology course at College of Science and Humanities, IAU University, KSA. Initially, all participants completed Daryanes et al.'s (2024) Research Skills Questionnaire to assess their baseline scientific research skills. After completing the pre-test, participants were introduced to Perplexity. An orientation session was held to familiarize students with the chatbot's interface and functionalities, including how it could support each phase of the research process, such as generating research questions, locating relevant literature, organizing citations, and providing feedback on research plans.

Over the subsequent 11 weeks, students engaged in assigned research activities requiring them to interact with the chatbot. These activities included refining research topics, conducting targeted literature searches through chatbot assistance, formulating hypotheses, and designing basic research plans. Participants were instructed to use the chatbot frequently and to document their interactions and any challenges faced.

Upon completion of the intervention period, participants took the post-test, which was identical in format

and content to the pre-test to enable direct comparison. Scores from pre- and post-tests were collected for statistical analysis to assess improvements in research skills attributable to chatbot use. Data from the usability questionnaire was analyzed to understand perceptions and acceptance of AI chatbot integration in the research learning process.

Results

Table Paired- samples t-test for the difference between the means of scores of the participants in the pretest and posttest of Research Skills

	Paired Differences		t	df	Sig. (2-tailed)
Posttest-Pretest	Mean	Std. Deviation	21.86	40	<0.001
	27.12	7.94			

A paired samples t-test was conducted to compare students' pretest and posttest scores. The analysis revealed that the mean of posttest scores ($M = 84.05$) was significantly higher than the mean of pretest scores ($M = 56.93$), $t = 21.8$, $p < .001$. These results indicate a statistically significant improvement in scores following the intervention. The extremely low p-value provides solid evidence that this gain is statistically significant and unlikely due to chance.

Observational data revealed several significant points corroborating the quantitative findings. Students initially faced challenges in formulating precise research queries and relying heavily on chatbot responses. However, over time, increased familiarity with Perplexity led to more targeted and effective interactions, contributing to the overall improvement in research skills. Observations also indicated the chatbot's role in scaffolding difficult tasks such as hypothesis formulation and literature evaluation. Despite some technical and engagement hurdles, the personalized AI support positively influenced students' research behaviors and confidence.

Discussion

The present study sought to evaluate whether the integration of AI chatbots—specifically, the conversational agent Perplexity—can enhance scientific research skills among Saudi college students enrolled in a Research Methodology course. The findings demonstrate a statistically significant improvement in posttest scores compared to pretest scores, indicating that the chatbot intervention was effective in fostering essential research competencies. This aligns with recent empirical evidence and meta-analytical studies suggesting that AI-powered chatbots can substantially improve student learning performance, particularly in skill- and competency-based contexts (Eteng-Uket & Ezeoguine, 2025; Pitts et al., 2025; Wang & Fan, 2025; Wu & Yu, 2024). Moreover, the findings of the present study go along with recent studies that confirm that AI chatbots significantly improve research skills by providing tailored educational tools that enhance critical thinking, problem-solving, and data analysis capabilities (Behnamnia, et al., 2024; Chassignol et al., 2018; Madanchian & Taherdoost, 2025; Rojas Quispe et al., 2024; Alshwiah, 2024).

One possible reason AI chatbots improved research skills is their ability to provide personalized, immediate feedback and support, enabling learners to reflect on and improve their work in real-time. For instance, a study by Zhang et al. (2025) found that EFL students using AI chatbots for argumentative writing showed significant improvement in critical thinking skills such as reasoning, supporting ideas, and organization due to the timely and targeted guidance offered by the chatbot. Similarly, Essel et al. (2022) demonstrated that AI-powered virtual teaching assistants enhanced learning outcomes by providing customized learning experiences and reducing learner anxiety through instant responses. This personalized interaction nurtures deeper engagement and self-regulated learning, crucial components of developing effective research abilities.

AI chatbots also facilitate research skill development by supporting active and scaffolded learning models such as problem-based learning. Wang and Fan (2025) in a meta-analysis revealed that AI

chatbots like ChatGPT are particularly effective in courses focused on skill and competency development because they offer clear explanations and guide learners through complex problem-solving. This scaffolding promotes higher-order thinking, metacognition, and autonomous knowledge construction, all essential for robust research skills. Additionally, chatbot systems assist in navigating and synthesizing large amounts of information, as shown by Lin and Ye (2023), thereby aiding learners in critical data analysis and evidence integration required for scientific research.

Finally, AI chatbots improve research skills by increasing student motivation and engagement through interactive and accessible learning environments. The chatbots' conversational, low-pressure interface encourages learners to persist with challenging tasks, thereby fostering the practice and reflective thinking necessary for skill mastery (Zhang et al., 2025; Wang & Fan, 2025). Furthermore, chatbots help overcome language and cultural barriers, providing support and translations that aid diverse learners, particularly international students, enhancing equitable access to research skill development (Essel et al., 2022; Lin & Ye, 2023). These motivational and inclusive features create a supportive atmosphere that positively impacts research skill acquisition and performance.

Importantly, these findings are also relevant within the specific context of higher education in Saudi Arabia. Local challenges—such as time constraints, limited access to expert mentorship, and language barriers—often impede research skills development. The success of the chatbot intervention suggests that conversational AI can help bridge these gaps by delivering individual support, addressing students' direct queries, and enhancing both motivation and confidence. Additionally, the observed skill improvement supports Saudi Arabia's Vision 2030 educational goals, which emphasize critical thinking, digital literacy, and independent learning.

However, the study's results should be interpreted in light of several limitations. The intervention's effectiveness partly depends on students' engagement with the chatbot, the quality and specificity of their queries, and the ability of the AI to provide contextually relevant feedback. Furthermore, the generalizability of the results may be affected by the limited sample size and the single-institution setting. There is also a risk of over-reliance on the chatbot, which could hamper the development of independent research and critical thinking skills in the long term if not balanced with guided instruction and reflective learning.

Conclusion and Suggestions for Further Research

This study provides compelling evidence that AI-powered chatbots, such as Perplexity, can significantly enhance college students' scientific research skills. The statistically significant improvement in posttest scores demonstrates that chatbot interventions offer effective, personalized support for complex research tasks including literature search, research design, and data interpretation. By enabling on-demand guidance and scaffolding, chatbots help students overcome common challenges related to critically evaluating sources, managing research processes, and applying theoretical concepts.

The integration of observational methodology provided complementary qualitative evidence supporting the efficacy of AI chatbots in developing scientific research skills. Addressing observed difficulties—such as query formulation and critical evaluation—through enhanced chatbot interfaces or targeted user training could further optimize learning outcomes. Overall, the study's findings from both quantitative and observational data underline the transformative potential of chatbots in higher education research training contexts.

Future research and practice should focus on further refining chatbot functionalities, exploring long-term impacts, and integrating these tools seamlessly into curricula to maximize educational benefits. Overall, AI chatbots hold substantial promise as transformative educational technologies that can empower students to become confident and competent scientific researchers.

References

- [1] Adamopoulou, E., & Moussiades, L. (2020). An overview of chatbot technology. *Artificial Intelligence Applications and Innovations*, 38(2), 373-383. <https://doi.org/10.1007/s10462-019-09788-z>
- [2] Al-Dighrir, W. (2018). Challenges that affect acquisition of scientific research skills and its relationships to the research opportunities among college students in Najran University. *Journal of Faculty of Education- Assiut University*, 34(12), 1-23.
- [3] Al-Mubarak, A. A. (2011). National and global challenges to higher education in Saudi Arabia: Current development and future strategies. *Higher Education in the Asia-Pacific: Strategic Responses to Globalization*, 413-430.
- [4] Alshwiah, A. (2024). Students' perceptions of an artificially intelligent chatbot as a support tool to develop their research skills. *Qualitative Research Journal*, <https://doi.org/10.1108/ORJ-06-2024-0117>
- [5] Al-Suhaibani, M., Al-Harbi, A., Inam, S., Alamro, A., & Saqr, M. (2019). Research education in an undergraduate curriculum: Students perspective. *International Journal of Health Sciences*, 13(2), 30-34.
- [6] Behnamnia, N., Hayati, S., Kamsin, A., Ahmadi, A., & Alizadeh, Z. (2024). Enhancing students' research skills through ai tools and teacher competencies: a mixed-methods study. *Journal of e-Learning and Knowledge Society*, 20(3), 39-55.
- [7] Bekkar, H. A., & Chtouki, Y. (2024, July). Chatbots in Education: A Systematic Literature Review. In *2024 10th International Conference on Smart Computing and Communication (ICSCC)* (pp. 637-644). IEEE.
- [8] Berg, M., & Seeber, B. K. (2016). *The slow professor: Challenging the culture of speed in the academy*. University of Toronto Press.
- [9] Binsahl, H., Chang, S., & Bosua, R. (2015). Information seeking challenges when moving across cultures: The case of Saudi female international students in Australia. Paper presented at the 26th Annual Conference of ISANA, December 1-4, 2015, Melbourne, Australia.
- [10] Booth, W. C., Colomb, G. G., & Williams, J. M. (2016). *The craft of research (4th ed.)*. University of Chicago Press.
- [11] Brandtzaeg, P. B., & Følstad, A. (2017). Why people use chatbots. In *Internet Science: 4th International Conference, INSCI 2017, Thessaloniki, Greece, November 22-24, 2017, Proceedings 4* (pp. 377-392). Springer International Publishing. https://doi.org/10.1007/978-3-319-70284-1_30
- [12] Bryman, A. (2015). *Social research methods (5th ed.)*. Oxford University Press.
- [13] Cactus Global. (2025). Saudi Arabia's scientific research revolution. <https://cactusglobal.com/media-center/saudi-arabias-scientific-research-revolution/>
- [14] Chassignol, M., Khoroshavin, A., Klimova, A., & Bilyatdinova, A. (2018). Artificial Intelligence trends in education: a narrative overview. *Procedia computer science*, 136, 16-24. <https://doi.org/10.1016/j.procs.2018.08.233>
- [15] Creswell, J. W., & Creswell, J. D. (2018). *Research design: Qualitative, quantitative, and mixed methods approaches (5th ed.)*. SAGE Publications.
- [16] Daryanes, F., Zubaidah, S., Mahanal, S., & Sulisetijono, S. (2024). Development and Validation of Research Skills Instruments for Pre-service Biology Teachers. *Participatory Educational Research*, 12(2), 75-96.
- [17] Dergaa, I., Chamari, K., Zmijewski, P., & Saad, H. B. (2023). From human writing to artificial intelligence generated text: examining the prospects and potential threats of ChatGPT in academic writing. *Biology of sport*, 40(2), 615-622.
- [18] Essel, H. B., Vlachopoulos, D., Tachie-Menson, A., Johnson, E. E., & Baah, P. K. (2022). The impact of a virtual teaching assistant (chatbot) on students' learning in Ghanaian higher education. *International Journal of Educational Technology in Higher Education*, 19(1), 57.
- [19] Eteng-Uket, S., & Ezeoguine, E. (2025). The Impact of Artificial Intelligence Chatbots on Student Learning: A Quasi-Experimental Analysis of Learning Outcome and Engagement. *Journal of Educators Online*, 22(2), 2.
- [20] Future DC. (2025). Innovation and scientific research in Vision 2030. <https://www.futuredc.com.sa/blog/innovation-and-scientific-research-in-vision-2030-strengthening-saudi-arabia-as-a-global-knowledge-powerhouse>
- [21] Gokcearslan, S., Tosun, M., & Erdemir, E. (2023). Methodological and general trends of AI chatbot studies in education. *International Journal of Technology in Education*, 7(1), 19-39.

- [22] Graff, G., & Birkenstein, C. (2021). *They say/I say: The moves that matter in academic writing* (5th ed.). W.W. Norton & Company.
- [23] Hobert, S. (2019). Say hello to 'coding tutor': Design and evaluation of a chatbot-based learning system supporting students to learn to program. *International Journal of Artificial Intelligence in Education*, 29(1), 45-78.
- [24] Holmes, W., Bialik, M., & Fadel, C. (2019). *Artificial intelligence in education: Promises and implications for teaching and learning*. Center for Curriculum Redesign.
- [25] Huang, J., & Tan, M. (2023). The role of ChatGPT in scientific communication: writing better scientific review articles. *American journal of cancer research*, 13(4), 1148.
- [26] Kazim, S. M., AlGhamdi, S. A., Lytras, M. D., & Alsaywid, B. S. (2024). Nurturing Future Leaders: Cultivating Research and Innovation Skills in Saudi Scientific Community. In *Transformative Leadership and Sustainable Innovation in Education: Interdisciplinary Perspectives* (pp. 231-265). Emerald Publishing Limited.
- [27] Khalifa, M., & Albadawy, M. (2024). Using artificial intelligence in academic writing and research: An essential productivity tool. *Computer Methods and Programs in Biomedicine Update*, 100145. <https://doi.org/10.1016/j.cmpbup.2024.100145>
- [28] Kooli, C. (2023). Chatbots in education and research: A critical examination of ethical implications and solutions. *Sustainability*, 15(7), 5614. <https://doi.org/10.3390/su15075614>
- [29] Labadze, L., Grigolia, M., & Machaidze, L. (2023). Role of AI chatbots in education: systematic literature review. *International Journal of Educational Technology in Higher Education*, 20(1), 56.
- [30] Lademann, J., Henze, J., & Becker-Genschow, S. (2025). Augmenting learning environments using AI custom chatbots: Effects on learning performance, cognitive load, and affective variables. *Physical Review Physics Education Research*, 21(1), 010147. <https://doi.org/10.1103/PhysRevPhysEducRes.21.010147>
- [31] Leedy, P. D., & Ormrod, J. E. (2020). *Practical research: Planning and design* (12th ed.). Pearson.
- [32] Madanchian, M., & Taherdoost, H. (2025). The impact of artificial intelligence on research efficiency. *Results in Engineering*, 104743.
- [33] Lin, Y. T., & Ye, J. H. (2023). Development of an educational chatbot system for enhancing students' biology learning performance. *Journal of Internet Technology*, 24(2), 275-281.
- [34] Mayer, R. E. (2020). *Multimedia learning*. Cambridge University Press.
- [35] Naji, H., Sarraj, J., Muhsen, I., Kherallah, S., Qannita, A., Obeidat, A., & Sajid, M. (2017). Faculty perspective on competency-based research education: A multi-centre study from Saudi Arabia. *Journal of Health Specialties*, 5(3), 129.
- [36] Okonkwo, C. & Ade-Ibijola, A. (2021). Chatbots applications in education: A systematic review. *Computers and Education: Artificial Intelligence*, 2, 100033. <https://doi.org/10.1016/j.caeai.2021.100033>
- [37] Noorelahi, M., Soubhanneyaz, A., & Kasim, K. (2015). Perceptions, barriers, & practices of medical research among students at Taibah College of Medicine, Madinah, Saudi Arabia. *Advances in Medical Education & Practice*, 6, 479-485.
- [38] Qasem, F. & Zayid, E. (2019). The challenges & problems faced by students in the early stage of writing research projects in L2, University of Bisha, Saudi Arabia. *European Journal of Special Education Research*, 4(1), 32-47.
- [39] Pitts, G., Marcus, V., & Motamedi, S. (2025). Student Perspectives on the Benefits and Risks of AI in Education. *arXiv preprint arXiv:2505.02198*. <https://doi.org/10.48550/arXiv.2505.02198>
- [40] Ravi, H., & Vedapradha, R. (2025). Chatbots as scaffolding tools: an active learning model to empower diverse learners. *On the Horizon: The International Journal of Learning Futures*, 33(2), 283-297.
- [41] Rojas Quispe, M. L., Meza Huamani, S. L., Ramos Huaman, F. G., Aldave Yábar, D. F., & Prado Lozano, P. (2024). Impact of Artificial Intelligence Strategies on the Research Skills of Teacher Training Students. *Pakistan Journal of Life & Social Sciences*, 22(1).
- [42] Rowley, J., & Slack, F. (2004). Conducting a literature review. *Management Research News*, 27(6), 31-39.
- [43] Schei, O. M., Møgelvang, A., & Ludvigsen, K. (2024). Perceptions and use of AI chatbots among students in higher education. *Education Sciences*, 14(8), 922. <https://doi.org/10.3390/educsci14080922>
- [44] Schmidhuber, J., Schlögl, S., & Ploder, C. (2021). Cognitive load and productivity implications in human-chatbot interaction. In *2021 IEEE 2nd international conference on human-machine systems (ICHMS)* (pp. 1-6). IEEE.

- [45] Sharma, K., Papamitsiou, Z., & Giannakos, M. N. (2021). Building personalized scaffolding experiences for learners in online educational systems. *Computers in Human Behavior*, 122, 106848. <https://doi.org/10.1016/j.chb.2021.106848>
- [46] Tang, K. Y., Chang, C. Y., & Hwang, G. J. (2023). Trends in artificial intelligence-supported e-learning: A systematic review and co-citation network analysis (1998–2019). *Interactive learning environments*, 31(4), 2134-2152.
- [47] Thomas, G. (2017). *How to do your research project: A guide for students (3rd ed.)*. SAGE Publications.
- [48] Vanichvasin, P. (2021). Chatbot development as a digital learning tool to increase students' research knowledge. *International Education Studies*, 14(2), 44-53. <https://doi.org/10.5539/ies.v14n2p44>
- [49] Verenikina, I. (2003). Understanding scaffolding and the ZPD in educational research. *Proceedings of the International Education Research Conference (AARE - NZARE)*, 30 November - 3 December 2003, Auckland, New Zealand
- [50] Wang, X., Chen, J., Li, N., Chen, L., Yuan, X., Shi, W., ... & Xiao, Y. (2024). SurveyAgent: A Conversational System for Personalized and Efficient Research Survey. *arXiv preprint arXiv:2404.06364*. <https://doi.org/10.48550/arXiv.2404.06364>
- [51] Wang, J., & Fan, W. (2025). The effect of ChatGPT on students' learning performance, learning perception, and higher-order thinking: insights from a meta-analysis. *Humanities and Social Sciences Communications*, 12(1), 1-21.
- [52] Winkler, R., & Soellner, M. (2018). Unleashing the potential of chatbots in education: A framework for design and evaluation. *Frontiers in Education*, 3(14), 1-16.
- [53] Wu, R., & Yu, Z. (2024). Do AI chatbots improve students learning outcomes? Evidence from a meta-analysis. *British Journal of Educational Technology*, 55(1), 10-33.
- [54] Zhang, Q., Siraj, S. B., & Abdul Razak, R. B. (2025). Effects of AI chatbots on EFL students' critical thinking skills and intrinsic motivation in argumentative writing. *Innovation in Language Learning and Teaching*, 1-29.