Engineering Educators Bringing the World Together
2025 ASEE Annual Conference & Exposition
Palais des congrès de Montréal, Montréal, QC • June 22–25, 2025 ASEE
Paper ID #46923

Integration of Conversational Agents into Learning Management Systems: A Systematized Literature Review

Maryam Khalid Multani, University of Florida

Maryam Khalid Multani is currently a first-year PhD student in Engineering Education at the University of Florida. Prior to this, she spent eight years as an instructional faculty member at Bahria University in Islamabad, Pakistan, where she taught various computer science courses.

Ms. Laura Melissa Cruz Castro, University of Florida

Dr. Laura Cruz is an instructional assistant professor in the engineering education department at University of Florida.

Integration of Conversational Agents into Learning Management Systems: A Systematized Literature Review

Abstract

The integration of conversational agents in educational settings has increased significantly in recent years, particularly within higher education institutions. Integrating these agents with Learning Management Systems (LMS) or Virtual Learning Environments (VLE) offers a strategic solution to challenges such as increased cognitive load and technology fatigue among students. Moreover, engineering education and education researchers play a crucial role in incorporating conversational agents within pedagogical frameworks, due to their unique position at the crossroads of technology and education. This systematized literature review aims to explore how these agents are being integrated into current educational platforms and the significant impact engineering educators can have in advancing this innovation. By employing an extensive database search, abstract review of 275 articles, and full article review of 90 articles, multiple researcher involvement, and both inductive and deductive thematic coding, this review reveals three main findings: (1) There has been a sharp increase in publications related to conversational agents over the past three years, indicating a growing interest in their development and integration, primarily outside the United States, with Python being the dominant programming language for its prototyping flexibility; (2) Platforms like Moodle, Blackboard, OLAT, and Google Classroom have the most integrations, indicating easier integration with these technologies; (3) There is a noticeable lack of discussion on learning theories among these studies, with most authors coming from computer science and STEM fields, which highlights a significant gap in interdisciplinary collaboration. This gap emphasizes the urgent need for more educational specialists and engineering educationists to ensure that conversational agents effectively enhance learning.

Introduction

The integration of conversational agents in educational settings has grown significantly over the past years, with implementations rising sharply across higher education institutions. These Artificial Intelligence (AI) powered tools offer promising ways to engage and support students through personalized interactions and immediate feedback, enhancing the learning experience by providing a dynamic, responsive educational environment [1], [2]. However, the rapid adoption of these technologies also presents challenges, such as increased cognitive load and technology fatigue among students. Current literature points to the need for careful consideration in implementing these agents to avoid overwhelming users and compromising educational effectiveness [2].

Integrating conversational agents with Learning Management Systems (LMS) or Virtual Learning Environment (VLE) represents a strategic approach to some of these challenges. LMS and VLE platforms serve as central hubs for educational content and interaction and provide an established infrastructure for deploying AI-powered support. However, it is not sufficient as research also indicates that successful integration depends on aligning with existing pedagogical frameworks, setting clear educational objectives, and ensuring a seamless user experience [2].

Engineering education plays a pivotal role in integrating conversational agents within pedagogical frameworks, given its position at the intersection of technology and education. Previous studies, such as those by [3], highlight that engineering instructors are keen to adopt new technologies in their teaching. This enthusiasm is likely due to their solid grasp of both technological and educational strategies essential for effective instruction, positioning them as ideal early adopters of AI conversational agents in educational settings. Consequently, this systematized literature review focuses on how these agents are being integrated into existing educational platforms and the significant role that engineering educators can play in advancing this innovation. Understanding these dynamics is essential for planning our future steps in this evolving field.

Literature Review:

Previous literature reviews on conversational agents in educational settings have explored a broad range of aspects, from technological implementations to the integration of learning theories and their pedagogical applications. Studies such as those conducted by [2] have delved into the roles of conversational agents across various interdisciplinary research domains, shedding light on their diverse applications in education. Tanvir and Kim's [4] review on chatbots in programming courses found that none of the articles that implemented chatbots in education included pedagogical underpinnings, and suggested building chatbots on educational frameworks and learning taxonomies such as Bloom's taxonomy, Universal Design for Learning (UDL) and training teachers to effectively integrate chatbots in their classrooms.

Findings from these reviews suggest that conversational agents can significantly enhance the learning experience by offering personalized interactions and immediate feedback. Research by [2] and [5] emphasizes the agents' roles in facilitating effective human-computer interaction and applying educational theories to meet diverse learning needs. However, challenges such as increased cognitive load, technology fatigue, and concerns about data privacy and the reliability of AI chatbots pose significant hurdles. Cultural and educational context differences also affect the adoption and impact of AI technologies in educational settings, as highlighted by [6], pointing to the need for context-sensitive approaches.

There is a consensus among researchers about the necessity for extended studies into the long-term effects of conversational agents [2], [4]. There is an ongoing need to understand how these agents influence learning outcomes over time and how their integration into educational systems

can be optimized. Researchers, including Freeman and Aoki [6], stress the importance of designing conversational agents that are pedagogically effective and that ethical frameworks should guide their implementation. In their literature review, Freeman and Aoki [6] build on the understanding of how to optimize these systems, explores theories that provide a framework for the use of pedagogical strategies and ethical considerations in deploying these agents.

With this context in mind, this study conducts a systematized literature review, focusing on three research questions to address the effective implementation and integration of conversational agents in current educational hubs (LMS or VLEs) education and current contributions of engineering educators to these applications:

RQ1: What is the purpose of conversational agents integrated or developed for LMS?

RQ1.1: What learning phase can be inferred from the purpose of the agent?

RQ2: What is the justification (if any) provided for conversational agents to be integrated or developed for LMS or VLE?

RQ3: What learning framework or theory is mentioned in the articles?

RQ4: What is the role of engineering education in developing these conversational agents?

Through this inquiry, we aim to bridge the current knowledge gap regarding conversational agents in engineering education, ensuring their potential is fully realized in enhancing educational outcomes.

Theoretical Framework

The learnability model in [7] offers a robust framework for exploring the pedagogical framework that leads to the implementation of conversational agents in educational settings. This model is particularly effective because it integrates multiple learning theories—behaviorist, cognitive, constructivist, and social constructivist—each of which provides a distinct lens through which the functionality and pedagogical efficacy of LMS can be evaluated. These are segmented into four distinct phases in the framework: Behaviorist, Cognitive, Individual Constructivist, and Social Constructivist. Each phase contributes uniquely to the learning environment, ensuring both technical and pedagogical aspects are addressed to optimize the learnability of the system.

Behaviorist Phase: This phase sets the foundation, focusing on direct instruction where students learn the basic functionalities of the LMS through structured, teacher-guided activities. The aim is to build comfort by navigating and using the system effectively.

Cognitive Phase: Transitioning from basic use to deeper engagement, this phase involves activities that challenge students to use the LMS for problem-solving and critical thinking,

tailored to their level of understanding, enhancing their ability to interact with and process the content.

Individual Constructivist Phase: Emphasizing self-directed learning, this phase supports tasks that simulate real-world applications, encouraging learners to apply their knowledge in practical contexts. It promotes self-reflection and personal knowledge construction, enhancing intrinsic motivation.

Social Constructivist Phase: The final phase integrates social learning, where students collaborate and engage in discussions and group activities. This phase uses the social features of the LMS to enrich learning through peer interactions and community feedback, solidifying the knowledge constructed in earlier phases.

Methods

To address the research questions, we will use a systematized literature review according to the PRISMA framework as proposed by [8]. Therefore, the stages are the following. First, we found alternative terms used for chatbots and Learning Management Systems and formed queries for our searches in the databases. Next, we consulted the databases ERIC, Compendex, INSPEC, Scopus, Web of Science, and ACM Digital Libraries, searching the titles, abstracts, and keywords of articles. Table 1 shows the number of initial hits for each database. We used the following search query:

(TITLE-ABS-KEY ("Learning Management System" OR "LMS" OR "Learning Management Systems" OR "Moodle" OR "Blackboard" OR "Canvas" OR "Google classroom" OR "D2L" OR "BrightSpace" OR "iSpring" OR "Absorb" OR "Docebo" OR "Schoology" OR "Seesaw" OR "Edmodo" OR "Teachfloor" OR "WeSchool" OR "Alma") AND TITLE-ABS-KEY ("chatbot" OR "chatbots" OR "chaterbots" OR "conversational agent" OR "conversational agents" OR "pedagogical agent" OR "pedagogical agents" OR "smart tutor" OR "smart tutors"))

Table 1 Number of Initial Hits for each Database

Database	Date of search	Initial Hits
Scopus	Sep 23, 2024	150
Web of Science	Sep 23, 2024	29
ERIC	Sep 23, 2024	14
ACM Digital Libraries	Sep 23, 2024	01
Compendex	Sep 23, 2024	189
INSPEC	Sep 23, 2024	117

We then removed duplicates and limited our search to peer reviewed documents. This is followed by a review of the abstracts to ensure that the papers are relevant to our research questions. To select the articles for review, three criteria were used. The articles must 1) be peer-

reviewed, 2) describe the actual conversational agent and LMS i.e. not just be a literature review, 3) the conversational agent and LMS must be integrated or connected.

Each member of the group reviewed the abstracts separately, after which we consolidated the results of the abstract review and came to a consensus about articles where there was a disagreement among the members. Then we removed the articles we did not have access to. For the full paper review data concerning year of publication, authors affiliation, target populations, countries of affiliation, type of agent, type of environment that the conversational agent is integrated into, technology used to develop the conversational agent were considered. Then a deductive thematic analysis [9] was used to infer the learnability phase [7] and inductive thematic analysis [9] to report the justification of the development of the agent.

Results

The findings of this study are organized into distinct subsections. We will discuss the general results, which provide an overview of the key findings across all aspects of the study. Followed by detailed sections dedicated to each of the four research questions, presented sequentially as RQ 1, RQ 2, RQ 3 and RQ 4.

General results:

After consulting the databases ERIC, Compendex, INSPEC, Scopus, Web of Science, and ACM Digital Libraries with custom queries, we found 500 articles. Upon removing duplicates and limiting our search to peer reviewed documents we found 275 unique articles. Each member then reviewed the abstracts separately to ensure that the papers were relevant to our research questions, after which we consolidated the results of the abstract review and came to a consensus about articles where there was a disagreement among the members. In all, both members initially disagreed on 23 articles, and reached an agreement after reading their abstracts together and discussing them. This resulted in 120 articles to review in full. Out of these, we did not have access to 18 articles, thus limiting our full review to 102 articles.

During a full review of the 102 articles, a further 12 articles were rejected as the conversational agent described was not integrated or connected with a VLE or LMS, or not having a conversational agent, LMS or VLE or not containing enough information about the conversational agent. Thus, a total of 90 articles were included in the detailed analysis. The PRISMA flow diagram for this entire process is shown in Figure 1.

From these 90 articles a complete article review was performed by one of the researchers after agreement on the data extraction was reached on the first five articles reviewed by both researchers. Of those 90 articles an increasing number of papers have been published in the last six years, with peaks in 2019 and 2023 (see Figure2). In addition, there are four countries that have the largest number of publications on this topic which are Italy, Brazil (9 each), UK and Indonesia (4 each) (see Figure 2).

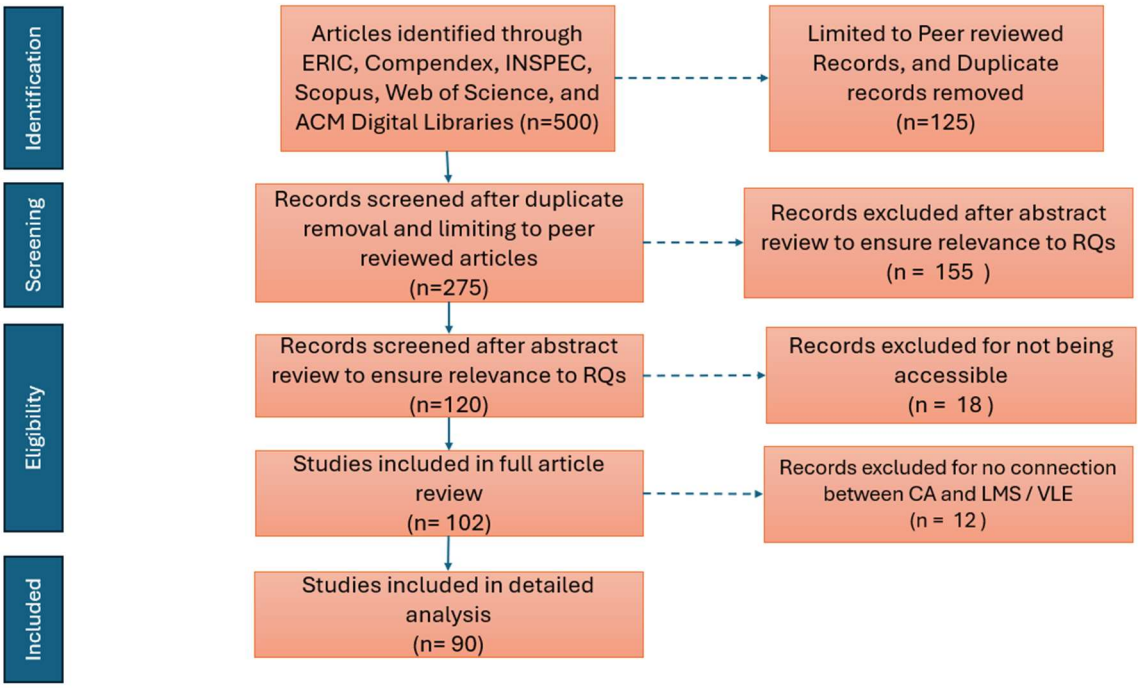

Figure 1 PRISMA flow Diagram for Systematized Literature Review adapted from [8]

Additionally, of the 90 articles reviewed, 40 articles discussed integration with a Learning Management System (LMS), 27 articles explored integrations with Virtual Learning Environment (VLE) while 4 used the terms LMS and VLE interchangeably. The remaining articles mentioned integrating with a Web portal, Serious Games, and an e-Learning environment, among other terms. Among those focusing on LMS, 29 articles specifically addressed integration with commercial systems such as Moodle, Blackboard, OLAT and Google classroom, which were the most mentioned. The remaining 61 articles dealt with integrating conversational agents into custom LMS platforms or VLEs.

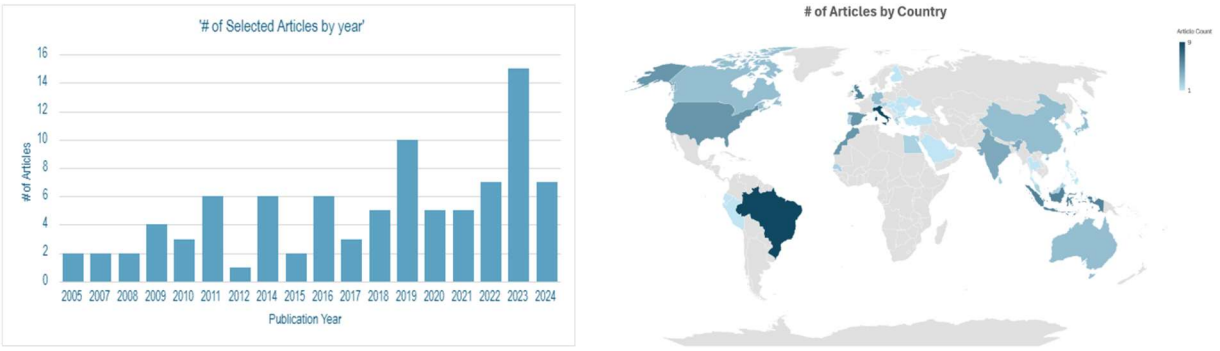

Figure 2 The distribution of the number of selected articles by year (Left), Heat Map of author Contributions to Selected Articles by Country (Right)

In terms of technology used, nine articles used Dialogflow with NLP, 24 used NLP or Artificial Intelligence Techniques other than LLMs, while five articles mentioned using LLMs. Another 17 articles only mentioned technologies such as LINE, Telegram, Java, Flash etc. but did not specify NLP, AI, or LLMs in developing the chatbot. Five articles used multiagent systems such as JADE, Jack, Jadex, etc. Interestingly if filtering by the last three years since LLMs have been released to the public, 14% of articles published during 2022, 2023, and 2024 used LLMs. Some articles did not provide any information about the technology they used (n = 28).

RQ1: What is the purpose of developing conversational agents?

Four themes emerged from the purpose of the conversational agents, the first one was *improving the learning experience for the students by making it more interactive and engaging* with the help of conversational agents (n = 13) as seen in [10], [11], [12]. The second one was *basic learning assistance*, which means helping students find information more easily or helping with logistical tasks (n = 11). The third one aimed to *personalize and adapt the learning* to the learner's knowledge level and learning needs by recommending appropriate learning tasks to the learner (n = 12) [13], [14], [15]. Finally, some of them saw the potential of conversational agents to *target students' retention* by identifying learners who were struggling to prevent students from dropping out (n = 1) [16].

RQ1.1: What learning phase can be inferred from the purpose of the agent?

As mentioned above, the Behaviorist Phase is where students learn basic system functions through teacher-guided instruction. The Cognitive Phase deepens engagement by challenging students to use the LMS for problem-solving and critical thinking. The Individual Constructivist Phase promotes self-directed learning, encouraging practical application of knowledge and personal reflection. Finally, the Social Constructivist Phase emphasizes collaboration and peer interaction, using the social features of the LMS to enhance learning and solidify knowledge. Table 2 shows some of the articles and the quotes that helped infer the phases of [7] learnability model.

In addition, at a general level, the most prominent phase was Cognitive with 32 number of articles, followed by Behaviorist with nine, however for most articles there was an overlap between them classifies into having two phases, with nine containing *Behaviorist & Cognitive* phases, seven *Cognitive & Individual Constructivist*, five *Cognitive & Social Constructivist,* and five *Behaviorist, Cognitive & Individual Constructivist* phases. Only two articles mapped to *Cognitive, Individual Constructivist, & Social constructivist* phases (see Figure 3). Ten articles did not map to any phase.

Table 2 Learnability Framework or Theory mentioned in selected articles

Reference	Learning framework or Theory	Quote
[17] page 1	Cognitivism	"The preparation of cognitivist learning paths aimed at the acquisition of subject related knowledge and skills"
[18] page 1	Cognitivism	"We programmed STUART to meet reactively and proactively students' main demands, based on the corpus of interactions scenarios on previous courses"
[19] page 481	Cognitivism, social constructivism	"Collaborative learning is an active and student-centered process, who expresses ideas, articulates thinking, develops representations, elaborates cognitive structures and engages in a social validation process regarding his/her new knowledge in collaboration with peers."
[20] page 2	Cognitivist, Socio-constructivist	"To develop and experiment learning paths leveraging different approaches (e.g: cognitivist, socioconstructivist) through significant online interaction; To design learning environments able to support ever changing learning paths and processes that teachers and tutors can adapt to arising needs."
[21] page 1	Constructivist	"Through analysis of constructivist learning theory, we present a new learning strategy with pedagogical agent. Based on this strategy, we take CG course in practice as an example to implement our multi-user application for individual learning and collaborative learning"
[22] page 1	Cognitivist	"Our model provides the agents with a cognitive architecture to make sound reasoning on its knowledge base"
[23] page 1	Socio-cognitive	"Pedagogical agents for social music learning in Crowd-based Socio-Cognitive Systems"

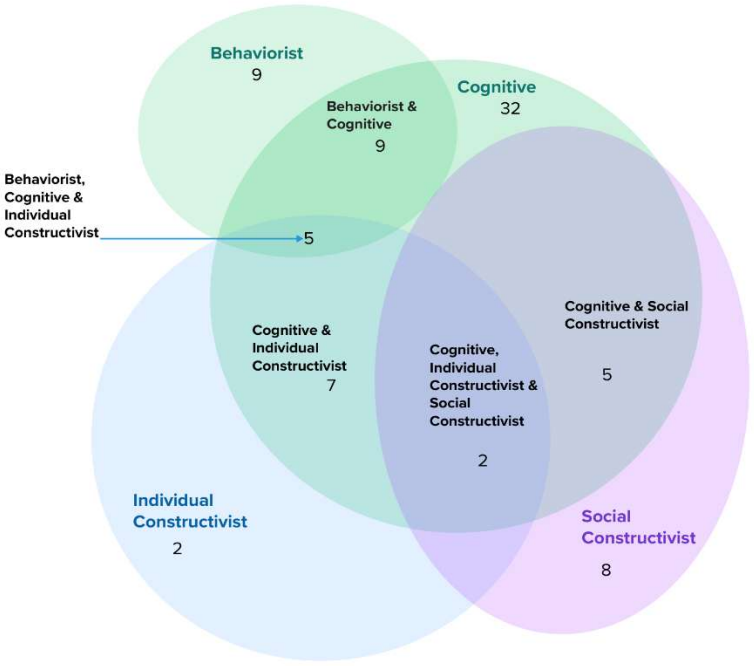

Figure 3 Venn Diagram showing phases applicable to Selected Articles

RQ2: ***What is the justification (if any) provided for conversational agents to be integrated or developed for LMS or VLE?***

In the inductive thematic analysis of integrating conversational agents into educational systems, three main themes emerged: *supporting educational actors, technical reasons, and research and data acquisition.* The first theme, *supporting educational actors*, includes the most direct benefits for students and instructors. The primary subtheme, *Further Support Students Outside of the Classroom*, appeared in 55 articles, highlighting the role of conversational agents in providing ongoing, personalized support beyond the classroom. For example, one article suggested that these conversational agents can support students 24/7 [24]. The subtheme *Improve Students' Written Skills*, mentioned in 3 articles, focuses on enhancing students' writing through interactive feedback. Another subtheme, *Helping Instructors*, noted in 2 articles, describes how conversational agents help teachers by automating routine tasks and answering frequent questions.

The second theme, *technical reasons*, relates to improving the infrastructure within educational systems. The main subtheme, *Enhance the LMS*, mentioned in 11 articles, is about using agents to improve Learning Management Systems, recognizing shortcuts of these platforms such as differences between different instructional design approach [13], [17], or difficulties accessing information [25]. *Accessibility*, discussed in 2 articles, refers to being able to comply with accessibility features. Finally, one article mentioned that there is *Dominance of LMS Over Other Systems*, suggesting using agents to give an LMS an edge over other platforms.

The third theme, *research and data acquisition*, found in 6 articles, focuses on using conversational agents for educational research by collecting data on students. The research proposed was both educational [13] and technical [26].

RQ3: What learning framework or theory is mentioned in the articles?

Most of the articles did not mention learning framework or theories that underpinned the development or integration of the conversational agents, however, 15% of them did. These articles included theories such as Self-Regulated Learning (SRL) [14], [27], Self Determination Theory (SDT) [28], Vygotsky's theory of social interaction [19], Vygotsky's theory of active learning and Zone of Proximal Development [18], Cognitivism, Constructivism, Social Constructivist, Activity Theory [18], Learning by teaching [29], and Embodied, Situated, Distributed Language Learning theoretical framework [30].

RQ4: What is the role of engineering education in developing these conversational agents?

In our review, we found that 20 of the articles did not specify any author affiliation. Among the remaining 70 articles, 28 were written by authors from multiple disciplines, showcasing a strong interdisciplinary approach. Conversely, 27 articles were authored by teams from the same field, with most of these affiliations predominantly within Computer Science and other STEM fields,

excluding engineering. Among these, roughly five articles had authors affiliated with Artificial Intelligence, and about nine articles were related to Engineering disciplines. Additionally, nine articles featured unique affiliations with Education-related subjects. Only one article, authored by [16], was from the field of Engineering Education.

Limitations

The limitations of this review include challenges such as not being able to access some of the articles, which could potentially skew the comprehensiveness of our analysis. Additionally, the absence of a formal quality assessment for the studies included means that the findings are dependent on the integrity and rigor of the published works. While this approach reduces the potential for reviewer bias, it also increases the reliance on the quality of the available literature. However, it is important to note that this limitation is somewhat mitigated by our exclusive use of peer-reviewed sources, ensuring a baseline level of scholarly rigor and credibility in the studies that were analyzed.

Discussion

Over the past three years, there has been a noticeable increase in the publication of articles related to conversational agents, hinting at a surge in their development and integration into educational technology. Yet, the geographic distribution of the authors of these articles reveals a significant trend: most of the work has been conducted outside the United States, suggesting that U.S. educational institutions may have more stringent regulations or different priorities that affect the adoption of such technologies. This observation raises questions about the global distribution of educational innovations and the factors influencing technological integration in U.S. educational settings.

In terms of technology, there is a prevalence in the use of Python for developing conversational agents. This could be due to the increasing use of Python ecosystems in general or a tendency to prototype these tools rather than fully implement them. Additionally, the number of studies mentioning the use of Large Language Models (LLMs) was unexpectedly low. This discrepancy could be attributed to the slow pace of academic publishing or the cautious use of LLMs due to concerns about privacy, cost, and cybersecurity, especially when integrating these systems into existing educational technologies. It remains to be seen whether future publications will reflect a more robust integration of conversational agents built with LLM platforms. In addition, Moodle, Blackboard, OLAT, and Google Classroom were the commercial systems with the most integrations, which could indicate that these platforms are more prepared to receive integrations or offer more plug-and-play solutions.

Finally, a critical gap persists in literature: the limited discussion of learning theories or educational frameworks in these studies. Our findings are consistent with previous literature reviews, which also report that only a minority of articles address learning theories or frameworks [2], [4]. This gap may reflect either an oversight in reporting foundational

educational theories or a lack of awareness among researchers. Given that most authors hail from computer science and other STEM fields and considering that many of these studies remain in the cognitive developmental phase, there appears to be a significant lack of awareness. Moreover, only a few studies include educational specialists, and even fewer involve engineering educationists, emphasizing the urgent need for interdisciplinary collaboration. Such collaboration is crucial to ensure that the development and integration of conversational agents are effective and fully leverage the technology's impact on learning.

Conclusion

Conversational agents have long been developed for learning management systems, sometimes integrated with LMSs and sometimes working separately from LMSs. In our systematized literature review we shortlisted 102 articles on conversational agents for LMSs. We found that conversational agents for education are developed for reasons mostly falling under one of four categories: improving the learning experience for the students by making it more interactive and engaging, basic learning assistance, personalizing and adapting the learning, and targeting students' retention. These are integrated with LMSs for *supporting educational actors, technical reasons, and research and data acquisition.* However, despite being developed for educational settings and for educational purposes, conversational agents are rarely developed explicitly based on learning theories or frameworks. The learning framework, if any, is mostly implicit. There is potential to intentionally develop and investigate conversational agents for LMSs based on learning theories and frameworks suitable for the educational setting. Future work can focus on investigating factors affecting long-term use of conversational agents integrated into LMSs.

Acknowledgements

This work was developed with the support of the University of Florida Presidential Award. The authors sincerely appreciate the University of Florida for its funding and continued support in advancing this research.

References

[1] A. Bozkurt, “Generative artificial intelligence (AI) powered conversational educational agents: The inevitable paradigm shift,” *Asian Journal of Distance Education*, vol. 18, no. 1, Art. no. 1, Mar. 2023, Accessed: Jan. 15, 2025. [Online]. Available: https://www.asianjde.com/ojs/index.php/AsianJDE/article/view/718

[2] B. Khosrawi-Rad *et al.*, “Conversational agents in education–a systematic literature review,” 2022.

[3] M. D. Koretsky and A. J. Magana, “Using Technology to Enhance Learning and Engagement in Engineering,” *Advances in Engineering Education*, 2019, Accessed: Jan. 15, 2025. [Online]. Available: https://eric.ed.gov/?id=EJ1220296

[4] S. H. Tanvir and G. J. Kim, “WIP: Generative and Custom Chatbots in Computer Programming Education and their Effectiveness A Systematic Literature Review,” in *Frontiers in Education 2024*, Washington DC, Oct. 2024.

[5] L. Labadze, M. Grigolia, and L. Machaidze, “Role of AI chatbots in education: systematic literature review,” *Int J Educ Technol High Educ*, vol. 20, no. 1, p. 56, Oct. 2023, doi: 10.1186/s41239-023-00426-1.
[6] B. Freeman and K. Aoki, “ChatGPT in education: A comparative study of media framing in Japan and Malaysia,” in *Proceedings of the 2023 7th International Conference on Education and E-Learning*, in ICEEL ’23. New York, NY, USA: Association for Computing Machinery, May 2024, pp. 26–32. doi: 10.1145/3637989.3638020.
[7] S. Hadjerrouit, “Learning Management Systems Learnability: Requirements from Learning Theories,” presented at the EdMedia + Innovate Learning, Association for the Advancement of Computing in Education (AACE), Jun. 2005, pp. 966–971. Accessed: Dec. 10, 2024. [Online]. Available: https://www.learntechlib.org/primary/p/20205/
[8] D. Moher, A. Liberati, J. Tetzlaff, D. G. Altman, and the P. Group*, “Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement,” *Annals of Internal Medicine*, Aug. 2009, Accessed: Jan. 13, 2025. [Online]. Available: https://www.acpjournals.org/doi/10.7326/0003-4819-151-4-200908180-00135
[9] J. W. Creswell and J. D. Creswell, *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches*. SAGE Publications, 2017.
[10] E. Puertas, G. Mariscal-Vivas, and S. Martínez-Requejo, “Development of chatbots connected to Learning Management Systems for the support and formative assessment of students,” in *ACM Int. Conf. Proc. Ser.*, Association for Computing Machinery, 2023, pp. 14–18. doi: 10.1145/3637989.3637998.
[11] K. Gaglo, B. M. Degboe, G. M. Kossingou, and S. Ouya, “Proposal of conversational chatbots for educational remediation in the context of covid-19,” in *Int. Conf. Adv. Commun. Technol. ICACT*, Institute of Electrical and Electronics Engineers Inc., 2022, pp. 354–358. doi: 10.23919/ICACT53585.2022.9728860.
[12] Q. Alqahtani and O. Alrwais, “Building a Machine Learning Powered Chatbot for KSU Blackboard Users,” *Intl. J. Adv. Comput. Sci. Appl.*, vol. 14, no. 2, pp. 781–789, 2023, doi: 10.14569/IJACSA.2023.0140290.
[13] V. Paunovic, S. Uyar, and M. Tanic, “Implementing Chat GPT in Moodle for Enhanced eLearning Systems,” in *CEUR Workshop Proc.*, Saqr M., S. of C. University of Eastern Finland Yliopistokatu 2, Joensuu, Lopez-Pernas S., S. of C. University of Eastern Finland Yliopistokatu 2, Joensuu, Conde M.A., E. de I. University of Leon Campus de Vegazana S/N, Leon, Conde M.A., E. P. S. de Z. Universidad de Salamanca Av. de Requejo, Zamora, Milic M.R., and F. of I. T. Belgrade Metropolitan University Tadeusa Koscuska 63, Belgrade, Eds., CEUR-WS, 2023, pp. 147–160. [Online]. Available: https://www.scopus.com/inward/record.uri?eid=2-s2.0-85195427565&partnerID=40&md5=3707774a42981c05b820c035f85d7741
[14] W. Kaiss, K. Mansouri, and F. Poirier, “Chatbot Design to Help Learners Self-Regulte Their Learning in Online Learning Environments,” in *Proc. - IEEE Int. Conf. Adv. Learn. Technol., ICALT*, Chang M., Chen N.-S., Kuo R., Rudolph G., Sampson D.G., and Tlili A., Eds., Institute of Electrical and Electronics Engineers Inc., 2023, pp. 236–238. doi: 10.1109/ICALT58122.2023.00075.
[15] G. C. S. Wijayawardena, S. G. T. S. Subasinghe, K. H. P. Bismi, and A. Gamage, “AI and Machine Learning Based E - Learning System For Secondary Education,” in *IEEE Int. Conf. Converg. Technol., I2CT*, Institute of Electrical and Electronics Engineers Inc., 2022. doi: 10.1109/I2CT54291.2022.9824643.

[16] V. S. Aluri, J. Alam, and J. Rencis, “Multimedia Aided Prototype e-Learning (MAPEL) modules for teaching the fundamentals of the finite element method,” in *114th Annual ASEE Conference and Exposition, 2007, June 24, 2007 - June 27, 2007*, in ASEE Annual Conference and Exposition, Conference Proceedings. Honolulu, HI, United states: American Society for Engineering Education, 2007, p. Dassault Systemes; DuPont; et al; HP; IBM; Lockheed Martin.

[17] P. G. Rossi and S. Carletti, “MAPIT: a pedagogical-relational ITS,” *Procedia Computer Science*, vol. 3, pp. 820–826, Jan. 2011, doi: 10.1016/j.procs.2010.12.135.

[18] A. R. P. Damasceno, A. R. Martins, M. L. Chagas, E. M. Barros, P. H. M. Maia, and F. C. M. B. Oliveira, “STUART: An intelligent tutoring system for increasing scalability of distance education courses,” in *IHC - Proc. Braz. Symp. Hum. Factors Comput. Sys*, Kemczinski A., Santos C.Q., Trevisan D.G., Gasparini I., Zaina L., Pereira M., Mota M., Villela M.L.B., Falcao T.P., Conte T.U., and Darin T.G.R., Eds., Association for Computing Machinery, Inc, 2020. doi: 10.1145/3424953.3426640.

[19] L. M. R. Tarouco, C. Silveira, and A. L. Krassmann, “Collaborative learning with virtual entities,” in *Lect. Notes Comput. Sci.*, Zaphiris P. and Ioannou A., Eds., Springer Verlag, 2018, pp. 480–493. doi: 10.1007/978-3-319-91743-6_35.

[20] P. G. Rossi, S. Carletti, and M. A. Impedovo, “Learning environments supported by software agents and chat-bot,” in *ICSIT - Int. Conf. Soc. Inf. Technol., Proc.*, Welsch F., Lesso W., Oropeza A., Callaos N., and Tremante A., Eds., International Institute of Informatics and Systemics, IIIS, 2011, pp. 341–345. [Online]. Available: https://www.scopus.com/inward/record.uri?eid=2-s2.0-85032961280&partnerID=40&md5=f6ee34693966806e01526b6e4596f54d

[21] Z. Pan, J. Zhu, M. Zhang, and W. Hui, “Collaborative virtual learning enviromment using synthetic characters,” in *ADVANCES IN WEB-BASED LEARNING - ICWL 2005*, vol. 3583, R. Lau, Q. Li, R. Cheung, and W. Liu, Eds., 2005, pp. 364–374.

[22] B. Nakhal and R. Querrec, “Cognitive embodied conversational agents in virtual learning environment,” in *2017 29th International Conference on Microelectronics (ICM), 10-13 Dec. 2017*, in 2017 29th International Conference on Microelectronics (ICM). Piscataway, NJ, USA: IEEE, 2017, p. 4 pp. doi: 10.1109/ICM.2017.8268858.

[23] M. Yee-King and M. D’Inverno, “Pedagogical agents for social music learning in crowd-based socio-cognitive systems,” in *Sintelnet WG5 Workshop on Crowd Intelligence: Foundations, Methods, and Practices, CROWD 2014, January 8, 2014 - January 9, 2014*, in CEUR Workshop Proceedings, vol. 1148. Barcelona, Catalonia, Spain: CEUR-WS, 2014, pp. 76–93.

[24] D. F. Murad, A. G. Iskandar, E. Fernando, T. S. Octavia, and D. E. Maured, “Towards Smart LMS to Improve Learning Outcomes Students Using LenoBot with Natural Language Processing,” in *2019 6th International Conference on Information Technology, Computer and Electrical Engineering (ICITACEE)*, Sep. 2019, pp. 1–6. doi: 10.1109/ICITACEE.2019.8904311.

[25] B. Babou, K. Sylla, M. Y. Sow, and S. Ouya, “Integration of a Chatbot to Facilitate Access to Educational Content in Digital Universities,” in *Int. Conf. Adv. Commun. Technol. ICACT*, Institute of Electrical and Electronics Engineers Inc., 2024, pp. 311–314. doi: 10.23919/ICACT60172.2024.10471975.

[26] Kwang Sik Chung and T. C.-T. Kuo, “Studies Suspension Prevention System of Distance University using Analysis of Learning Activity and Learner’s Big Data,” in *5th*

International Conference on Data Mining, Communications and Information Technology (DMCIT 2021), 16-18 April 2021, in J. Phys., Conf. Ser. (UK), vol. 1944. UK: IOP Publishing, 2021, p. 012001 (6 pp.). doi: 10.1088/1742-6596/1944/1/012001.

[27] M. Calle, E. Narváez, and J. Maldonado-Mahauad, "Proposal for the Design and Implementation of Miranda: A Chatbot-Type Recommender for Supporting Self-Regulated Learning in Online Environments," in *CEUR Workshop Proc.*, Klinge Orlando K.O., C. S. J. s/n U. Universidad Catolica de Santa Maria Arequipa, Maldonado-Mahauad J., and Av. 12 de Abril. S. C. Universidad de Cuenca, Eds., CEUR-WS, 2021, pp. 18–28. [Online]. Available: https://www.scopus.com/inward/record.uri?eid=2-s2.0-85122674629&partnerID=40&md5=a32616f642adc3620d7286bf77cec982

[28] B. Aksu Dünya and H. Yıldız Durak, "Hi! Tell me how to do it: examination of undergraduate students' chatbot-integrated course experiences," *Qual. Quant.*, vol. 58, no. 4, pp. 3155–3170, 2024, doi: 10.1007/s11135-023-01800-x.

[29] G. Mehlmann, M. Haring, R. Buhling, M. Wissner, and E. Andre, "Multiple agent roles in an adaptive virtual classroom environment," in *Intelligent Virtual Agents. 10th International Conference, IVA 2010, 20-22 Sept. 2010*, in Intelligent Virtual Agents. Proceedings 10th International Conference, IVA 2010. Berlin, Germany: Springer Verlag, 2010, pp. 250–6. doi: 10.1007/978-3-642-15892-6_26.

[30] Y. Wang, S. Petrina, and F. Feng, "VILLAGEVirtual Immersive Language Learning and Gaming Environment: Immersion and presence," *BRITISH JOURNAL OF EDUCATIONAL TECHNOLOGY*, vol. 48, no. 2, pp. 431–450, Mar. 2017, doi: 10.1111/bjet.12388.