

AI-Supported Learning in Online Discussion Forums: A Scoping Review

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Abstract: As the popularity and accessibility of artificial intelligence (AI) in learning continue to rise, online education has increasingly incorporated AI. It is imperative to investigate how AI in the scholarly community supports the learning of autonomous students. This scoping review investigated articles that employed AI in discussion forums. The objective of this study is to develop a summary that denotes the effective integration of AI in discussion forums, thereby characterizing the overall learning experience. In accordance with the search, appraisal, synthesis, and analysis (SALSA) framework, the preferred reporting items for systematic reviews and meta-analyses (PRISMA) flow diagram was employed to design the article screening and selection process. Scopus was utilized for the literature search, resulting in the identification of twelve articles that met the predetermined inclusion and exclusion criteria. The extracted articles covered the following six applications: intelligent tutoring systems, AI-assisted apps, chatbots, automatic formative assessment, AI teaching assistants, and AI-assisted lifelong learning assistants. Three types of man-machine partnerships related to the activities are discussed: student-AI partnerships, student-AI-student partnerships, and student-AI-teacher partnerships, the latter being the most commonly observed. The generated content was frequently processed through teacher adjustments and checks. Components of community of inquiry theory were adapted as indicators. Cognitive presence was observed to be more predominant than social presence, with a particular emphasis on individual learning achievements. Three distinct perspectives regarding the role of AI in learning were identified. The first perspective posited that AI functioned as a virtual teacher, supplementing the teaching functions of human teachers and delivering information to students. In the second perspective, AI facilitated students in collecting information by enabling interactions with messages or peers. In the third perspective, the significance of the automatic evaluation function, which assessed learning activities and provided feedback to enhance the system while simultaneously implementing immediate changes in the learning process, was acknowledged. Regarding the role of communication, teachers clearly intended for students to acquire knowledge through it. Despite the focus on assisting individual learners, each article encompassed references from a wide range of fields and exhibited substantial diversity overall. Consequently, the domain of discussion forums with AI was depicted through the complex interplay between technology, pedagogy, and the learning environment. This context is known as entangled pedagogies, which emphasize understanding the interconnections among these elements and their reciprocal influences. In summary, AI was predominantly utilized in the form of chatbots and GenAI in discussion forums. Emerging AI roles included virtual teachers, peer/message matching, and automated evaluation. Aggregated information was presented in a manner that supported student learning. AI also served as a conduit between students and teachers.

Keywords: Artificial intelligence, Community of inquiry, Discussion board, Discussion forum, PRISMA, SALSA framework

1. Introduction

1.1 AI-Supported Discussion Forums

The practical use of remote education in response to the global pandemic has resulted in a significant increase in interest in autonomous learning (Kukulska-Hulme et al., 2022). In contrast to traditional teacher-centered instruction, online autonomous learning courses prioritize self-directed learning (Lasfeto, 2020). Furthermore, learners are required to independently design learning processes for organizing self-regulated learning (Saks and Leijen, 2014). Within this context, students must recognize that they do not merely serve as passive recipients of instruction; instead, they actively engage in the learning process (Yoshida, 2022).

Regarding learning assistance, students require support in developing efficient study habits and techniques that will enable them to regulate their own learning (Murray, 2014). Innovative online services and tools can enhance learners' autonomy and empower them to take greater control of their learning experiences. These tools include

websites and mobile applications specifically designed to facilitate scheduling, planning, time management, and reflection (Giannini, 2023). Learning Management Systems (LMSs) have been utilized in instructional settings for over two decades (Hassan et al., 2020).

Discussion forums within LMSs facilitate communication among users, providing teachers with the opportunity to manage protocols and respond to student inquiries while allowing students to communicate with their peers (Onyema et al., 2019). Discussion forums serve as a tool for fostering an online community (Ducate and Lomicka, 2024). In the discussion forums, students can communicate through even superficial or low-level discussions, which involve activities such as summarizing information or expressing agreement or disagreement with their peers (Sakeef et al., 2025). The application of collaborative online learning methodologies has been significantly enhanced through the use of discussion forums (Kalmar et al., 2022; Lu and Smiles, 2022). Discussion forums represent an optimal setting for the implementation of AI, which is a tool that enhances student learning (Spence et al., 2024). As AI becomes increasingly prevalent, cases for its application in online learning environments are expanding (Wang and Song, 2024). AI enhances these communications by mediating interactions between players as virtual tutors or virtual peers to support learners and introducing novel options for learning activities, such as Generative AI (GenAI) or translation services (Ackermann et al., 2025). The integration of GenAI in education is occurring at an unprecedented pace, outstripping the time required for curriculum validation and updates (Giannini, 2023). Additionally, the implementation of AI has the potential to assist teachers in managing a substantial volume of inquiries and overseeing lesson protocol management among diverse and heterogeneous participant groups (Leondes, 2010; Chang et al., 2023). This technological advancement presents a spectrum of opportunities and challenges within the field of education (Jose and Jose, 2024).

1.2 Community of Inquiry Framework

The online learning communication has the potential to facilitate the integration of individual learning, thereby fostering a sense of belonging within a community (Peacock et al., 2020). Recent studies have reported on the collaborative learning processes that have emerged within a Community of Inquiry (CoI) across various types of higher-order thinking (Garrison, 2007). The experiences within online communities encompass three interrelated components of CoI: social presence (SP), cognitive presence (CP), and teaching presence (TP) (Rolim et al., 2019; Guo et al., 2021). The CoI framework for online learning serves as a theoretical model within discussion forum (DeNoyelles and Mannheimer Zydney, 2014).

- SP in the discussion forums is essential for establishing effective practices that foster an environment conducive to community building and the development of shared understanding and trust, where students feel connected and supported in their learning. Generally, a higher frequency of posts is positively correlated with enhanced social presence.
- CP is intricately linked to the processes of knowledge construction and problem-solving. It encompasses the capacity to create, construct, and confirm meaning through ongoing reflection and discourse.
- TP aims to achieve learning outcomes that are personally meaningful and educationally valuable to students through effective design and facilitation. It addresses the problems of teachers face due to limited time and the overwhelming demands of facilitating students.

CP elucidates the mechanisms through which students acquire knowledge, whereas SP pertains to learners' ability to connect socially and emotionally with learning materials and environments (Green, Wyllie and Jackson, 2014).

In light of these elements, which highlight the application of AI in facilitating learning within educational frameworks, a comprehensive investigation was undertaken to understand the evolving role of AI. Furthermore, this study illustrates the role and function of AI. The objective of this study is to develop a summary that denotes the effective integration of AI in discussion forums, thereby characterizing the overall learning experience. The findings will elucidate how AI supports learners' academic interactions in online discussion forums and will contribute to providing knowledge materials that can be beneficial for future course designers' planning and educators' instruction.

1.3 Methodological Framework

This study employed a scoping review methodology to synthesize current literature in a transparent manner. A scoping review is a method of literature review utilized for knowledge synthesis that adheres to a systematic approach to delineate evidence on a specific topic. Its primary objective is to comprehensively map the existing

literature, thereby identifying the principal concepts within a research area, including relevant theories, sources, key issues, and knowledge gaps. (Tricco, et al., 2018). The scoping review approach is advantageous when a body of literature has not yet undergone a comprehensive review (Munn et al., 2018). The protocol of the search, appraisal, synthesis, and analysis (SALSA) framework was utilized, as it provides a systematic process for conducting reviews that ensures methodological rigor (Table 1) (Grant and Booth, 2009).

Table 1: SALSA framework

Phase	Outcome	Methods
Search	Search strategy	Searching strings
	Search articles	Search databases and article identification
Appraisal	Selecting articles	Defining inclusion and exclusion criteria
Synthesis	Extracting data	Defining extraction fields
	Categorizing the data	Categorization of fields
Analysis	Data analysis	Quantitative categories, description, and narrative analysis
	Results	Data analysis, identification of gaps, and comparison of results

1.4 Research Questions

The present study investigates published articles that utilize AI to support student learning within online discussion forums. Articles that involve records of learning behaviors and the effects of AI are selected and analyzed. The following three research questions were formulated:

RQ1 What is the role of AI in facilitating student learning within discussion forums?

RQ2 In what ways do AI-powered tools support learners in online discussion forums?

RQ3 What are the trends in learning in the discussion forum when AI services are utilized?

2. Method

In accordance with the SALSA framework, the preferred reporting items for systematic reviews and meta-analyses (PRISMA) flow diagram was employed to illustrate the article screening and selection process (Figure 1) (Page et al., 2021). The compliance of all extracted articles was examined and confirmed for each separate item of the PRISMA-ScR checklist (Prisma Executive, 2024.). The findings of the review are conveyed through descriptive summaries or data categorization, rather than through quantitative summaries or meta-analysis.

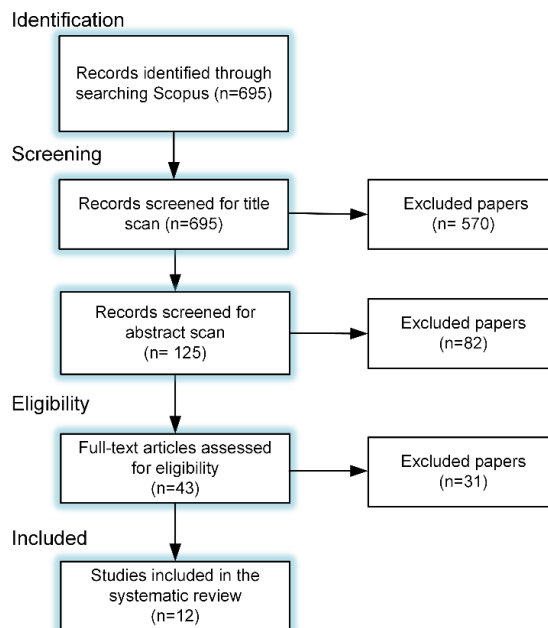


Figure 1: Flow diagram of literature search and study selection

2.1 Search

This phase entailed the identification of pertinent sources of information. The search query utilized variations of the following terms, applied to the title, abstract, and keywords: (“AI” OR (“artificial” AND “intelligence”)) AND (“discussion” AND “forum”) OR (“discussion” AND “board”). The search parameters were confined to articles published in English. Articles were extracted from Scopus on June 2, 2025, resulting in the identification of a total of 695 articles.

2.2 Appraisal

2.2.1 Study screening and selection

The selection of articles concentrated on studies that investigated practical online learning within discussion forums to elucidate the effects of AI. The established inclusion and exclusion criteria for the articles are delineated in Table 2. Following the application of the screening criteria to the titles, the number of articles was reduced to 125. Subsequently, the abstracts underwent a screening process, leading to the exclusion of 82 articles. The remaining 43 articles were assessed for eligibility through a comprehensive review of the full text and coding utilizing Atlas.ti version 9. Studies that collected relational data from post-interviews or post-questionnaires were excluded, while articles that specifically examined the practical communities themselves were extracted. Research studies conducted on AI trials that fall outside the realm of educational management have been excluded, as the findings of this study are specifically intended for use by educators tasked with implementation.

Table 2: Inclusion and exclusion criteria

Inclusion Criteria	<ul style="list-style-type: none"> • Empirical, primary research • AI featured by machine learning, deep learning, or natural language processing applications • AI-powered learning is concrete and focused • Use of AI service by students or connections from AI system to students • Existence of forum communication between participants • Conversational agents or chatbots are considered as participants (e.g. virtual teacher, tutor, assistant or peer)
Exclusion Criteria	<ul style="list-style-type: none"> • Not in English • Reviews, principles, or overviews of AI-based education: no practice is conducted • No real data on student learning with AI in the discussion forum • No information, feedback, or assistance provided to learners by AI • Data mining of forum messages: extracting targets for purposes other than providing a learning service • Measuring AI function takes precedence over learning assistance • Studies designed to deny the use of AI in self-directed learning

2.3 Synthesis

2.3.1 Data extraction

A data extraction schema for online discussion forums was proposed (Yu et al., 2024), and the present study selected two categories: study outline and study design (Table 3). The data fields in the data extraction schema were designed to align with the research objectives and questions of this study. The schema incorporated the field-weighted citation impact (FWCI), a time- and field-normalized citation metric provided by Scopus, which is less biased than traditional citation counts (Yu et al., 2020). These data fields are arranged to contribute to a deeper understanding of the unique characteristics of students and the role of AI in providing support.

Table 3: Data extraction schema

Category	Data field
Study Outline	Author, Publication year, FWCI, Used AI system, Outline of AI Function, Types of AI, Course Title, Content of Discussion, Participants
Study Design	Author, Publication year, Used Pedagogy, Emerged AI Effect, Challenging Part, AI effects on Students' Communication, AI Function on Student-Teacher Communication, Presences of Col, Appeared New Learning Mode

In the SALSA process, two reviewers independently conducted the screening. The retrieved results were subjected to a preliminary screening and subsequent removal process using EndNote 21. Any discrepancies were addressed through discussion, consultation of supplementary materials (e.g., AI system manuals), and clarification. The inter-rater reliability between the reviewers was measured at 88.8% at the title and abstract level and 96.2% at the full-text level.

2.4 Analysis

The analysis phase involved evaluating the utilization of AI and extracting meaningful information and effects. The key components of the twelve articles were organized according to the data extraction schema and tabulated based on the year of publication (Table 4-5 in Appendix 1-2). The subsequent step involved processing work to clarify the relationship between AI services and the implemented education.

3. Results

3.1 Study Outline

The extracted articles indicate that the reports in conference proceedings (n=9) significantly exceed those of journal articles (n=2) and a book chapter (n=1). This finding suggests an increased demand for the immediate reporting of results. Table 4 in Appendix 1 presents five pivotal views.

Firstly, two strategies for the utilization of AI emerged. The first strategy involved the implementation of market AI services within discussion forums (Irish et al., 2022; Lin et al., 2024; Sinha et al., 2024; Huo et al., 2024; Jureynolds, 2024). The second strategy comprised research trials that integrated publicly available AI repositories into the discussion forums (Kim and Shaw, 2009; Zylich et al., 2020; Wang et al., 2022; Chang et al., 2023; Liu et al., 2024). These attempt settings were frequently revised, resulting in ambiguous reporting of student numbers and quantitative data on learning activity records (Zylich et al., 2020; Teo and Tan, 2023; Sinha et al., 2024; Huo et al., 2024).

Secondly, the variety of AI types deployed in society was unevenly used in the discussion forums. Chatbots were extensively utilized to engage with students, and AI functioned as virtual tutors with their AI status clearly denoted (Zylich et al., 2020; Wang et al., 2021; Liu et al., 2024; Lin et al., 2024; Sinha et al., 2024; Huo et al., 2024; Jureynolds, 2024). In contrast, the types of "metaverse" and "multimodal" were conspicuously absent, indicating a lack of introduction of AI technologies in design, identification, authentication, and gamification. The student code of conduct was emphasized, influencing the development stall for gamification and edutainment in the metaverse. Conversely, students placed a higher value on the content of the information provided and exhibited minimal concern regarding the identity of the sender (Irish et al., 2022).

Thirdly, the influence of the student code of conduct is notably observable in the integration of generative AI tools, such as ChatGPT, into learning activities. Due to the pervasive recognition of their usefulness and necessity, measures have been implemented to mitigate issues such as the unauthorized use of GenAI outputs and concerns regarding the hallucination of GenAI-generated documents by incorporating usage measures into discussion forums (Lin et al., 2024). The aggregation of substantial data through interactions with GenAI raises ethical considerations (Yu, 2024). For instance, a case was documented in the lessons for a coding program, where the purpose of AI-generated messages was to offer guidance rather than to provide direct solutions. In this instance, AI responses to student inquiries are generated using prompts developed by teacher (Liu et al., 2024). In other situations, the scope of machine learning is constrained (Huo et al., 2024), and the format of questions is specified (Lin et al., 2024). The content of GenAI necessitated adjustments and checks by teachers, ranging from small tweaks to wholesale regeneration, to make it suitable for the learning context for which it was intended (Kukulska-Hulme et al., 2024).

Fourthly, a notable application of AI in this context includes the incorporation of AI into online systems with large-scale participant engagement, such as Massive Open Online Courses (MOOCs). These systems employ AI to address students' questions and provide course protocols, thereby ensuring that student behavior is proactively managed rather than overlooked (Zylich et al., 2020; Liu et al., 2024; Lin et al., 2024; Sinha et al., 2024; Huo et al., 2024).

Finally, there are AI services that facilitate and support learning communication. These include a system that recommends communication partners based on the homophily evident in students' profiles (Wang et al., 2022)

and a system that recommends a student based on the relevance of their posted messages (Kim and Shaw, 2009; Jureynolds, 2024).

As illustrated in Table 4, course offerings are predominantly concentrated in the domains of computer science and language training. This trend appears to reflect the adoption of social markets in translation and programming. Consequently, the educational domain presented in the articles seems misaligned with contemporary educational trends.

3.2 Study Design

Table 5 in Appendix 2 presents the data fields included in the study design.

The count of components of the Col framework, as identified in the extracted articles, revealed the following: CP in 11 articles, SP in 6 articles, and TP in 12 articles. Students were provided with tailored learning experiences, thereby facilitating the attainment of higher-order thinking skills. In the discussion forums, CP was observed to be more predominant than SP, with a particular emphasis on communication for individual learning achievements (Chang et al., 2023; Lin et al., 2024; Sinha et al., 2024; Huo et al., 2024). The preceding finding that students are perceived as a group of individuals who collaboratively participate in intentional critical discourse and reflection to construct personal meaning and establish mutual understanding in Col (Sevnanayan and Vaughan, 2024) was explicated.

Regarding man-machine partnership, layers were proposed based on interactions of people and groups within social and cultural environments (Campa, 2016; Teo and Tan, 2023). Three types of partnerships related to the activities in the discussion forums are the subject of this study.

First, individual student-AI partnerships (Teo and Tan, 2023; Chang et al., 2023; Lin et al., 2024) were established. Students received AI-generated reports on their contributions and advice for assignments with structural manner. Furthermore, the students were prompted to follow prepared patterns in their learning activities. The articles delved into the reasons why students generate ideas within specific confines and identified whether these patterns align with effective learning methodologies. Two out of three articles (Chang et al., 2023; Lin et al., 2024) did not involve SP, while all articles involved CP, in which teachers aimed to enhance students' knowledge acquisition using AI.

Next is the student-AI-student partnership (Irish et al., 2022; Wang et al., 2022; Jureynolds, 2024). The AI's role in this partnership was to navigate the discussion data and assist students in expanding their ideas through communication over time. Furthermore, the AI provided advice to introduce students' idea-building patterns and reflect on their learning processes. All studies of this partnership involved SP and CP, in which teachers clearly intended for students to acquire knowledge through communication.

Finally, there is the student-AI-teacher partnership (Kim and Shaw, 2009; Zylich et al., 2020; Wang et al., 2021; Liu et al., 2024; Lin et al., 2024; Huo et al., 2024). The AI addressed the shortage of teacher assistance, especially in large-scale courses. A potential solution to facilitate the establishment of high-level communication with virtual teachers was presented. Five of the six articles involved CP, and four of the six articles involved SP, in which teachers aimed to assist in developing students' competencies through scholarly communication. However, students felt that the advice and answers provided by the AI were inferior to those provided by teachers or tutors (Zylich et al., 2020; Wang et al., 2022; Lin et al., 2024; Huo et al., 2024).

Regarding the pedagogical theory outlined in Table 5, there is a lack of incorporation of contemporary theories. Conversely, the studies were designed to indicate the fundamental components expected to enhance the efficacy of online learning systems through the implementation of AI. Subsequently, a qualitative content analysis was conducted to discern analogous objectives and challenges in the collected literature and to ascertain the educational trends implicated in these studies. The selected 12 articles contained a total of 458 references. The mean reference age was 9.09 years ($\sigma = 10.67$), and given the novel nature of this domain, the cited literature is somewhat dated. The highest FWCI was observed (103.94) in the article with a short mean reference age (Liu et al., 2024) of 1.85 years. The results involved the collection and counting of these terms, which were then compiled into a Sankey diagram (Figure 2).

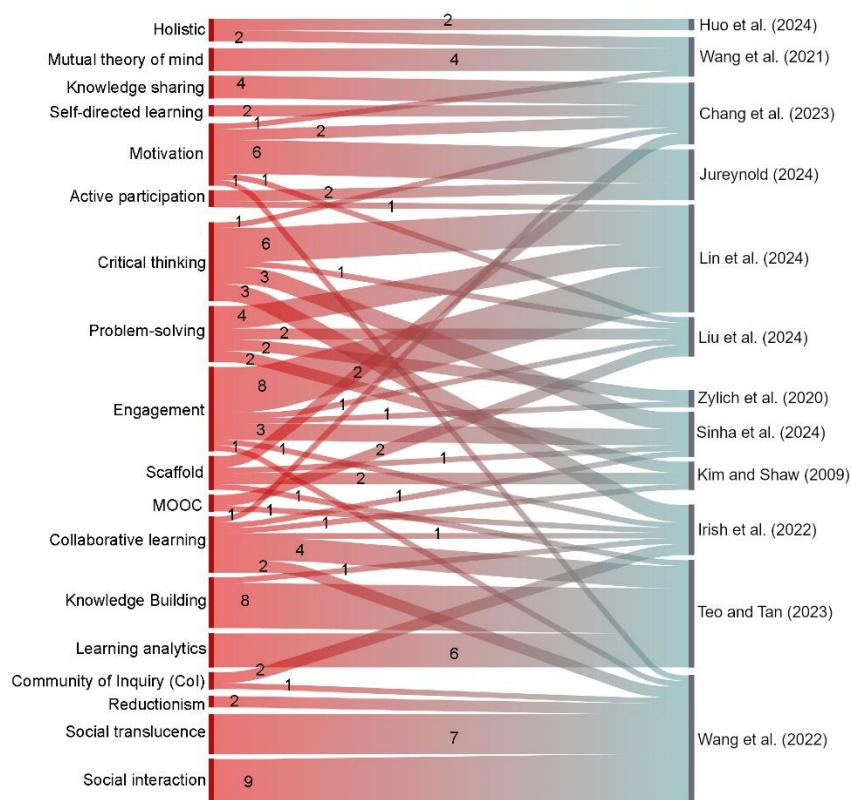


Figure 2: Sankey diagram of key terms of educational statements in articles

Given the wide range of man-machine partnerships employed, the educational terms extracted encompassed a broad array of topics, with minimal overlap among the emerging terms. A comprehensive analysis of the articles indicated that each article included a unique educational term. Nevertheless, instructional designs that incorporate active learning strategies—such as knowledge sharing, active participation, problem-solving, engagement, collaborative learning, and Communities of Inquiry (CoI)— have demonstrated consistent effects that enhance cognitive engagement. (Sakeef et al., 2025).

4. Discussion

4.1 RQ1 What is the Role of AI in Facilitating Student Learning Within Discussion Forums?

Broadly, three distinct perspectives regarding the role of AI in learning were identified. The first perspective posited that AI functioned as a virtual teacher, supplementing the teaching functions of human teachers and delivering information to students (Zylich et al., 2020; Wang et al., 2021; Liu et al., 2024; Lin et al., 2024; Sinha et al., 2024; Huo et al., 2024). In the second perspective, AI facilitated students in collecting information by enabling interactions with messages or peers (Kim and Shaw, 2009; Irish et al., 2022; Wang et al., 2022; Teo and Tan, 2023; Jureynolds, 2024). Additionally, in the third perspective, the significance of the automatic evaluation function (Chang et al., 2023), which assessed learning activities and provided feedback to enhance the system while simultaneously implementing immediate changes in the learning process, was acknowledged.

The extracted articles in this study clearly demonstrate that AI is utilized to promote conventional activities within discussion forums, such as knowledge acquisition and communication facilitation. The most sophisticated function is the information aggregation and notification system offered by AI. Fundamentally, the role of AI is to facilitate learners' access to external storage records. This role as a transducer is an extension of AI that serves to bridge the connection between the learner and the vast resources available in cyberspace. Conversely, this reveals the potential for the expansion of the learning environment in current discussion forums through the introduction of AI. Notably, the incorporation of generative AI (GenAI) created an environment that allowed students to access information beyond what was included in the course materials. Indeed, three of the articles selected for this study (Teo and Tan, 2023; Lin et al., 2024; Jureynolds, 2024) contained connections with individuals who had societal contexts outside classroom settings.

Regarding the provision of information by AI, the argument of its dual nature was noted, recognizing it as both a potential asset and a significant concern. In this context, the necessity for prior AI training has been emphasized, alongside a concurrent advocacy for prioritizing human expertise over excessive dependence on AI (Jose and Jose, 2024). Specifically, the researchers articulated that the benefits presented by AI outweigh the apprehensions and associated risks (Sinha et al., 2024).

4.2 RQ2 In What Ways do AI-Powered Tools Support Learners in Online Discussion Forums?

The AI technologies within discussion forums employed primarily consisted of GenAI (Liu et al., 2024; Lin et al., 2024; Sinha et al., 2024; Huo et al., 2024) and chatbots (Wang et al., 2021; Chang et al., 2023; Liu et al., 2024; Lin et al., 2024; Sinha et al., 2024; Huo et al., 2024; Jureynolds, 2024). While the existing review reports concerning online education and artificial intelligence published to date indicate that there are limited instances of the application of GenAI (Golrang and Sharma, 2025), the findings of this study will provide an opportunity to discuss GenAI in greater depth. The rationale behind the exclusive utilization of multimodal technology only in Teo and Tan (2023) can be attributed to the specific nature of the issues addressed in other discussion forums, which pertained solely to the domain of written communication. Although there is a general consensus in the overall articles that learning is a complex endeavor requiring information and support from teachers, there remains a paucity of initiatives that engage learners in activities outside an online course environment. Furthermore, the statuses of AI, peers, and teachers within the discussion forums were emphasized.

Holmes and Tuomi (2022) identified a taxonomy of twenty-two different applications of AI in education, ranging from student-focused to teacher-focused AI. The extracted articles in this study covered the following six applications: intelligent tutoring systems (Liu et al., 2024; Huo et al., 2024), AI-assisted apps (Jureynolds, 2024), chatbots (Ibid.), automatic formative assessment (Teo and Tan, 2023; Chang et al., 2023), AI teaching assistants (Wang et al., 2021; Wang et al., 2022; Liu et al., 2024), and AI-assisted lifelong learning assistants (Zylich et al., 2020; Wang et al., 2021; Liu et al., 2024; Lin et al., 2024; Sinha et al., 2024; Huo et al., 2024). The AI-assisted lifelong learning assistant showed a notable trend (n=6) and was the only item that ranked in the speculative stage of application in the taxonomy, confirming its cutting-edge nature in the domain.

AI revealed hidden patterns and prompted students to ask new questions while AI learned from students' inputs. Students could benefit from AI insights. In Zylich et al. (2020), students were advised the timing of posting a follow-up message. In Irish et al. (2022), AI introduced a relevant message before posting.

In an environment of information overload, AI aggregated vast amounts of data in milliseconds by tracking trends, compiling literature, or summarizing social sentiment, which could identify patterns invisible to the human eye. However, aggregated data was raw material; student curators needed to shape it into drafts worth posting. Students had to inject value, empathy, and purpose into machine outputs.

4.3 RQ3 What are the Trends in Learning in the Discussion Forum When AI Services are Utilized?

The diverse roles of AI were demonstrated in RQ1, and various applications utilizing AI were identified in RQ2. The domain of discussion forums with AI highlighted the complex interplay between technology, pedagogy, and the learning environment. This context is referred to as entangled pedagogies, which emphasize understanding the interconnections among these elements and their reciprocal influences (Fawns, 2022). The implementation of GenAI tools, such as ChatGPT, exemplifies the intricate relationship between technology and pedagogy, thereby necessitating ethical considerations and critical evaluation. The adoption of entangled pedagogies encourages teachers to reflect on the purposes and contexts of learning, as well as on how these are influenced by the intricate relationship among learning spaces, pedagogy, and technology (Wilde and White, 2025).

Moreover, a notable aspect of the integration of AI into online discussion forums was that many reports appeared to prioritize increasing support for difficulties faced by autonomous learners rather than focusing on quality control of student outcomes. In the extracted articles, the order of priority for the placement of supporters was as follows: virtual tutor > recommending a peer as a mentor > tutor > instructor. This could be considered an order of decreasing precision in instruction. However, since teachers needed to confront challenges with technology, there were limited opportunities to address the internal structure of the learners. This trend was likely attributable to the nascent stage of AI implementation in the discussion forums, as evidenced by the findings of RQ2, which demonstrated focused technologies and a concomitant focus on that application. Indeed, the effectiveness of the course was not examined from the perspective of any established educational theory. Additionally, there were articles with extremely limited use of education-related

terminology (Zylich et al., 2020; Huo et al., 2024). Although all these AI approaches seemed new, they were not grounded in a proactive understanding of pedagogy.

While a greater number of extracted terms pertained to relationships among students ($n = 8$) than to individual learning ($n = 6$) in Figure 2, the content analysis revealed a higher frequency of related sentences in individual learning ($t = 61$) compared to relationships among students ($t = 58$). Nevertheless, both autonomous students and interactions among students were reconfirmed as mechanisms for facilitating learning development.

Additionally, the learners in some studies were not unified (e.g., Zylich et al., 2020; Teo and Tan, 2023; Liu et al., 2024; Sinha et al., 2024; Huo et al., 2024; Jureynolds, 2024). The course enrollment for these courses was designed to cater to the needs of learners from various backgrounds. A substantial proportion of the articles were primarily case studies, characterized by ambiguous cohorts and a lack of clarity regarding the scope of application of the findings. Consequently, the subjects and issues of learning were not the focus of the research.

To comprehend the intricate learning landscape of AI, the analysis of discussion forum content is crucial as it offers valuable insights into student engagement, learning outcomes, and the overall effectiveness of online learning environments (Nadeesha, Weerasinghe and Abeyweera, 2025). Furthermore, it is essential to adopt a holistic view that considers the entangled elements (Fawns, 2022). To achieve a comprehensive understanding of learner behavior, a holistic method—social network analysis for exploring structural connections—has been used (Yoshida and Theeraroungchaisri, 2024). However, there are currently no reports on the application of AI in education within this context.

5. Conclusion and Future Research

In discussion forums, AI was predominantly utilized in the form of chatbots and GenAI. Emerging AI roles included virtual teachers, peer/message matching, and automated evaluation. Aggregated information was presented in a manner that supported student learning. AI also served as a conduit between students and teachers. The articles encompassed references from a wide range of fields and exhibited a diversity of perspectives. As all Col components in the articles focused on assisting individual learners, the domain was explicated by applying entangled pedagogies that led to an understanding of the interconnections among diverse roles and various applications of AI. The findings of this scoping review will serve to inform educators utilizing AI in online educational contexts regarding practical considerations and challenges. While the advent of AI has demonstrated the potential to expand the discussion forum environment into a broader cyberspace, there are no reports that provide a detailed analysis of the scholarly communication that has emerged from the discussion forum, and future research is anticipated. The utilization of AI into society and business raises the need for rapid solutions. The education sector is recognized as lagging in the social application and dissemination of AI technologies, highlighting the need for a dialogue to reach a consensus on the prerequisites for introducing AI into educational environments (Kukulska-Hulme et al., 2020). When students are allowed to use GenAI freely in their learning, a challenge arises in determining whether it is possible to create settings that "raise the bar" for learning objectives in educational theories (Sinha et al., 2024).

AI Statement: The authors declare that they have not used generative or assisted artificial intelligence tools at any stage of the paper's conception and revision. All content presented results exclusively from the authors' autonomous investigation, which guarantees originality, integrity, and compliance with ethical and scientific principles.

Ethical Declaration: This study does not require ethical approval.

Author Contributions: All authors contributed to the review and revision of the manuscript. MY conceptualized the study design. MY conducted the literature search and data extraction. MY authored the original draft of the manuscript. All authors independently screened the retrieved publications and extracted data, engaging in collaborative discussions to resolve any remaining conflicts until a consensus was achieved regarding the final inclusions.

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Appendix 1

Table 4: Study Outline

No	Author(year)	Indexes (FWCI/Quartile/Education)	Used AI system	Outline of AI function	Types of AI				Course title	Content of discussion	Participants
					Metaverse	Multimodal	GenAI	Chatbot			
1	Kim and Shaw (2009)	2.04 N/A N	TF-IDF and LSA	The PedaBot tool recommended related messages from the past in the relation to the current one. The MentorMatch tool recommended a peer as a mentor.	-	-	-	-	Operating Systems (for PedaBot)	Informal discussion including Q&A	114 students
2	Zylich et al. (2020)	1.57 Q3 N	DrQA, BERT, recurrent neural network	The AI program answered students' questions and predicted the timing of follow-up posts.	-	-	-	-	An introductory physics course.	Logistical Q&A	2,004 posts, N/A
3	Wang et al. (2021)	8.42 N/A N	N/A	It is a Q&A conversational agent and a virtual teaching assistant. The system was evaluated based on its anthropomorphism, intelligence, and likability.	-	-	-	Y	Human-computer interaction in online master of science courses	Jill Watson, an ML-based conversational Q&A agent, responded to students' questions about class logistics.	376 students
4	Irish et al. (2022)	0.91 N/A Y	PARQR tool, Information Retrieval Models, Universal Sentence Encoder	A post recommendation system helped students find relevant messages when writing new posts. The impact of this intervention on forum interactions and performance was evaluated.	-	-	-	-	Artificial Intelligence	General discussion	68 students

No	Author(year)	Indexes (FWCI/Quartile/Education)	Used AI system	Outline of AI function	Types of AI				Course title	Content of discussion	Participants
					Metaverse	Multimodal	GenAI	Chatbot			
5	Wang et al. (2022)	2.71 Q1 N	SAMI (inc. Named Entity Recognition), AI-MC (inc. NLP, Recommendation Algorithms)	Introduced SAMI in discussion forums to help students build social connections. Identified that AI-mediated social interaction fulfills the requirements of the socio-technical gap and social translucence.	-	-	-	-	3 classes of online Master of Science in Computer Science	Students: self-introduction, class-related discussions, Q&A. Instructors: announcements and Q&A. SAMI and instructor: can appoint students into private groups.	26 students
6	Teo and Tan (2023)	3.85 Book Chapter Y	N/A, function of corpus analysis	Scaffolds were placed as templates for posting opinions. The developed links were displayed as a network graph. Messages posted were also linked with terms found in texts and related web lesson records. AI leverages existing records to reconfigure and calibrate, thereby enhancing collective idea improvement. Learning analytics: report cards are to be provided.	-	Y	-	-	N/A, a literature class	Poetry study and appreciation	15-year-old students, N/A
7	Chang et al. (2023)	0.98 N/A Y	BERT-based AI model, and Chatbot; Pypal	An automated post-rating system and feedback by chatbot.	-	-	-	Y	Python Programming & Introduction to AI	To share learning experiences and insights	5,100 posts, 44 students
8	Liu et al. (2024)	103.94 N/A Y	CS50.ai, CS50 Duck	Emulating a competent teacher using GenAI. Ensuring access to GenAI is provided in a controlled manner.	-	-	Y	Y	Introductory course in computer science	Asking curricular matters and administrative matters. Using AI generated hints. Coding.	15 prompts/participant. more than 50,000 participants
9	Lin et al. (2024)	4.23 Q1 Y	ChatGPT, Canvas	ChatGPT was accessed using a designated prompt, and the collected information and remarks were posted on the discussion board.	-	-	Y	Y	2 sections of the same graduate-level online course	Students utilized ChatGPT to generate reports, then added their own reflections on the generated information and posted them in the discussion forum.	27 adult students
10	Sinha et al. (2024)	N/A Q3 Y	BoilerTAI, ChatGPT	The AI system prepared answers to queries on forums. TAs used it, following an approval	-	-	Y	Y	4 courses of computer science	Logistical Q&A	About 800

No	Author(year)	Indexes (FWCI/Quartile/Education)	Used AI system	Outline of AI function	Types of AI				Course title	Content of discussion	Participants
					Metaverse	Multimodal	GenAI	Chatbot			
				workflow to post the answers. It integrates collaboration between human expertise and AI to enhance the learning and teaching experience.							
11	Huo et al. (2024)	N/A N/A Y	GenAI, Chatbots with LLMs, Prompt Perfect, dair.ai, Llama 2	A chatbot with LLM was introduced to answer student questions and provide feedback that is interpretable and visually represented. GenAI was used as an online tutor to offer immediate feedback on coding and debugging.	-	-	Y	Y	Programming 2	Logistical Q&A, including exam, and assignments. Management.	About 1,110 students
12	Jureynolds (2024)	N/A Q3 N	N/A HiNative, the article did not specify details of AI system beyond	Connecting with native speakers in a commercial-based discussion forum for learning foreign languages. Communication templates are provided to ask, and native speakers are available to double-check students' answers or provide examples.	-	-	-	Y	Mandarin, not specified	Q&A regarding language learning	56 students

Note. Indexes include three things: FWCI score (top), quartile in Scopus (middle), and whether or not it is indexed in the education category (bottom), BERT = Bidirectional Encoder Representations from Transformers, GenAI = Generative AI, TF-IDF = Term Frequency–Inverse Document Frequency, LSA = Latent Semantic Analysis, PyPal = Python learning Pal, LLM = Large language model, CS50 = An online computer science course offered by Harvard University, HiNative = An online service that helps you learn foreign languages, N/A = Not disclosed in the publications, “-“ = N/A, NLP = Natural Language Processing

Appendix 2

Table 5: Study Design

No	Author(year)	Used Pedagogy	Emerged AI effect	Challenging part	AI effects on students' communication	AI function on Student-teacher communication	TP	SP	CP	Appeared New learning mode
1	Kim and Shaw (2009)	Collaborative learning	PedaBot retrieved moderately relevant messages. The number of messages per thread increased with PedaBot, especially for females. Students found PedaBot's features relevant and useful. MentorMatch results showed that 52% of responding students opened the mentor menu. Of those who noticed the links, 69%	Student discussions should focus on problem-solving rather than on task requests and commitments.	These tools are designed to promote student interactions.	N/A	Y	Y	Y	N

No	Author(year)	Used Pedagogy	Emerged AI effect	Challenging part	AI effects on students' communication	AI function on Student-teacher communication	TP	SP	CP	Appeared New learning mode
			reportedly clicked through to a discussion.							
2	Zylich et al. (2020)	Importance of TA in self-regulated learning	AI provides a virtual TA who interacts with many students at the same time. AI is not yet performing at the same level as humans when it comes to answering questions. The developed system performed better than other systems.	Difficulty conducting research using information from different parts of the document.	Delay a post to maintain a useful discussion among students.	Virtual TA	Y	Y	Y	N
3	Wang et al. (2021)	Mutual Theory of Mind	Students' perception of AI agents changed a lot over time. The students' perception of the AI agent was revealed through the use of complex language, readability, emotion, diversity, and adaptability.	The system could not be transferable to private dyadic interaction.	Student perception and interaction with JW might be interfered with by other students' interactions.	Virtual TA, Verbosity negatively associates with student perception of JW. Readability, sentiment, diversity, and adaptability were positively associated with anthropomorphism, intelligence, and likeability.	Y	N	N	N
4	Irish et al. (2022)	N/A	Students were successfully guided to a suitable ongoing thread, where they wrote follow-up comments and replies. The average number of initial posts in the discussion forum dropped by 55%. Passive learners did better than active learners. The decrease in initial posts did not discourage the students from participating in the forum.	To identify logistical questions typically contributes less than posts that demonstrate a deeper critical thinking.	The system led to fewer posts.	Decreased 8.35 instructor responses per instructor per assignment.	Y	Y	Y	N
5	Wang et al. (2022)	AI-mediated social interaction	Illustrated difficulties in remote social interactions. Identified ethical and social challenges such as user agency and privacy. Helped students build social connections. Found that deep social connections were uncommon yet desired among learners. SAMI augmented social translucence by improving the visibility of social signals and increasing students' feelings of accountability. SAMI automatically recommended social matches, eliminating the need for students to	Lack of visibility. SAMI needs to be more human-like. There is a lack of spontaneity and randomness compared to interactions in person. SAMI took away students' agency in choosing groups to join.	Supported the creation of social interactions that extend beyond the learning environment. 8/26 students reported building friendships through the course.	N/A	Y	Y	Y	Y

No	Author(year)	Used Pedagogy	Emerged AI effect	Challenging part	AI effects on students' communication	AI function on Student-teacher communication	TP	SP	CP	Appeared New learning mode
			proactively seek out opportunities to expand their social connections. However, SAMI did not bridge the social-technical gap.							
6	Teo and Tan (2023)	Knowledge Building	The student-machine partnership was key to actively engaging with and making sense of analytics. The report card helped students understand their classmates' strong points and made them think of their own arguments and ways to strengthen their points and ideas. The report card also informed progress in active discussions and encouraged sharing more ideas.	A danger of over-relying and over-generalizing sets of indicators or instructions put into AI.	Students were shown LA visuals to help them build on their peers' ideas and understand how their ideas are adopted by their friends.	Teachers used learning analytics to help students develop a habit of mind. AI encourage acceptance and support.	Y	Y	Y	Y
7	Chang et al. (2023)	Interdisciplinary knowledge sharing	Improving post quality, reducing plagiarism, and enhancing comprehension.	Students have a negative view of the system's accuracy. They are curious about the criteria for post ratings and hope to indicate how to improve post quality.	N/A	AI is seen as a feature, not a teacher	Y	N	Y	N
8	Liu et al. (2024)	Pedagogical guardrails	Provided students with high-quality online educational support. Students praised the AI for being very helpful (47%), very effective (35%), and very confident (23%). Provided students with an alternative way to use Gen AI.	Establish an AI tool that automates design grading.	N/A	Complementing human instruction by AI. All responses are subject to endorsement, amendment, or deletion by staff. Designating a prompt that makes the AI act as a teaching assistant.	Y	-	Y	Y
9	Lin et al. (2024)	Kolb's Experiential Learning Theory	Twice the number of times contributed to the discussion board when ChatGPT was involved. Students reported that discussion forums with ChatGPT helped them develop generic skills and abilities. It made the online discussion engaging and motivated effective learning.	AI-generated info is very long and all very similar.	A student felt more engaged when they did not rely on it for every discussion post.	Assist in how to use the discussion system.	Y	N	Y	Y

No	Author(year)	Used Pedagogy	Emerged AI effect	Challenging part	AI effects on students' communication	AI function on Student-teacher communication	TP	SP	CP	Appeared New learning mode
10	Sinha et al. (2024)	Vygotsky's sociocultural theory	No significant difference in student reception exists between the responses from AI-TAs and those from instructors. GenAI can effectively meet educational needs when managed well.	Faced limitations from a smaller TA sample size and the fact that responses were infrequent.	N/A	The system was designed to augment the instructional capabilities of course staff, serving as an auxiliary function to facilitate educational dialogue between students and instructors.	Y	N	Y	N
11	Huo et al. (2024)	Tutoring	Demonstrated an apparent improvement in student performance after using the LLM to help them code. Most students praised LLM tool for its helpfulness, effectiveness, and reliability. Simpler programming questions on code structure, logic, or syntax could be addressed by the LLM. 23.4% of questions on the discussion board are unanswered. 62.2% of questions are resolved. In 11/14 questions, students voted for better answers provided by staff than by chatbots.	Possibilities for ethical considerations around student privacy, social responsibility, and research integrity exist. The current LLM still requires additional development to provide suitable personalized online assistance.	N/A	Teachers still offered more accurate and preferred answers than the LLM. The students, first and foremost, value accuracy in answers.	Y	N	Y	N
12	Jureynolds (2024)	N/A	93% strongly agreed that HiNative helped them learn Mandarin. 75% agreed that HiNative enabled students to use Mandarin fluently.	N/A	HiNative accommodated collaborative learning among online users.	N/A	Y	Y	Y	N

Note. TA = Teaching Assistant, JW = Jill Watson, LLM = Large language model, N/A = Not disclosed in the publications, “-“ = N/A