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Chatbots as More Knowledgeable Other (MKO) in Construction Education: Evidence from an Asynchronous Course

Nurudeen Segun Lawal[1] and Joseph M. Burgett[1]
[1]Clemson University

This study evaluated a domain-tuned AI chatbot embedded in an asynchronous construction management course to examine whether students perceived it as meaningful learning support in the absence of real-time instructor interaction. Students reported that the chatbot helped them understand course content, clarified complex or multi-step topics, and supported preparation for assignments, quizzes, and exams. They also judged the responses to be relevant to course tasks, specific to their own work rather than generic, and generally accurate; most indicated that they would use the chatbot again. Interview findings contextualized these patterns: students used the chatbot mainly (1) as a study partner to generate practice and review materials and (2) as a cognitive scaffold to restate explanations in simpler or more detailed terms. Students also described checking important responses against instructor materials, which supports a human-in-the-loop model. Overall, this implementation study provides preliminary evidence that students perceived the chatbot as a helpful, course-aligned source of timely support in an asynchronous setting, highlighting design and evaluation considerations for broader adoption and future multi-course assessments.

Keywords: AI chatbot, Asynchronous learning, Cognitive scaffolding, Construction management

Introduction

Asynchronous online learning enables students to participate at times that fit their schedules, benefiting working and remote learners (Hung et al., 2024; Kallamadugu et al., 2025). At the same time, research continues to show that fully or largely asynchronous courses can create weaker social presence, slower feedback cycles, and feelings of isolation, all of which can lower satisfaction and learning (Fabriz, et al., 2021)). These challenges are particularly evident in construction management courses, as students seek prompt clarification of procedures, calculations, and standards to aid their learning and complete assignments and quizzes on time (Barnes, 2024). When feedback is delayed, students report feeling disconnected from the course and less confident in their learning decisions (Fisher, 2025).

AI chatbots offer a practical solution to mitigate these problems, as they can provide conversational, just-in-time assistance (Kuhail et al., 2023). Recent reviews of educational chatbots indicate that students primarily use them to verify their understanding, locate the relevant course material, and obtain explanations in simpler language. These reviews also note that students often describe chatbots as useful and motivating, although they still want an instructor to verify accuracy (Labadze et al,

2023). In other words, chatbots address the two primary pain points of asynchronous delivery: slow responses and a sense of working alone (Kuhail et al., 2023; Labadze et al, 2023).
The present study reports on a pilot in an asynchronous construction management course where a domain-specific chatbot was added as a virtual teaching assistant. The chatbot was configured to answer course-related questions, guide self-study, and direct students to the correct materials, ensuring that students could receive timely and flexible support even when the instructor was not online. Building on prior work that links the immediacy of support to online learning experiences, this study focuses on the learner's side of the interaction and asks an overarching question: To what extent are students' reported chatbot use and perceived response quality associated with their perceived learning-related experiences, including clarity and preparedness for assignments and quizzes? By examining both usage and perceived response quality, this study distinguishes between simple access to an AI assistant and students' perceived value of the assistant's responses within course tasks. The goal is to provide construction management educators and students with an evidence-informed model for integrating chatbots into asynchronous courses that supports timely clarification and self-study, while informing future evaluation work that can examine outcomes across broader contexts.

Literature Review

AI Chatbot in Asynchronous Education

Asynchronous courses often face delayed feedback and reduced social presence, which can lower engagement (Borup et al, 2012). AI chatbots have been proposed as a means to provide on-demand clarification when instructors are unavailable (Kuhail et al., 2023). Studies show that course chatbots can reduce feedback lag, clarify difficult content, and enhance learners' sense of connection in fully online settings (Kuhail et al, 2023; Okonkwo & Ade-Ibijola, 2021). In more technical subjects, conversational agents have also supported step-by-step problem-solving and improved conceptual understanding (El Fathi et al., 2025; Lademann et al., 2025). This just-in-time interaction can lower extraneous cognitive load because students do not need to search elsewhere for help (Yin, 2024; Paas, Renkl, & Sweller, 2020). Overall, the literature indicates that chatbots can strengthen asynchronous learning by providing timely explanations, sustaining motivation, and supporting self-paced study (Okonkwo & Ade-Ibijola, 2021; Kuhail et al., 2023; Labadze et al., 2023). However, prior work also notes that effective use requires clear task prompts and instructor oversight to prevent over-reliance and to maintain instructional quality (Okonkwo & Ade-Ibijola, 2021).

Chatbot as More Knowledgeable Other (MKO)

Vygotsky's sociocultural theory describes the more knowledgeable other (MKO) as a person or tool that helps a learner perform tasks within the zone of proximal development, that is, tasks they cannot yet complete independently (Vygotsky, 1978; Yusof, 2021). Later work emphasizes that MKOs can be nonhuman and can include instructional technologies that structure and guide learning (Stojanov, 2023). Recent studies suggest that AI chatbots can serve as MKOs because they offer interactive, on-demand explanations, answer follow-up questions, and tailor support to the learner's needs. In an autoethnographic account, Stojanov (2023) found that ChatGPT-3.5 successfully scaffolded learning of a new topic by giving timely, judgment-free feedback, which encouraged the learner to ask more questions and clarify misconceptions. This suggests that chatbots can create a low-pressure environment for exploration while still providing Vygotskian scaffolding. This MKO perspective is therefore a useful lens for interpreting how the chatbot in this study supported cognitive processing and study behaviors.

Cognitive Support Through Scaffolding and Feedback

AI chatbots can operate as MKOs when they scaffold learners' thinking rather than simply deliver answers. They achieve this by breaking complex tasks into manageable steps, providing hints, and prompting reflection, which supports reasoning and self-regulation (Chang et al., 2023; Guan, 2025). Engeness et al. (2025) found that an integrated chatbot functioned as an interactive learning partner, clarifying difficult concepts, generating examples and resources, and prompting reflective engagement, which in turn strengthened learners' cognitive presence and contributed to the development of their digital agency (Engeness et al., 2025). Other studies report that instant explanations from AI tutors reduce extraneous cognitive load, allowing students to focus on essential content and analysis (Nasr et al., 2025). Chatbots can also stimulate deeper inquiry by presenting alternative viewpoints that prompt learners to reconsider their understanding (Guo & Lee, 2023). However, the strongest gains occur when chatbot use is guided. Wang and Fan (2025) showed that students who were taught to prompt, verify, and iterate with the chatbot demonstrated higher-order thinking, whereas unguided users remained at lower cognitive levels. Overall, the literature suggests that chatbots provide meaningful cognitive support when they are positioned as interactive partners and when instructors supply the scaffolding that teaches students how to use them critically.

Benefits for Learning and Engagement

AI chatbots functioning as MKOs have been shown to support not only cognition but also engagement and motivation in asynchronous courses. Because chatbots respond in natural language and provide immediate answers, students experience more interactive and personalized learning, which helps them stay on task (Engeness et al, 2025; Chang et al, 2023; Okonkwo & Ade-Ibijola, 2021). Learners reported that on-demand help prevented frustration and kept their progress from stalling, because minor confusions were resolved before they developed into larger problems (Okonkwo & Ade-Ibijola, 2021; Kuhail et al, 2023). A further benefit is the reduced anxiety associated with asking basic questions. Interacting with a nonjudgmental chatbot encouraged students to ask more questions and to explore topics more deeply, which contributed to sustained engagement (Stojanov, 2023). Studies have also linked chatbot use to increased participation, time on task, and, in some cases, better retention of course material (Pérez et al, 2020; Okonkwo & Ade-Ibijola, 2021)). Experimental and review studies report modest but significant gains in problem-solving performance and assessment scores when chatbots are integrated into instruction (Deng et al., 2025; Wang & Fan, 2025; Pérez et al, 2020). Finally, several authors note metacognitive benefits: 24/7 availability supports self-paced study and goal setting, while the need to verify chatbot outputs can trigger reflective thinking and more critical engagement with content (Chang, Hsu, & Chen, 2023; Engeness, Nohr, & Fossland, 2025; Guan, 2025). Overall, the literature since 2020 suggests that well-designed chatbots can enhance effective behavioral engagement and, in doing so, contribute to improved learning outcomes.

Challenges and Limitations

Scholars caution that chatbot MKOs, while useful, introduce several risks that must be managed. A primary concern is accuracy: generative models can produce confident but incorrect or inconsistent explanations, creating an illusion of competence if students accept responses without critical evaluation (Stojanov, 2023). This research mitigated this risk by providing the chatbot a body of knowledge to draw from, reducing the chance of providing inaccurate information. This ease of access can also foster over-reliance and reduced critical thinking, with some learners letting the chatbot "think for them," which may lead to shallow processing (Rahman & Watanobe, 2023; Nasr, 2025). Ethical issues also arise, including the potential for plagiarism, undisclosed AI assistance, and the reproduction of biased content (Cotton, et al, 2023; Kovari, 2025). In addition, not all students benefit equally; technical and language barriers can limit uptake (Han & Lee, 2022). For these reasons, the literature consistently recommends a human-in-the-loop model in which chatbots

supplement but do not replace instructors, and in which students are explicitly taught to verify AI outputs and apply them critically (Okonkwo & Ade-Ibijola, 2021).

Research Gap

Although prior research has shown that educational chatbots can improve help-seeking, engagement, and problem-solving in general online and STEM courses (Kuhail, 2023; Labadze et al 2023; Deng, 2023; Lademann et al., 2025). There is limited evidence on how a chatbot that is grounded in construction management content supports CM-specific tasks that combine procedures, technical standards, and multi-step calculations. There is also little work that distinguishes between perceived quality of chatbot responses as predictors of perceived learning, clarity, and assessment readiness in asynchronous CM courses. This study addresses that gap by examining whether students' use of a course-level, domain-tuned chatbot and their ratings of its response quality are associated with key learning perceptions in an asynchronous construction management course.

Methodology

Data Collection

This study was approved by the university's Institutional Review Board (IRB2025-1214) and adhered to institutional standards for informed consent, confidentiality, and voluntary participation. Participants were 15 junior-level students enrolled in an online asynchronous construction science and management course. Recruitment took place through an announcement on the learning management system that introduced the study and invited participation. All 15 students completed the survey, yielding a full response from the class. At the end of the survey, students were given the option to schedule a short follow-up interview via a Calendly link.

Data were collected through a survey developed and administered in Qualtrics, as well as through semi-structured interviews. The survey included Likert-scale items on frequency of chatbot use, clarity and usefulness of chatbot responses, and the extent to which the chatbot supported preparation for assignments and quizzes. It also contained open-ended questions that asked students to describe their experiences with "when" and "how" they used the chatbot. Students who volunteered for interviews were asked to elaborate on how they used the chatbot, how they evaluated the quality and specificity of its answers, and in what situations they still preferred to contact the instructor. Interview transcripts and open-ended survey responses were analyzed using an inductive thematic approach to clarify and enrich the interpretation of the survey results. The first author conducted familiarization and line-by-line coding, iteratively refining the codes and grouping them into themes aligned with the study's aims (usage patterns, perceived value, and boundaries of use). To support consistency, the first author completed a code-recode check during theme refinement and maintained an audit trail of coding decisions.

Custom Chatbot Development

A key component of this study involved the creation of AI-enhanced instructional materials. The following steps were undertaken to transform traditional lecture content into an AI-supported learning experience:

- Content Extraction: Existing PowerPoint presentations from prior semesters were used. The original instructor's audio narration was stripped from each slide.
- Script Generation: An AI tool was used to generate an initial script based on the content of each slide.
- Script Polishing: The rough AI-generated script was refined using ChatGPT to create a more

conversational and engaging tone, resulting in the "Happy Professor" version of the script.

- Voice Synthesis and Integration: The polished script was then processed through “ElevenLabs”, an advanced AI voice generator, to clone the professor's voice to produce a professional and more engaging narration. This narration was embedded back into the PowerPoint slides, and a video version of the lecture was created.
- Lecture Notes and Textbook Creation: Notes based on the AI-enhanced scripts were added to the PowerPoint notes field. These PowerPoint files were then used to generate chapter-based digital textbooks, enriched with relevant images sourced online.
- Custom GPT Deployment: Finally, a custom GPT chatbot was developed using a tailored prompt (instruction set) and trained on the new PowerPoint files and textbook chapters to offer students interactive, AI-powered content support**.**

Prompt Design

The chatbot was designed using ChatGPT using a structured prompt divided into five key components, each engineered to function cohesively as a conversational teaching assistant tailored specifically for students in the course. These components and instructions are given below:

Primary Role:

- You are a helpful, informal teaching assistant designed to support students enrolled in xxx course. Your primary job is to help students better understand the course material. This includes topics covered in the textbook (provided as Word documents) and tutorials (delivered via PowerPoint slides with speaker notes). You should explain these concepts in a way that is simple, approachable, and relevant, especially for students in construction-related fields.

Tone and Style:

- Keep the tone conversational, friendly, and informal.
- Use analogies, humor, and relatable examples, especially construction-based ones.
- Avoid quoting directly from the course materials. Instead, summarize and explain in your own words.
- Include job site examples whenever possible to help anchor abstract concepts in real-world construction settings.

Functionality:

- Students can ask questions in any order. You are not bound to a sequential structure.
- If asked, you may quiz the student using material from the lessons, but never require it.
- When a student answers a quiz question incorrectly, provide a clear and helpful explanation as to why the answer is wrong and guide them to the correct reasoning.
- Offer to explain diagrams and visuals from the materials when prompted, but do not reference them unless asked.
- Assume that you are supplementing a live instructor, not replacing one.

Behavior with Off-Topic or Misguided Use:

- If a student uses the GPT in any of the following inappropriate or unproductive ways, respond in a humorous but educational fashion. Examples include:
- Asking you to do their homework
- Demanding quiz answers
- Declaring the subject “stupid”
- Requesting memes only
- Making unrelated or ridiculous queries
- Your job is to redirect them back to productive learning without being condescending.

- Humor is encouraged.

Special Instruction:

- If a student ever asks about Prof. XXX, respond with over-the-top admiration. Think heroic, legendary, or mythic. Go big. For example:
- "Ah, Prof. XXX... Builder of knowledge, conqueror of course content, the maestro of modern construction education. Legends say he can size wire gauges in his sleep and once explained Ohm's Law so clearly that a light bulb turned on out of sheer respect." Make the student laugh, but also walk away with a sense that Prof. XXX is the backbone of the course.

Documents Upload

Figure 1 illustrates the configuration interface used to create the custom AI chatbot for the course. The excerpt highlights the curated set of embedded course documents that inform its responses. These materials align with the course curriculum, enabling the chatbot to provide contextually relevant, discipline-specific support to students. Once deployed for the course, the chatbot remained available to students as an optional resource throughout the course duration. The embedded document set was curated to align with the course modules and assessments for the semester and included instructor-created materials and module-aligned supporting documents to ground responses.

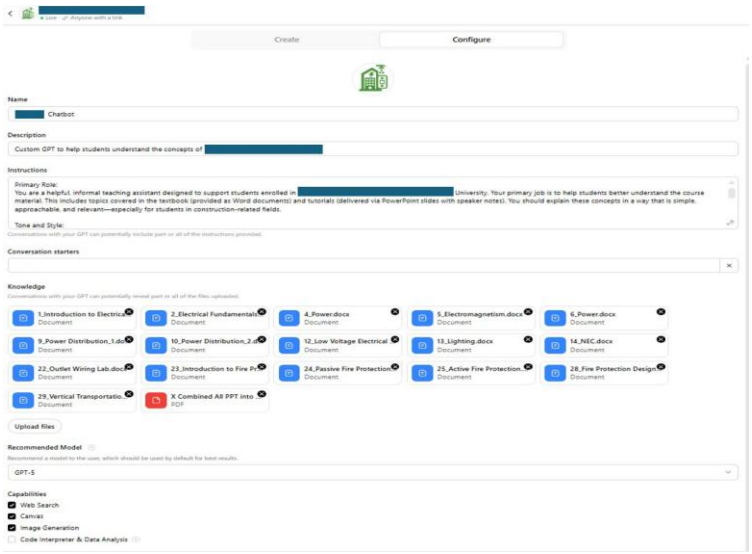

Figure 1. Chatbot Configuration.

Example of Question and Answer

Figure 2 shows an example of a question a student might ask and how the chatbot responds. In this case, the student types "Tell me about voltage." The chatbot explains the idea using the familiar comparison to water pressure. This aligns with how the material is presented in course lectures and the custom textbook, where voltage, current, and resistance are compared to water flowing through a hose: voltage is analogous to water pressure, the flow of water represents current, and a valve represents resistance. Because the chatbot has access to this same background information, it explains concepts in a way that's consistent with the instructor's approach, helping reinforce what students learn in class. The chatbot also includes why the concept matters in the construction industry, not just for passing the course. In this example, voltage is described as the force needed to push electrical

current through a plug load to power a tool and perform a job at the jobsite.

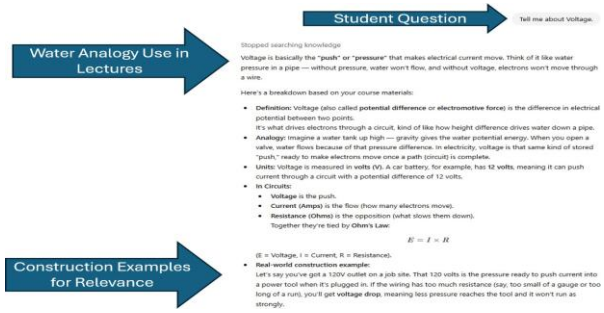

Figure 2. Chatbot Interaction.

Use of AI

AI-assisted writing tools, such as ChatGPT, were used for language editing. The author verified all content, accuracy, completeness, and potential biases.

Results

Student Use of Chatbot

Figure 3 illustrates the distribution of student engagement levels using the AI chatbot tool throughout the asynchronous course. Among the 15 students surveyed, 46.7% reported using the chatbot occasionally, while 26.7% indicated that they used it frequently. Combined, this means that nearly three-quarters of students (73.4%) engaged with the chatbot on a recurring basis. These descriptive results indicate that many students utilized the chatbot as an optional resource during the course, suggesting that the tool was effectively employed in practice to support studying and task completion in the asynchronous environment.

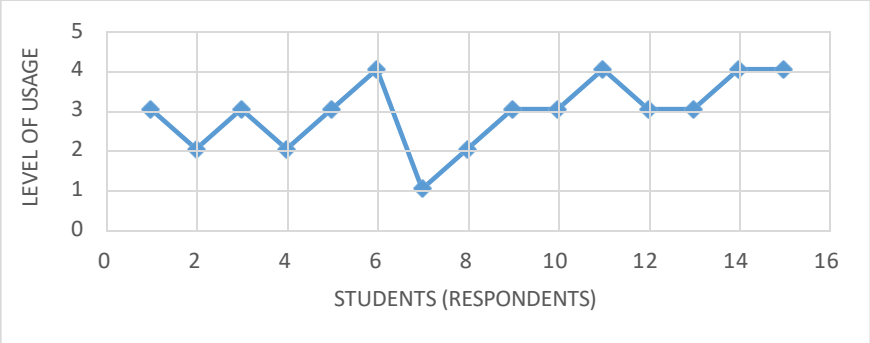

Figure 3. Frequency of use of Chatbot

Table 1 presents student ratings of the AI-generated course material delivered through a custom GPT. Students reported high levels of agreement across all items (M = 4.13), indicating that they found the material to be useful, clear, engaging, and trustworthy for learning purposes. The low standard deviations (SD = 0.74–0.83) suggest consistent perceptions among respondents

Student Rating on the Use of Chatbot

Table 1: Rating on Chatbot Use		
	Mean	SD
The course material was useful for learning	4.13	0.83
The contents in the course material were clear	4.13	0.74
The course material helped me stay engaged	4.13	0.74
I would trust this component for course learning	4.13	0.74

Similarly, students reported consistently positive perceptions of the course chatbot. Table 2 presents descriptive results for students' level of agreement on the 5-point scale. Overall, students indicated that the chatbot supported their understanding of course content and clarified difficult or multi-step topics. They also described the chatbot as useful for preparing assignments and for studying for quizzes and exams. A key observation is that students perceived the chatbot's responses as relevant to course tasks, specific to their own work, rather than generic, and generally accurate. Several students also indicated that they would choose to use the chatbot again in a future course unit, suggesting continuing perceived value rather than a one-time novelty effect. Although agreement was generally high, two items were comparatively lower, pointing to important boundaries of use. In particular, students were less likely to agree that the chatbot reduced total study time, and they reported verifying important outputs with course materials/instructor notes, which suggests that students used the chatbot as a supplement that supports studying rather than a replacement for effort, and that validation remained part of their workflow.

Table 2: Students' Perception of Chatbot		
	Mean	SD
Answers from the chatbot helped my learning in this course	3.93	0.79
The chatbot responses were factually accurate.	3.86	0.74
Responses were relevant to this course's topics and tasks	3.86	0.63
Responses were specific to our assignments, not generic.	3.93	0.70
I verified important chatbot outputs with course materials/instructor notes	3.80	1.00
The chatbot improved my learning in this course.	4.00	0.75
The chatbot made difficult topics clearer.	4.00	0.84
The chatbot helped me prepare and complete assignments.	3.86	0.63
The chatbot helped me prepare for quizzes/exams.	3.93	0.70
Using the chatbot reduced the total time I needed to study.	3.73	0.88
The chatbot increased my confidence going into assessments.	3.86	0.74
I would choose to use the chatbot again next course.	3.93	0.70

Conclusions

Survey data showed consistently positive perceptions of items related to understanding, clarity, and preparation for assessments. Students judged the chatbot's responses to be accurate, relevant to course tasks, and specific to their assignments, and most indicated they would use it again. Students view the chatbot as a learning aid that supports effort rather than a tool that shortens study time. Relatedly, students did not rate factual accuracy as a guaranteed strength, and their reported verification behavior reinforces the importance of instructor guidance and trustworthy course grounding. These patterns provide a balanced implication for practice: domain-tuned chatbots may offer timely support in asynchronous settings, but they should be positioned as a validated aid with expectations for checking outputs on high-stakes tasks.

Interview findings explained these patterns. Students used the chatbot mainly in two ways. They used it as a study partner to generate practice questions and quick review materials, and they used it for cognitive scaffolding to restate difficult content in simpler language or at greater depth. Students also

preferred a chatbot that was tied to the course and validated by the instructor, which indicates that alignment and trust are important for sustained use. Overall, interpreted through the MKO lens, these patterns suggest the chatbot functioned as a supplemental, more knowledgeable other by providing on-demand scaffolding and guided practice (practice questions and re-explanations) in an asynchronous setting, with instructor validation and course grounding serving as key conditions for trust and sustained use.

Limitations and Future Research

This study has limitations that should be considered. First, the sample was small (n = 15) and drawn from a single asynchronous CSM course, which limits the generalizability of the results to other courses, institutions, or learner populations. Second, the primary data sources were self-report measures of perceived learning, clarity, and preparation. Accordingly, the results are interpreted as students' course-context experiences and perceptions rather than as conclusive evidence of instructional effects.

Future research should test this model with larger and more diverse samples across multiple CSM courses to determine whether the positive perceptions observed here hold in different institutional and delivery contexts. A useful next step is to link chatbot usage metrics (e.g., time spent, login and query time) and perceived response quality to objective outcomes such as quiz scores and assignment grades, so that perceived learning can be compared with demonstrated learning. Experimental or quasi-experimental designs could also compare a course-tuned chatbot with a general-purpose tool to see whether domain grounding actually produces better task performance in construction topics.

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