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Alicia Drelick

Casey L. Woodfield
Rowan University

Justin E. Freedman
Rowan University

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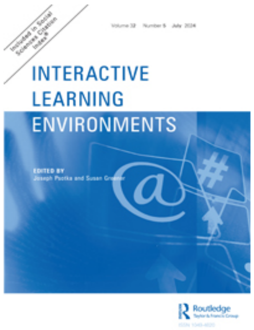

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Alicia M. Drelick, Casey Woodfield and Justin E. Freedman

Department of Wellness and Inclusive Services in Education, Rowan University, Glassboro, NJ, USA

ABSTRACT

This manuscript introduces an innovative approach to developing educational chatbots informed by clinical simulations to enhance learning experiences. With the rapid interaction of generative AI in education, this work provides a structured process to creating chatbots that simulate interactions for educational purposes. The four development phases, Conceptualization, Protocol Design, Technical Design, and Trials and Revisions are grounded in the foundational practices of clinical simulations. This approach bridges gaps between theory and practical application of emerging technologies while emphasizing the role of humans at the center of AI-enhanced learning. In addition to technical guidance, pedagogical strategies for introducing chatbots to students are provided. This comprehensive framework can provide educators with tools to create and implement dynamic learning tools to create more personalized and immersive experiences.

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Educational chatbots; clinical simulations; AI in education

Generative Artificial Intelligence (GenAI) tools offer broad possibilities for content generation, translations, image creation, problem-solving, and question-answering (Dwivedi et al., 2023). Mishra et al. (2023) note that the initial release of platforms such as ChatGPT, Google Gemni, and Claude made some educators feel that this advancement would lead to cheating, plagiarism, and overall adverse effects on student learning. Many schools responded by limiting access to these tools. This proved ineffective, as AI tools quickly became embedded in applications such as Google Apps for Education (GAFE) and Microsoft Suite (Mishra et al., 2023). Nevertheless, many educators continue exploring new technologies to enhance their instruction.

One such technology is chatbots, which rely on GenAIto simulate conversations and interactions through voice or text responses (Adamopoulou & Moussiades, 2020). Chatbots can "create new avenues for creative expression and help establish immersive and interactive learning environments" (Mishra et al., 2023, p. 238). Pérez et al. (2020) report that the early use of chatbots in education was primarily focused on serving as a teaching assistant or service assistant, providing on-demand information, or completing tasks. AI users can now create custom chatbots with intuitive development interfaces like Poe and ChatGPT; this advancement allows educators to create chatbots that enhance learning activities with tailored, interactive experiences. Research into the effects of using these tools and practical guides for educators is key to ensuring the integration of GenAI and chatbots is educationally, ethically, and technically sound (Hwang & Chang, 2021; Okonkwo & Ade-Ibijola, 2021; Pérez et al., 2020; Torrado et al., 2023; USDOE, 2023).

In designing a custom GenAI chatbot for students, educators must be informed by best practices and research-based approaches. This manuscript proposes a process for conceptualizing,

CONTACT Alicia M. Drelick drelick@rowan.edu

developing, and implementing a chatbot customized for student participation in simulated interactions as an instructional activity. Our process integrates foundational research on clinical simulations with emerging techniques for designing chatbots to support educators in creating meaningful and innovative learning experiences while upholding ethical standards.

Background

Clinical simulations in education

Clinical simulations are instructional tools developed in the 1960s by neurologist Howard Barrows for medical education. In this now widely-used approach, medical students engage in a face-to-face encounter with a "standardized patient," portrayed by an actor trained to consistently display characteristics of medical concern to each medical student with whom they interact (Barrows, 1987). Clinical simulations allow doctors and nurses in training to practice engaging with a patient in a context indicative of a medical setting and provide their instructors with an opportunity to assess their studens' dispositions and diagnostic skills (Bambini et al., 2009).

Based on this model, Dotger (2015) partnered with a medical simulation center to adapt the use of clinical simulations for teacher education. In this domain, pre-service teachers engage in a situation that approximates a challenge they might encounter in schools. Multiple actors are trained to portray a standardized individual, such as a concerned parent or colleague, using a protocol of predetermined traits and scripted prompts. Participating pre-service teachers, on the other hand, are given only a brief overview of the scenario (e.g. the premise of the encounter) and are asked to respond naturally, relying on their own instincts and skills. Following the video-recorded simulated encounters, pre-service teachers participate in a structured small-group debriefing with peers and are also asked to watch and reflect on the recording (Dotger, 2015). Teacher education courses across disciplines such as mathematics, science, music, English and physical education have incorporated clinical simulations into their curricula. This approach has also been adopted by educational Leadership and Counselor Education programs (Dotger & Chandler-Olcott, 2022). Freedman et al. (2020) extended the use of clinical simulations outside of professional education to examine how college students with disabilities advocate for instructional accommodations when engaging in meetings with a standardized professor.

Barrows' (1987) tenets for clinical simulation offer a conceptual framework that guides the design of simulated scenarios. These tenets – prevalence, instructional importance, clinical impact, and social impact – can frame the pedagogical purpose of simulations. *Prevalence* suggests that experiences are designed to address a common issue that will be encountered in practice. *Clinical impact* focuses on rarely experienced but potentially critical situations that require a particular type of training. Simulations with *instructional importance* aim to build specific skill sets and gradually prompt deeper learning. Finally, the *social impact* tenet focuses on programs that have a substantial benefit for certain individuals or groups (Barrows, 1987). Dotger and Chandler-Olcott (2022) has drawn upon these tenets to develop the problem-based context for clinical simulations in teacher education. For example, mathematics pre-service teachers engage with a standardized high school student who is experiencing difficulty solving a common equation (prevalence), and counselors in training engage in a simulation with a standardized high school student who is exhibiting signs of suicidal ideation (clinical impact). Drawing on Barrows's tenets for simulation design, educators can recreate elements of carefully chosen situations, creating immersive learning experiences for students in low-risk environments.

Clinical simulations are underpinned by the theory of situated cognition, which posits that learning occurs *in situ*; it is interrelated with a given social and cultural context and cannot be abstracted from the situation in which it occurs (Lave & Wenger, 1991). Drawing on this emphasis on learning through enculturation to the practices of a community, Dotger (2015) proposed clinical simulations as a signature pedagogy in teacher education. A signature pedagogy is one that asks novice learners to put discipline-specific knowledge into action and carefully reflect on their decision-making process and the impact of their choices (Shulman, 2005).

Clinical simulations provide an approximation of a professional context for pre-service teachers that introduce them to elements of the cultural expectations of the profession as they decide how to respond to the questions and concerns of another human being. Whether used within professional education programs or to locate students in other sociocultural contexts, clinical simulations are an example of situated learning that provides a shared experience for students via engaging with and reflecting on encounters with a standardized individual who has been trained to convey uniform verbal cues and dispositions. However, developing and implementing face-to-face clinical simulations require a significant resource investment. AI tools, such as chatbots, can offer a cost-effective and widely accessible method of applying elements of clinical simulations to develop simulated interactions for students.

Chatbots in education

Chatbots' ability to simulate conversations allows them to broaden simulated learning experiences in new ways. Okonkwo and Ade-Ibijola (2021) describe chatbots as technology capable of emulating human interaction, allowing users to engage with auto-generated responses. Chatbots can serve various purposes, including as teaching agents, peer agents, teachable agents, and motivational agents (Kuhail et al., 2023). As the name reflects, teaching agents can provide students with instructional information. Meanwhile, peer agents serve as more of a guide or assistant in accessing information. Teachable agents simulate a conversation where content is being taught to the chatbot, allowing a student to demonstrate mastery. A motivational agent provides positive feedback and encouragement. Teaching agents, which embed elements of motivational agents, are the most common role of educational chatbots (Kuhail et al., 2022). Table 1 defines and outlines examples of applications for each purpose.

Hwang and Chang (2021) suggest the benefits of using chatbots in education include enhanced engagement, personalized learning opportunities, and innovative pedagogical approaches. While the possibilities for chatbot creation are nearly endless, some researchers have created exemplars to guide exploration into their utility. For example, Guo and colleagues (2023) used task-specific chatbots to prepare and support students in debating activities. Graesser et al. (2005) developed an early chatbot that served as a tutor for middle and high school students. Ondáš and colleagues (2019) highlighted the impact of multiple chatbots designed for educational purposes, including a

Table 1. Examples of educational chatbots by design purpose.

Chatbot purpose	Definition	Example of application
Teaching agent	Simulates instructor by engaging in education conversation, presenting learning material or helping access knowledge	Chatbot presents mathematical problems to students. Chatbot can ask questions, provide hints or give feedback through problem solving.
Peer agent	Simulate a learning companion or peer-to-peer conversations. Typically less knowledge than teaching agents but can foster engagement and collaboration	Chatbot used to support learning a new language. Provides translation and opportunity to practice social exchange
Teachable agent	Simulates a novice learner seeking to learn about a topic a student is working to master. Often a user provides feedback to demonstrate their knowledge	Chatbot created to ask about historical events. Users provide key information and the chatbot asks followup questions allowing user to provide additional context, reinforcing their learning.
Motivational agent	Designed to encourage and support users in the learning process. Can help set goals, manage time, and provide praise to accomplishments.	Chatbot created to support online learning. Encouraging messages provide reminders to start and complete tasks, personalized goals can be set and empathy and redirection can be provided if a user express frustration

Note: Derived from Kuhail et al., 2022.

voice-based chatbot built for smart home speakers such as Amazon's Alexa. The focus of these tools was to increase connectivity to information, support efficiency in accessing information, and make interactions familiar to students.

The approach to chatbot development we describe is guided by the U.S. Department of Education (2023) recommendations for AI development, which include: Emphasize Humans in the Loop; Align AI Models to a Shared Vision; Design Using Modern Learning Principles; Prioritize Strengthening Trust; Inform and Involve Educators; Focus R&D on Addressing Context and Enhancing Trust and Safety; Develop education-specific Guidelines and Guardrails (see Figure 1). First and foremost, any learning experience should center on both the learner and the educator. As such, this generation of chatbots should be guided by student input and experience (USDOE, 2023). Teachers should also embed humanistic approaches to instruction, including reflection and considerations for future instruction. By creating instructional loops centered around students and educators and drawing from a long-standing model of clinical simulations, we offer a pedagogical process for developing and utilizing chatbots as instructional tools. Our intent is to leverage GenAI's ability to customize interactions, a feature that has the potential to establish *new* opportunities for creative expression and immersive learning while increasing engagement and access (Mishra et al., 2023).

While the ability to create chatbots customized for student use is novel, simulating conversations for educational purposes is well-established (Dotger & Chandler-Olcott, 2022). Both AI-generated

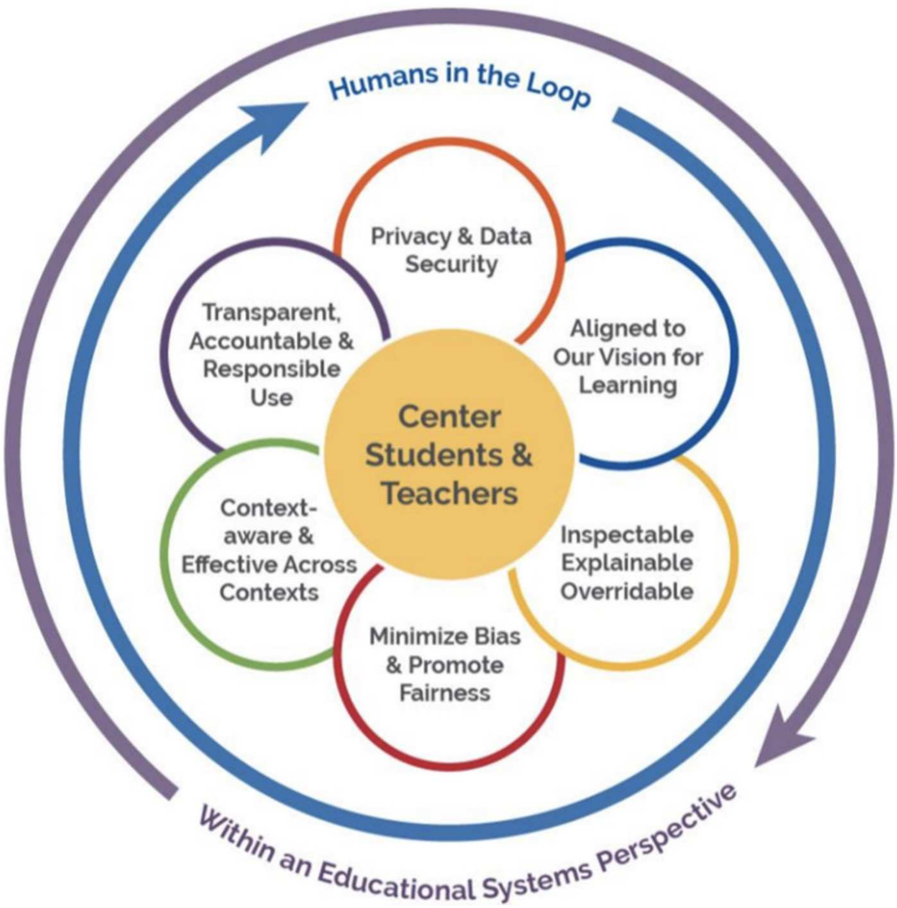

Figure 1. USDOE Recommendations for AI tools and systems in education. Image from: U.S. Department of Education, Office of Educational Technology, 2023, p. 55.

chatbots and face-to-face clinical simulations offer the potential to create interactive learning experiences that intentionally situate students in a specific context. In the subsequent sections, we propose a process for developing chatbots that are informed by tenets of clinical simulation design (Barrows, 1987), principles of designing educational chatbots (Kuhail et al., 2022), and components of clinical simulations in educator education (Dotger & Chandler-Olcott, 2022).

A process for developing chatbots informed by clinical simulation designs

In this four-step process, informed by clinical simulations for education, we guide educators through conceptualization, information gathering, technical design, and trials and revisions. (See Figure 2). We discuss how overlaying chatbot design strategies with frameworks for developing clinical simulations can provide a robust approach to embedding chatbots into instruction to prompt the generalization of acquired skills.

Conceptualization: building the context

This phase focuses on the theoretical and planning phases. Developers should consider the overall objectives and educational outcomes intended to be addressed through chatbot interaction. Just as

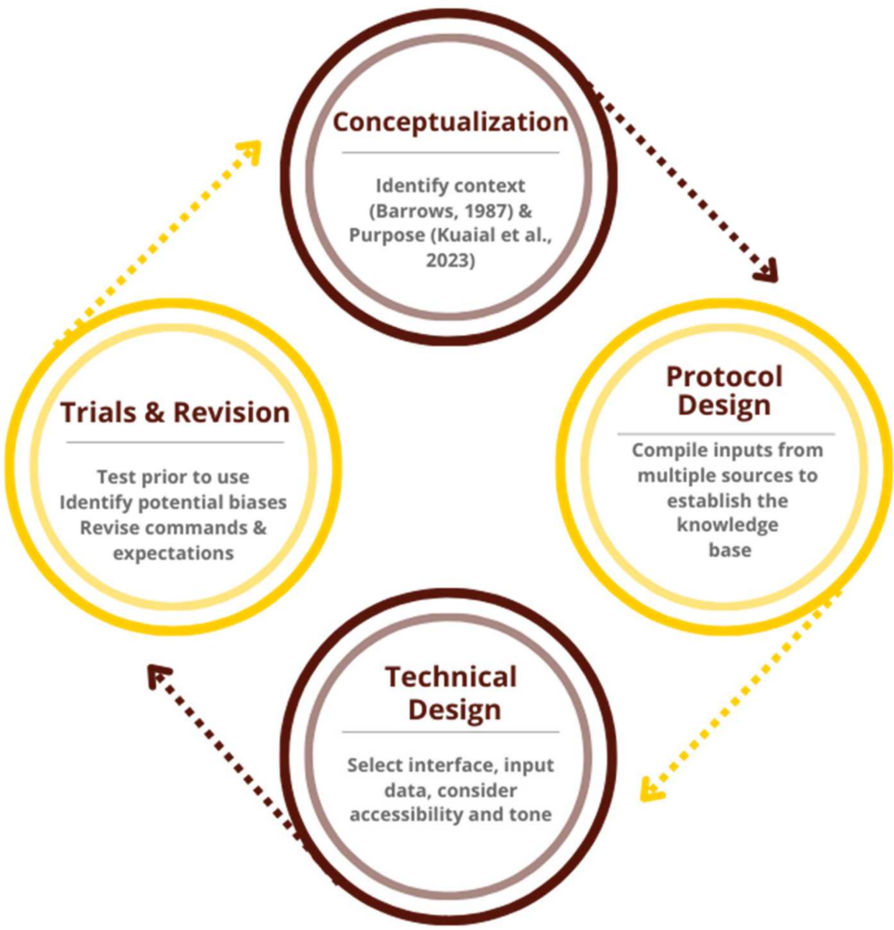

Figure 2. Visual of four-step process for developing chatbots informed by clinical simulation designs.

Barrow's (1987) tenets for clinical simulation design have been applied in medical and teacher education (Dotger & Chandler-Olcott, 2022), these tenets can also guide educators in conceptualizing the context in which students will engage with a chatbot. Educators can choose to prioritize a situation that is likely to occur frequently (prevalence); that may occur rarely but be highly impactful, and necessitate specific skills (clinical impact); that align with other learning experiences to build specific skills over time (instructional importance), or that addresses an issue or skill relevant to particular individuals or social groups (social impact). Prioritizing one or two of these tenets can help educators carefully attend to the purpose of the experience and consider the potential impact of the interaction on students' short- and long-term learning.

Developers should be mindful of the needs of their users–in this case, students–when establishing the context and purpose of the chatbot interaction. In addition to factual information and pedagogy, educators should consider students' cognitive, social-emotional, and academic needs when designing chatbots while also generating common questions and search terms relevant to the subject area (Kuhail et al., 2022; Ramadais & Xinogala, 2023). Mateos-Sanchez et al. (2022) offer an example of this kind of user-informed data collection, which began with interviews to determine design priorities based on the lived experiences of the target audience for the chatbot and drew on non-experimental observations for additional insight into design considerations. Deveci Topal et al. (2021) further examine student needs by inquiring about chatbot perceptions in pre-design interviews; their questions focused on preferred features and functions and students' opinions on interactions with the chatbot.

In addition to determining *how* the chatbot will interact with end users, determining *what information* is needed for the data set generating exchanges is equally essential. Guided by the chatbot's purpose, designers must collect data to support interactions. This varies based on the intended use. For example, teachable agents must have the knowledge. Ramandanis and Xinogalos (2023) identified various ways of training chatbots for education, including using previously collected or constructed data sets. This could include educational materials, corpora data (i.e. Wikipedia), or previous student experiences (i.e. work samples, interviews) (Ramandanis & Xinogalos, 2023). Additionally, chatbots can be trained using machine learning, which would require chatbots to expand outside of a dataset provided, such as searching the web. For the purposes of the process we outline based on clinical simulations, we focus on creating "walled gardens" (Klein, 2023) to parallel the use of carefully constructed protocols.

Protocol design: compiling the knowledge base

Once the context and purpose of a chatbot interaction have been identified, information is needed to develop a dataset to supply a chatbot with data to inform its interactions effectively. The quality of interaction with a chatbot depends wholly on the quality and size of the dataset provided to train the chatbot (Goyal et al., 2018). A high-quality dataset should be one that is likely to lead to an interaction that is both authentic to the context and meaningful in that it allows participants to make decisions and apply their current knowledge and skills. Efforts to create an engaging experience should be guided by research relevant to the selected context and a process for developing research results into a training protocol that will guide how a chatbot interacts with a user, including what information is shared.

Using protocols to train actors for clinical simulations in teacher education can provide a helpful example to inform chatbot development. Clinical simulation protocols of standardized individuals (SIs) rely on research collected from multiple sources, such as interviews with experienced professionals (e.g. educators and school leaders) and reviews of professional literature (Dotger, 2015). These data are used to create an approximately three to five-page interaction protocol. Given to actors during live training, this protocol describes the context of the interaction, character-building information, such as dispositions and background, nonverbal communication, and verbal prompts–specific statements or questions for each actor to communicate to the participating pre-service teachers. During this training, actors typically ask questions and provide feedback about how to enact the SI consistently across a range of potential participant responses (Dotger & Chandler-Olcott, 2022).

A similar training protocol can be developed as the foundation for the knowledge base of a chatbot. Based on research collected from interviews and reviews of current literature about a given context, a protocol can be developed that resembles that of a standardized individual protocol for clinical simulations used in teacher education (Dotger, 2015). A protocol sets parameters for the character traits and the purpose of the interaction and provides specific examples of prompts for the chatbot to communicate. However, there are notable differences between designing a knowledge base for a chatbot and training live actors that create both challenges and possibilities. One challenge to training a chatbot is replicating elements of the back-and-forth "what if … ?" discussion with live actors that elucidates how to respond to a range of potential statements and questions from a participant. Sample predictive responses should be included in the chatbot's knowledge base to address this gap. The use of chatbots can also increase the amount of training input. Whereas live actors are provided a brief three-to-five-page protocol that is the end product of background research and analysis of the context, the chatbot knowledge base can include curated research, such as selected de-identified data from pre-design interviews and a synthesized literature review. When doing so, it is imperative to identify raw data to protect privacy and to be mindful of copyright and fair use policies.

Technical design: putting it together

Technical design is the applied phase of chatbot development. This section will detail the technical and practical steps of creation. First, a platform for creating the chatbot should be investigated. Platforms can be web-based or mobile. Further, different platforms have accessibility options that best support students of various ages and abilities, such as speech-to-text or text-to-speech features. Additional considerations for selecting a platform relate to data security and student privacy (USDOE, 2023). While cost is a notable consideration, free should not sacrifice security and accessibility.

Each platform for creating chatbots will have its own interface with unique prompts or commands used to build out the chatbot. Using the selected tool's chatbot-building interface, clearly define the role outlined in the conceptualization phase. Provide additional context by outlining the design principle(s) selected to guide the interactions. Further, the characteristics that comprise the chatbot's persona contribute to a greater connection during the interaction. In developing the chatbot's persona and engagement, educators should review the design principles for educational chatbots summarized by Kuhail et al. (2023), as outlined in Table 2.

In applying Kuhail et al.'s (2023) design principles during technical design, educators can create chatbots that focus on both the pedagogical delivery of information and the social interactions with students. Further, these principles can be used to train a chatbot to provide the desired support for student users.

Finally, the designer should determine if a chatbot should have access solely to the knowledge base provided in the dataset or if it can explore the World Wide Web. Klein (2023) suggests using

Table 2. Educational chatbot design principles.

Design principles	Definition
Personalized learning	Ability to customize the output to meet individual users' needs
Experimental learning	Encourages users to construct knowledge through engagement
Social dialog	Focuses on conversational exchanges over content
Collaborative learning	Engages in co-constructing knowledge by engaging on completing a task together
Affective learning	Ability to provide encouraging or sympathetic feedback based on user interaction
Learning by teaching	Users demonstrate and increase mastery by explaining concepts
Scaffolding	Gradually build knowledge through structured engagement

"walled gardens" or GenAI with limited datasets to provide a safer and more reliable experience. Further, creating a walled garden can ensure that reputable sources are provided, increasing the trustworthiness of the response (Klein, 2023). Our process reinforces Klein's (2023) recommendation since, drawing on the use of "standardized individuals" in clinical simulation, this allows for a more consistent experience rooted in the carefully curated knowledge base.

Trials and revisions: improving interactions

USDOE (2023) asserts that "teachers need to be involved in the design and evaluation of AI systems before they are used in classrooms and when needs for improvement are observed" (p. 53). As such, chatbot designers must engage with their bots before using them with others. For education purposes, sample conversations should mirror expected engagements with students. Pérez et al. (2020) warn that chatbots can present ethical, diversity, and accessibility concerns. For example, chatbots may present biased responses when engaging with users of different genders (Pérez et al., 2020). A chatbot developed to help explore careers could guide more male users into STEM fields than female users due to the data set provided to train the model. Further trials should consider the experience of all users and anticipate biased responses during testing. Designers can return to the design interface to revise commands and expectations. Careful consideration should be given to the bot's tone.

Attention to accessibility is also warranted during the trial and revisions phase. Griol et al. (2017) noted that students with disabilities, in particular, can experience benefits such as increased motivation, higher engagement, and the development of metacognition skills through the use of educational chatbots. Mirsha and colleagues (2023) further assert the ability of chatbots to create new immersive learning opportunities for students. Mateos-Sanchez et al. (2022) suggest interactions are aligned with the learning process for individuals with disabilities and have capacities for the use of assistive technologies such as text-to-speech and speech-to-text tools. Designing tools that are accessible to all users is a dynamic process that necessitates ongoing evaluation and revision.

Implementing chatbots informed by clinical simulations as instructional tools opening and closing activities

Chiu et al. (2023) findings underpin the importance of supporting educators to effectively implement chatbots for instructional purposes. To uphold the Cardona et al. (2023) emphasis on humans in the loop, chatbots created via the above-described process must be bookended with carefully crafted guidance and reflection opportunities. The authors urge educators seeking to implement our outlined chatbot design process to consider educator-led opening and closing activities as inseparable from the use of the chatbot itself. Drawing from research on clinical simulations as instructional tools for postsecondary students (Freedman et al., 2020; Dotger, 2015), we recommend three key touchpoints to guide educators in implementing a chatbot informed by clinical simulations: Preparation, real-time debriefing, and post-reflection.

Pre-interaction preparation: a focus on context. In addition to designing and responsively adapting the chatbot, educators can proactively reduce barriers to student engagement with a chatbot by orienting students to the experience in advance. This pre-interaction preparation should include the following components: (1) Scenario setup (e.g. the premise of the encounter and advanced notice of what will occur when interactions begin) (2) Explicit reminders about the simulated nature of the chatbot interaction as a form of practice (3) Instructions to engage using their best judgment. This guided introduction to the activity mirrors the process of orienting students to a structured opportunity to practice a conversation, such as that used in clinical simulations in teacher education.

Real-time debrief: a focus on the experience. We suggest using the simulation-informed chatbot with multiple student-chatbot pairs engaging simultaneously as a cohort. As Dotger and Chandler-Olcott (2022) note of this aspect of implementing clinical simulations as signature pedagogy, this consistency promotes joint analysis and deep learning. Following the activity, we recommend an immediate instructor-facilitated debrief across pairs. This debrief offers space for students to share reactions to their in situ experience interacting with the chatbot and to connect about their common experiences. The information gleaned from debriefs can also inform responsive revisions to the chatbot design.

In-depth reflection; a focus on content. A final step of our recommended implementation cycle of simulation-informed instructional activities is an individualized opportunity for students to reflect on their decision-making process and contributions. If appropriate, students can review their conversation dialogue. This kind of reflection might focus on students' choices about self-representation and supportive planning for future conversations (either with a chatbot or otherwise). We suggest educator-designers mediate these reflections through structured questioning with an open-ended response format to create space for students to incorporate communication modalities of their choice (Figure 3).

We consider the steps of designing (see Figure 1) a simulation-informed chatbot and implementing it as an instructional activity with multiple touchpoints (see Table 2) to be inseparable components of our overall process. This approach–design, practice, reflect, repeat, revise–is an adaptation of well-established use of clinical simulations– a signature pedagogy in educator preparation (Dotger & Chandler-Olcott, 2022) – and as a tool for students to develop nuanced interactive approaches in low-stakes contexts to the realm of generative AI. The inseparability of the design and implementation process ensures that the use of carefully designed chatbots is rooted in DOE's central recommendation to maintain the "humans in the loop" use of AI in education. The iterative design, implementation, reflection, and revision process ensures that human interaction remains central to and meaningfully involved across all aspects of simulation-informed chatbot use, distinguishing our procedures as contributing to a novel and reliable form of pedagogical practice in education.

Future of chatbots as instructional tools

The role of chatbots in educational settings is unfolding and expanding. With the ability for educators to create their own educational chatbots, the possibilities for engaging students in unique learning experiences are limitless. Hwang and Chang (2021) call attention to the limited research on the use of chatbots in K-12 and the need to improve the design process for this audience. Educators and designers must focus on implementing research-based practices in their design and use of chatbots. Given this, we have proposed this chatbot design and implementation process based on research on clinical simulations in education. This process aims to provide guidance and structure to ensure student interactions are meaningful, engaging, and address the intended purpose.

As AI rapidly evolves and develops, we continue to improve GenAI tools like chatbots to better meet students' learning needs and build educators' skills in using them in pedagogical activities. Refining and enhancing chatbots will necessitate a process to evaluate their effectiveness in educational settings. Gonda et al. (2018) suggest an evaluation process to ensure a chatbot meets the principles for good practice in teaching. Evaluating chatbot designs in this way can allow developers to focus on providing a more effective learning support tool and making ongoing revisions using feedback loops where data from interactions informs future learning. Future efforts should focus on creating a formal evaluation tool for educational chatbots that is easy to navigate, practical, and reliable, similar to the scale developed by Stoyanov et al. (2015) for rating mobile applications that promote health and well-being.

While chatbots can serve various functions in education–from answering basic questions to serving as a peer tutor to simulating a college interview–educators play a key role in supporting

	Purpose	Example Content
Prior to the interaction activity		
Pre-interaction preparation	• Contextualize the experience • Clearly define the opportunity as a low-risk, non-evaluative layer of practice • Proactively reduce barriers	Brief written and/or recorded introduction that sets up the scenario in a consistent way and provides students with advance notice about the activity components.
Immediately following activity		
Real-time small group debrief	• Elicit students' initial reactions about the experience • Inform revisions to chatbot	How did you feel while participating in the [activity] conversation with [name of chatbot]? How would you describe the way [chatbot] responded to you? Is there anything you said or did that you regret, or would want to do differently next time you practice this kind of interaction? How well do you feel the interaction with [chatbot] resembled an exchange you have had with an actual [parallel role] in [specific format, i.e. in person, email]?
Approximately 1 week after activity (after students have reviewed the transcript or screen recording of the conversation)		
In depth reflection	• Engage students' in metacognitive process about their choices • Proactively plan for future choices • Inform revisions for continued evolution of chatbot use for instructional purposes	What are some of the things that you noticed when you review the conversation? What are some things you said in the conversation that you are pleased with? What, if anything, did you say or do during this practice experience that you would want to do differently next time?
		What surprised you when you reviewed your [transcript/recording]? Is there anything else you would like to add, that we have not already discussed? What do you wish was different about this experience? Or how could it be better?

Figure 3. Chatbot implementation process guide.

their effective utilization and maximizing learning. Incorporating human-led interactions into the design and use of any education chatbot allows the content or skills learned to be generalized to real-world applications. Much like clinical simulations have evolved into what can be considered a signature pedagogy in educator preparation (Dotger & Chandler-Olcott, 2022), our simulation-informed chatbot design and implementation process offers possibilities for a new kind of mediated learning activity for students across all fields, including those in which human-led clinical simulations are well-established pedagogical tools.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Notes on contributors

Alicia Drelick, Ed.D., A.T.P., is an Assistant Professor of Inclusive Education at Rowan University. Her research focuses on assistive, accessible, and educational technologies, teacher preparation, and inclusive education.

Casey Woodfield, Ph.D. is an Assistant Professor of Special Education at Rowan University in the Interdisciplinary and Department of Wellness and Inclusive Services in Education. Her research uses Disability Studies-informed methodologies to understand inclusive education as a vehicle of social justice, and the experiences of students who use augmentative and alternative communication.

Justin E. Freedman, Ph.D. is an instructor at Rowan University. His research examines issues including barriers to accessing disability-related accommodations in postsecondary education and the application of Universal Design for Learning in postsecondary education.

ORCID

Alicia M. Drelick http://orcid.org/0000-0002-4485-5858
Casey Woodfield http://orcid.org/0000-0001-5545-055X
Justin E. Freedman http://orcid.org/0000-0003-0598-9586

References

Adamopoulou, E., & Moussiades, L. (2020). An overview of chatbot technology. In *IFIP international conference on artificial intelligence applications and innovations* (pp. 373–383). Springer, Cham.

Bambini, D., Washburn, J., & Perkins, R. (2009). Outcomes of clinical simulation for novice nursing students: Communication, confidence, clinical judgment. *Nursing Education Perspectives*, *30*(2), 79–82.

Barrows, H. S. (1987). *Simulated (standardized) patients and otherhuman simulations: A comprehensive guide to their trainingand use in teaching and evaluation*. Health Sciences Consortium.

Cardona, M. A., Rodríguez, R. J., & Ishmael, K. (2023). Artificial intelligence and the future of teaching and learning: Insights and recommendations.

Chiu, T. K. F., Moorhouse, B. L., Chai, C. S., & Ismailov, M. (2023). Teacher support and student motivation to learn with artificial intelligence (AI) based chatbot. *Interactive Learning Environments*, 1–17. https://doi.org/10.1080/10494820.2023.2172044

Deveci Topal, A., Dilek Eren, C., Kolburan Geçer, A. (2021). Chatbot application in a 5th grade science course. *Education and Information Technologies*, *26*(5), 6241–6265.

Dotger, B. H. (2015). Core pedagogy: Individual uncertainty, shared practice, formative ethos. *Journal of Teacher Education*, *66*(3), 215–226. https://doi.org/10.1177/0022487115570093

Dotger, B., & Chandler-Olcott, K. (2022). *Clinical simulations as signature pedagogy: Educator preparation across the disciplines*. Harvard Education Press.

Dwivedi, Y. K., Kshetri, N., Hughes, L., Slade, E. L., Jeyaraj, A., Kar, A. K., Baabdullah, A. M., Koohang, A., Raghavan, V., Ahuja, M., Albanna, H., Albashrawi, M. A., Al-Busaidi, A. S., Balakrishnan, J., Barlette, Y., Basu, S., Bose, I., Brooks, L., Buhalis, D., … Wright, R. (2023). Opinion paper: "So what if ChatGPT wrote it?" Multidisciplinary perspectives on opportunities, challenges and implications of generative conversational AI for research, practice and policy. *International Journal of Information Management*, *71*, 102642. https://doi.org/10.1016/j.ijinfomgt.2023.102642

Freedman, J. E., Woodfield, C. L., & Dotger, B. H. (2020). Using Simulated Meetings to Practice Advocating for Disability-Related Accommodations (Practice Brief). *Journal of Postsecondary Education and Disability*, *33*(4), 387–394.

Gonda, D. E., Luo, J., Wong, Y. L., & Lei, C. U. (2018). Evaluation of developing educational chatbots based on the seven principles for good teaching. In *2018 IEEE International Conference on Teaching, Assessment, and Learning for Engineering (TALE)*, 446–453. IEEE.

Goyal, P., Pandey, S., & Jain, K. (2018). *Deep learning for natural language processing*. Apress.

Graesser, A. C., Chipman, P., Haynes, B. C., & Olney, A. (2005). Autotutor: An intelligent tutoring system with mixed-initiative dialogue. *IEEE Transactions on Education*, *48*(4), 612–618. https://doi.org/10.1109/TE.2005.856149

Griol, D., Molina, J. M., & Callejas, Z. (2017). Incorporating android conversational agents in m-learning apps. *Expert Systems*, *34*(4), e12156. https://doi.org/10.1111/exsy.12156

Guo, K., Zhong, Y., Li, D., & Chu, S. K. W. (2023). Investigating students' engagement in chatbot-supported classroom debates. *Interactive Learning Environments*, 1–17.

Hwang, G.-J., & Chang, C.-Y. (2021). A review of opportunities and challenges of chatbots in education. *Interactive Learning Environments*, 1–15. https://doi.org/10.1080/10494820.2021.1895827

Klein, A. (2023). Welcome to the 'walled garden.' Is this education's solution to AI's pitfalls?. *Education Week*, *43*, 2.

Kuhail, M. A., Alturki, N., Alramlawi, S., & Alhejori, K. (2023). Interacting with educational chatbots: A systematic review. *Education and Information Technologies*, *28*(1), 973–1018. https://doi.org/10.1007/s10639-022-11177-3

Lave, J., & Wenger, E. (1991). Situated learning: Legitimate peripheral participation.

Mateos-Sanchez, M., Melo, A. C., Blanco, L. S., & García, A. M. F. (2022). Chatbot, as educational and inclusive tool for people with intellectual disabilities. *Sustainability*, *14*(3), 1520. MDPI AG. https://doi.org/10.3390/su14031520

Mishra, P., Warr, M., & Islam, R. (2023). TPACK in the age of ChatGPT and generative AI. *Journal of Digital Learning in Teacher Education*, *39*(4), 235–251. https://doi.org/10.1080/21532974.2023.2247480

Mishra, P., Warr, M., & Islam, R. (2023). TPACK in the age of ChatGPT and Generative AI. *Journal of Digital Learning in Teacher Education*, *39*(4), 235–251.

Okonkwo, C. W., & Ade-Ibijola, A. (2021). Chatbots applications in education: A systematic review. *Computers and Education: Artificial Intelligence*, *2*, 100033. https://doi.org/10.1016/j.caeai.2021.100033

Ondáš, S., Pleva, M., & Hládek, D. (2019, November). How chatbots can be involved in the education process. In *2019 17th international conference on emerging elearning technologies and applications (ICETA)* (pp. 575–580). IEEE.

Pérez, J., Daradoumis, T., & Marquès Puig, J. M. (2020). Rediscovering the use of chatbots in education: A systematic literature review. *Computers & Applied Engineering Education*, *28*(6), 1549–1565. https://doi.org/10.1002/cae.22326

Ramandanis, D., & Xinogalos, S. (2023). Designing a chatbot for contemporary education: A systematic literature review. *Information*, *14*(9), 503. https://doi.org/10.3390/info14090503

Ramandanis, D., & Xinogalos, S. (2023). Designing a chatbot for contemporary education: A systematic literature review. *Information*, *14*(9), 503.

Russell, S. J., & Norvig, P. (2021). *Artificial intelligence: A modern approach* (4th ed.). Pearson.

Shulman, L. S. (2005). Signature pedagogies in the professions. *Daedalus*, *134*, 52–59.

Stoyanov, S. R., Hides, L., Kavanagh, D. J., Zelenko, O., Tjondronegoro, D., & Mani, M. (2015). Mobile app rating scale: A new tool for assessing the quality of health mobile apps. *JMIR MHealth and UHealth*, *3*(1), e27. https://doi.org/10.2196/mhealth.3422

Torrado, J. C., Bakke, C., & Gabarron, E. (2023). "Chatbots and children with special educational needs interaction." In M. Antona & C. Stephanidis (Eds.), *HCII 2023, LNCS 14021* (pp. 443–452). Springer Nature Switzerland AG. https://doi.org/10.1007/978-3-031-35897-5_32

U.S. Department of Education, Office of Educational Technology (2023). *Artificial Intelligence and Future of Teaching and Learning: Insights and Recommendations*. Washington, DC.