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Research Paper

An exploration of virtual standardized patients and their effect on clinical readiness in pharmacy education

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A R T I C L E I N F O

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A B S T R A C T

Background: Simulation-based learning is widely used in pharmacy education to support the development of communication skills essential for effective patient care. Human Standardized Patients (HSPs) are a longstanding method for clinical and communication training, yet their high cost and logistical demands have prompted interest in scalable alternatives such as Virtual Standardized Patients (VSPs).

Objective: This review synthesizes current literature on HSPs, VSPs, and clinical readiness in pharmacy education and examines how theoretical frameworks explain the potential of VSPs to enhance students' self-efficacy and preparedness for clinical practice.

Methods: A narrative review approach was used to integrate research from pharmacy, health professions education, and simulation scholarship. Social Cognitive Theory and Constructivist Learning Theory served as guiding frameworks to analyze how simulation-based experiences contribute to confidence development.

Findings: Evidence suggests that VSPs may support clinical readiness by offering repeatable, low-stakes practice with immediate feedback. Theoretical mechanisms such as performance accomplishment, experiential interaction, and reflective engagement align with VSP learning affordances.

Implications/conclusions: VSPs represent a promising complement to traditional HSP-based instruction. Their integration may expand access to clinical readiness while supporting self-efficacy development. Future research should evaluate long-term learning outcomes and curricular integration strategies.

Introduction

Contemporary pharmacy education is transitioning toward competency-based approaches designed to ensure graduates are prepared to perform in evolving clinical roles.[1] Consistent with pharmacy education standards, which emphasize foundational, biomedical, pharmaceutical, behavioral, social, and administrative sciences, clinical readiness in this study is defined as a learner's preparedness to integrate knowledge across these domains and apply clinical judgment, communication, and professional skills effectively in patient-care settings.[2] Among the strategies used to develop these competencies, simulation-based learning has become a cornerstone for fostering both clinical reasoning and communication skills. Traditionally, Human Standardized Patients (HSPs), who are trained actors who portray patients in realistic pharmacy scenarios, have been employed to provide students with a safe, structured environment to practice and receive feedback on their interpersonal abilities. These interactions are widely regarded as effective in

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enhancing communication confidence among pharmacy students.[3–5]

More recently, however, Virtual Standardized Patients (VSPs) have emerged as a digital alternative. VSPs use computer-generated avatars or AI-driven agents to simulate patient interactions, offering a potentially scalable and accessible complement to HSPs. Despite their promise, the evidence supporting the feasibility and effectiveness of VSPs in pharmacy education remains limited.[6] This is particularly relevant in the post-COVID-19 era, where the shift toward remote and digital learning has accelerated the integration of virtual tools into health professions education.[7]

Confidence in communication is critical for pharmacy students, who must navigate sensitive and complex conversations with patients, caregivers, and interprofessional teams.[8] Without adequate preparation and self-assurance, students may hesitate in clinical encounters, potentially compromising both patient outcomes and their own readiness for practice. As such, understanding whether VSPs can provide meaningful opportunities for communication practice, and whether they can replicate or enhance the confidence-building benefits associated with HSPs, is essential for curriculum development.

This article presents a literature-informed review of Virtual Standardized Patients (VSPs) and their potential to support clinical readiness in pharmacy students, drawing on Social Cognitive Theory, particularly the construct of self-efficacy,[9] and Constructivist Learning Theory, with emphasis on Dewey's principles of continuity and interaction.[10] Specifically, the article contributes to the scholarship of education by clarifying the pedagogical promise and limitations of VSPs as a technology-enhanced approach to supporting clinical readiness in pharmacy education.

Human standardized patients in pharmacy education

Human Standardized Patients (HSPs) have played a foundational role in healthcare education since the 1960s, when Dr. Howard Barrows and Dr. Stephen Abrahamson of the University of Southern California introduced the concept.[11] Barrows, then an early-career neurologist, developed the idea that an ordinary person could be trained to simulate a neurological condition reliably, thus creating the first "programmed patient".[12] Today, HSPs are individuals trained to portray patients consistently in specific clinical scenarios in many healthcare disciplines, such as Medicine, Nursing, Optometry and Pharmacy. A pharmacy-focused clinical scenario or "case" might involve an HSP simulating a patient starting a new medication and requiring counseling on how to take the medication and potential side effects. In these scenarios, students practice real-world communication and clinical decision-making, engaging in experiential learning, or learning by doing. This method encourages students to apply knowledge, develop professional competencies, and reflect on their performances (Concordia University, n.d.). HSPs are widely regarded as the gold standard for assessing both the clinical and communication skills of healthcare professionals.[13]

To ensure consistency and authenticity, HSPs undergo structured training based on scripts developed by instructors, with some flexibility for improvisation to enhance realism.[14] Training approaches vary. For example, one model uses a "building blocks" method, in which new HSPs participate in multiple sessions over a month, gradually absorbing case details to avoid cognitive overload. These sessions combine group and individual instruction and often begin with a review of prior material.[15] Another model involves small-group training led jointly by a pharmacist and a medical education specialist, delivered over three two-hour sessions.[16]

These HSP interactions provide students with opportunities to develop technical communication skills, explain medication regimens and check for patient understanding. The safe, low-stakes nature of these simulations encourages students to learn from mistakes, integral to building communication confidence.[17] Gillette et al.[18] found that pharmacy students who trained with HSPs were more likely to pass high-stakes communication assessments and reported feeling more prepared for clinical encounters compared to peers who practiced through peer role-play. Similarly, Davies et al.[4] evaluated an interprofessional activity involving both a standardized patient and a standardized physician colleague. Third-year pharmacy students completed a practice and final simulation, with performance assessed via rubrics and confidence measured through pre- and post-activity surveys. Results showed significant improvement in patient communication and confidence when interacting with both patients and physicians.

Despite their value, HSPs are not without limitations. Issues such as performance fatigue, variability between portrayals, and difficulty simulating certain conditions can affect reliability.[19,20] If an HSP provides inaccurate information or deviates from the script, students may become confused or make clinical errors. Also, incorporating HSPs into teaching requires considerable time and effort from faculty, who must write tailored cases, train HSPs in both clinical accuracy and performance, and often facilitate sessions. Simulation programs are also resource-intensive, typically requiring several full-time staff to manage scheduling, recruitment, quality assurance, and remuneration for SPs, who are usually paid hourly. These logistical and financial demands can limit scalability across pharmacy programs. As a result, virtual standardized patients (VSPs), which use artificial intelligence (AI) and computer-based simulations, have emerged as a promising, scalable alternative for experiential learning.[5] As Talbot et al.,[21] noted, VSPs may offer greater consistency, repeatability, and accessibility while still supporting the development of essential communication and clinical skills in pharmacy education.

The rise of virtual standardized patients

Introduced during the rise of digital learning technologies in the 1990s, VSPs are interactive, computer-based agents designed to replicate clinical conversations and decision-making processes. Early developments focused on applications such as cognitive training and exposure therapy, but over time, VSPs have been adapted to support communication skill development in healthcare education.[22] Like their human counterparts, VSPs simulate realistic patient scenarios, but with the added advantages of standardization, scalability, and 24/7 accessibility. As Hubal et al.[23] notes, these virtual agents aim to mirror HSPs in their ability to promote clinical skill development, offering students new ways to practice counseling, interviewing, and therapeutic communication in low-risk environments.

Early efforts by the University of Southern California's Institute for Creative Technologies (ICT) demonstrated the feasibility and potential of virtual standardized patients (VSPs) in clinical training. One notable study featured “Justina,” a teenage virtual patient designed to simulate a post-traumatic stress disorder scenario.

Fifteen psychiatry residents interacted with the VSP to gather clinical information and formulate a preliminary diagnosis. Participants rated the system as moderately believable (average 4.5/7) and generally understandable (5.1/7), though they reported frustration (5.3/7) with occasional speech recognition errors and out-of-domain responses. Despite these limitations, most users expressed enthusiasm for the technology's future use and reported satisfaction when meaningful dialogue occurred. Concordance analysis between clinician questions and VSP responses showed moderate effect sizes for trauma-related topics, indicating that realistic and relevant interaction was often achieved. Overall, the study served as a successful proof of concept, validating that VSPs can offer a valuable, low-risk environment for practicing sensitive clinical interviews.[21]

Early virtual standardized patient (VSP) systems were limited by challenges in real-time, naturalistic conversation and constrained dialogue structures.[21,23] Recent advances in large language models and multimodal AI systems have substantially reduced these technical barriers, enabling more adaptive and human-like simulated clinical interactions.[24–26] Communication practice using standardized patients has been shown to improve pharmacy students' confidence in clinical encounters.[4,18] Together, these developments position modern VSPs as a complementary simulation-based learning modality capable of supporting realistic communication practice and confidence development within pharmacy education.

Social cognitive theory

According to Bandura,[9] self-efficacy refers to individuals' judgments of their capabilities to organize and carry out actions required to achieve specific goals. In pharmacy education, self-efficacy plays a vital role in shaping students' confidence in clinical decision-making, communication, and problem-solving. These skills are essential for safe and effective patient care.[27] Bandura's Social Cognitive Theory (SCT) suggests that individuals with higher self-efficacy are more likely to approach challenges with resilience and persistence, which is particularly important in high-stakes healthcare environments. Resilience not only supports student well-being but also helps reduce burnout and improve patient safety.[28]

SCT also offers a valuable framework for understanding how confidence develops in pharmacy students. Learning occurs through a continuous interaction between personal factors (e.g., beliefs and emotions), behavior (e.g., practicing communication), and the environment (e.g., simulation-based settings). This process, known as triadic reciprocal determinism (TRD), explains how individuals adjust their thoughts, actions, and behaviors in response to changing environmental circumstances to achieve desired outcomes.[29]

In the context of VSPs, repeated engagement in simulated clinical conversations within a supportive, low-risk environment can reinforce communication behavior and build confidence over time. When combined with targeted feedback, these experiences may strengthen self-efficacy and better prepare students for real-world patient interactions.

Confidence is especially important in pharmacy education, where communication is central to professional practice. Between 67.0% and 81.8% of a pharmacist's daily activities involve direct patient interaction.[30] As such, students must not only possess clinical knowledge but also feel confident in their ability to communicate effectively with patients. While competencies in pharmacy education are often developed through lectures, co-op placements, and lab-based simulations, confidence remains an underemphasized yet essential outcome of experiential learning. Yorra[31] highlights this gap, noting that some pharmacy students graduate without sufficient confidence to fully assume their professional roles. This underscores the need for simulation tools that support not only technical skill development but also affective growth.

Self-efficacy, the belief in one's ability to perform specific tasks, differs from self-esteem, which refers to a broader sense of self-worth. Although self-esteem is internally rooted, it can be shaped by external factors such as peer comparison, mentorship, and feedback from instructors or standardized patients.[31] Enhancing both self-efficacy and self-esteem through simulation-based learning, whether with human standardized patients or virtual standardized patients (VSPs), may be critical to preparing students for the complex demands of clinical practice.

In a study at Northeastern University, Yorra[31] developed the *Pharmacy Self-Efficacy and Self-Esteem Study Questionnaire*, administered to third-year pharmacy students. Results showed that self-esteem varied depending on the learning environment, with hands-on, experiential settings contributing to measurable improvements. These findings suggest that increasing students' exposure to experiential learning may significantly bolster both their self-efficacy and self-esteem.

While SCT emphasizes the role of self-efficacy and the reciprocal interaction between behavior, personal beliefs, and environment, constructivist theory, another important key to self-efficacy, highlights how learners actively build knowledge through authentic experience, reflection, and social engagement. The following section will discuss constructivist theory and the connection to VSPs.

Constructivist learning theory

Constructivist learning theory further supports the integration of simulation-based tools such as VSPs in pharmacy education. One of the most influential figures in this field is John Dewey, a psychologist, philosopher, and educator whose work continues to shape modern educational theory and practice. As a leading figure in the pragmatist movement, Dewey[10] believed that truth should be evaluated based on practical outcomes, or what “works” in real-world contexts. This perspective deeply informed his educational philosophy, particularly his emphasis on experiential learning. Dewey believed that not all experiences lead to meaningful learning. Some experiences, which he called miseducative, may distort growth or create habits that hinder future learning. As he famously stated, “while all genuine education comes about through experience, this does not mean that all experiences are genuinely or equally educative” ([10] p. 25). To determine whether an experience is truly educative, Dewey introduced two key principles, continuity and interaction, which help evaluate the impact of an experience on future growth and the learner's engagement with their environment.

1. The Principle of Continuity means that an experience should contribute to future growth. Educators must consider not just whether an experience is positive in the moment, but whether it leads to meaningful development and prepares students for future learning.
2. The Principle of Interaction emphasizes the balance between a learner's internal state (such as interests, needs, and prior knowledge) and the external environment (such as tasks, tools, or simulations). For an experience to be educative, there must be a good fit between the learner and the situation.

Together, these principles highlight that effective learning is shaped both by the learner's past experiences and by their interaction with the environment. Dewey believed it is the educator's responsibility to structure experiences that support both immediate engagement and long-term growth.

More broadly, constructivism emphasizes that learners build knowledge actively through experience, reflection, and social interaction.[32] Rather than passively absorbing information, students engage in meaning-making processes that connect new experiences to existing knowledge frameworks. In pharmacy education, simulations provide authentic, real-world scenarios in which students can develop and refine clinical communication and patient care skills. VSPs offer feedback-rich, repetitive experiences that support reflection, and improvement which are key components of constructivist learning.[10] Dewey's work underscores the need to design learning environments that engage students with previous experience and promote reflective practice, principles that align closely with the educational potential of VSPs.

Social Cognitive Theory (SCT) and Constructivist Learning Theory both provide strong theoretical foundations for the use of VSPs in pharmacy education. SCT highlights the importance of self-efficacy in shaping students' motivation, resilience, and clinical performance, qualities that can be developed through repeated, low-risk practice with VSPs. The principle of triadic reciprocal determinism explains how learners' beliefs, behaviors, and environments interact dynamically, making simulation-based learning an ideal context for reinforcing communication skills and clinical decision-making. At the same time, Constructivist Learning Theory, particularly Dewey's emphasis on continuity and interaction, frames VSPs as tools for designing experiences that are both immediately engaging and developmentally meaningful. VSPs offer authentic, feedback-driven encounters that align with learners' needs and prior experiences, promoting reflection, adaptation, and long-term growth. Together, these theories support the broader use of VSPs as effective educational tools that not only transmit knowledge but also cultivate the confidence, critical thinking, and interpersonal skills essential for professional pharmacy practice.

The role of simulation in clinical readiness

Simulation, whether in-person or virtual, allows pharmacy students to engage in the role of a pharmacist within a low-stakes environment. If a student makes an error, there is no risk of harm to a real patient; instead, depending on whether the simulation is assessed, the student may lose marks or receive feedback to support their future development. Although receiving a low score can be disappointing, simulation offers a valuable opportunity for reflection. According to Tsingos et al.,[33] reflective practice activities promote learning from both personal and peer experiences, and they provide a potential bridge between knowledge-based curricula and the complexities of real-world practice. As students gain experience through repeated simulation practice and assessment, their knowledge and confidence tend to increase over time. While there is currently limited evidence on the most effective instructional strategies for improving pharmacy student confidence, simulation remains a widely used approach for this purpose.[34]

Simulation-based learning, particularly through HSP encounters, has been repeatedly shown to enhance pharmacy students' confidence in communication. Lupa et al.,[35] observed that first-year pharmacy students achieved their highest performance scores in both formative and summative assessments when engaging in motivational interviews with HSPs, highlighting the role of experiential repetition in building confidence.[35] Similarly, Chen et al.[3] found longitudinal improvements in students' self-efficacy across multiple communication domains, including introductions, patient questioning, and medication counseling. While both studies emphasize increased confidence, Chen's study offers additional insight through its longitudinal design, suggesting that confidence gains may be sustained over time. These findings collectively support the argument that repeated, structured interactions with HSPs can foster not only clinical communication skills but also durable self-efficacy. However, they stop short of determining whether similar gains can be achieved through digital simulation methods, such as VSPs, which remain less studied in Pharmacy as they are a novel method of learning.

While HSP encounters have been shown to improve pharmacy students' confidence in communication, there are barriers to their use. Simulation can be both cost-effective and costly, depending on the approach used. The high expenses are often linked to hired standardized patients, who are paid for their services. Even when using volunteers or students as standardized patients, time and resources are required to design the learning experience, create and write realistic scenarios, and ensure standardized patients are properly trained to deliver consistent portrayals and conduct reliable student assessments.[14] Interactions with HSPs can also be inconsistent, with quality depending on the training and experience of the person or actor portraying the patient.[36] As a result, educators may have to utilize alternative methods such as VSPs to create a rich learning environment. The question then becomes: can VSPs replicate or even enhance the confidence-building effects of HSPs? Early research is showing promise. In the following section, the focus shifts to exploring whether and how VSPs can support and mirror HSPs and the development of confidence in pharmacy students.

Artificial intelligence and clinical readiness in virtual patient simulations

Typically developed using computer software, virtual standardized patients (VSPs) offer several advantages, including immediate feedback, extended learning opportunities beyond the classroom, and flexible, self-paced practice.[37] While artificial intelligence has evolved over the decades, the public release of OpenAI's ChatGPT in late 2022 marked a turning point in the mainstream adoption of large language models (LLMs). Widely available LLMs, such as OpenAI's ChatGPT, Google's Gemini, Anthropic's Claude, and Microsoft Copilot, illustrate recent advances in conversational AI that have expanded the feasibility of more responsive virtual patient interactions. These AI systems, based on artificial neural networks, can generate human-like text and perform a wide range of tasks, from writing essays to generating code.[38,39] One of the most visible applications of LLMs is in AI chatbots that mimic human conversation. These tools have already demonstrated utility in domains such as education, information retrieval, business, and e-commerce.[40]

LLM-powered systems, especially those combining generative AI and adaptive reasoning simulations, are gaining attention for their potential to augment clinical decision-making and transform patient care, education, and research.[26] These advancements are now driving innovation in simulation-based education. AI-enhanced platforms enable the creation of highly realistic and interactive training environments in which Pharmacy students can engage in immersive simulations with naturalistic, AI-generated dialogue and tailored feedback, providing authentic opportunities to practice diagnostic reasoning, therapeutic decision-making, and communication skills. With wider availability through web-based platforms, their potential to transform health professions education globally continues to grow.[19,20]

Because virtual standardized patients (VSPs) are not constrained by instructor availability or in-class scheduling, students can access these tools independently, whether at home or during clinical placements, supporting both flexibility and scalability. Reflecting this growing interest, a PubMed search for “artificial intelligence” AND “pharmacy” revealed an increase in publications from 306 in 2019 to 1426 in 2024, highlighting the profession's rapidly expanding engagement with AI-related research and applications.[41] Together, these trends underscore the increasing maturity of AI-enabled approaches within pharmacy education and practice.[24]

LLMs, while showing promise, are not without their limitations. Hallucinations are a process in which the LLM generates false or fabricated information. There are multiple reasons in which an LLM may hallucinate, such as the size of the training dataset, which can influence hallucination type and degree. It has been demonstrated on multiple LLMs that the larger the training dataset size, the more likely the model will be capable of recognizing its limitations and acknowledging uncertainty.[42] Published literature has shown hallucination rates as high as 90% in specific medical contexts.[41]

In pharmacy education, while these models can process large datasets, they lack access to real-time, continuously updated medical databases, potentially leading to outdated or incorrect advice. For example, studies have found that ChatGPT-3.5 provided inaccurate information about self-managed medication abortion, exaggerating risks despite evidence supporting its safety when properly administered. Such misinformation can increase patient anxiety, perpetuate stigma, and discourage evidence-based healthcare decisions.[43]

VSP simulations have increasingly been adopted in pharmacy education to support core clinical competencies, including patient interaction, communication, and therapeutic reasoning. Confidence, discussed earlier as a key component of self-efficacy, is frequently cited as a desired learning outcome in the literature reviewed for this paper. In a study by Taglieri et al.,[44] pharmacy students who completed virtual patient activities before mock clinical encounters with HSPs performed significantly better than those in the control group. However, no corresponding change in self-reported confidence was observed, possibly due to the brief nature of the intervention and reliance on a single pre/post survey, which may not fully capture more nuanced shifts in self-efficacy. Furthermore, the study involved only one simulation session, limiting opportunities for reflection and iterative learning.

In contrast, a mixed-methods study by Borja-Hart et al.[36] involved first-year pharmacy students in a virtual patient simulation targeting communication skills. Results showed significant improvements in eight of ten self-assessed confidence domains, including history-taking, interview organization, and data documentation. Although the study lacked a control group, its large sample size (over 200 students) and the combined use of quantitative and qualitative data strengthened the credibility of its findings. Student reflections emphasized usability and realism as critical elements in their learning experience. These findings suggest that well-designed VSP simulations can effectively bolster self-efficacy.

Additional evidence comes from a qualitative study by Thompson et al.,[45] which explored the experiences of pre-registration pharmacy trainees in the UK. Trainees who participated in virtual patient simulations—compared to those using non-interactive case studies—reported higher engagement and greater confidence in real-world practice. They emphasized the ability to make mistakes in a safe environment and the value of repeating scenarios to improve. As one participant noted, “These virtual patients… are as close as you can get to real life, to situations you will have to deal with every day... it gives you confidence… if you make a mistake… you haven't killed anyone, and you can try again” (p. 9). While limited by its small sample size and reliance on self-reporting, the study offers deep qualitative insights into the experiential benefits of interactivity and reflective practice.

While most existing research in pharmacy education has focused on traditional branching-scenario VSPs, simulations that follow a decision tree where student choices dictate subsequent outcomes, emerging evidence from adjacent health disciplines suggests that LLM-powered VSPs hold considerable promise. Studies using GPT-4 to simulate patient interactions in medical and nursing training have demonstrated significant improvements in self-reported confidence ([25,46];). AI-driven systems offer dynamic, personalized conversations and feedback, which can be particularly beneficial for pharmacy students developing patient counseling and nuanced communication skills. While direct research within pharmacy education remains limited, the integration of large language models (LLMs) presents a promising avenue for building student confidence in increasingly complex clinical.

learning environments. Early applications of tools like ChatGPT have shown potential, but they also come with limitations. In a systematic narrative review, Gharib et al.[47] identified several recurring challenges, including resistance to change, cost, time constraints, software usability, alignment with accreditation standards, student motivation and engagement, faculty readiness, and curricular limitations.

Table 1 summarizes the impact of virtual standardized patients (VSPs) on student confidence across the studies discussed, highlighting differences in study design, sample characteristics, intervention, outcomes and limitations. (See Figs. 1–3.)

Future directions for curriculum

From a curriculum design perspective, VSPs should not be viewed as a replacement HSPs, but rather as a complementary modality following a hybrid simulation integration. Hybrid simulation approaches, which integrate computer-based simulations with human experiences, have been shown to enhance learning and understanding compared to traditional lecture-based instruction alone.[48] While VSPs offer clear advantages in scalability, standardization, and flexible access, they may not fully capture the emotional nuance and human connection that characterize authentic patient–pharmacist interactions. These experiences are supported through HSP encounters and remain essential for preparing learners to engage confidently with real patients in practice. A blended approach may be most appropriate, wherein VSPs are used to support early, repeated, and low-stakes communication practice that builds foundational confidence and self-efficacy, while HSP-based simulations are strategically embedded to foster higher-order interpersonal skills such as patient resistance to taking a medication and empathy, a form of emotional intelligence. Such hybrid models align with principles of experiential learning and readiness for practice, allowing educators to leverage the strengths of both modalities while mitigating their respective limitations. The use of multiple simulation modalities within a hybrid model is also consistent with accreditation expectations, particularly standard 6, that emphasize the integration of varied teaching, learning, and assessment approaches to ensure graduates achieve required educational outcomes.[2] As AI-enabled technologies remain in relatively early stages of adoption within health professions education, continued technical improvements are anticipated over time. However, given the potential for inaccurate or incomplete health information, human oversight remains essential, reinforcing the need for hybrid educational models that integrate AI-based tools with human-facilitated learning.

Conclusion

Virtual Standardized Patients (VSPs) offer a promising solution to a longstanding challenge in pharmacy education: how to provide repeated, low-stakes, and authentic practice opportunities that build communication confidence. This paper has argued that when thoughtfully integrated into experiential curriculum, VSPs, particularly those powered by large language models (LLMs), can support the development of both professional readiness and self-efficacy in pharmacy students.

Drawing on Social Cognitive Theory, VSPs contribute to the reinforcement of self-efficacy through mechanisms such as performance accomplishment, feedback, and vicarious learning. Students gain confidence as they engage in realistic clinical dialogues, reflect on outcomes, and make improvements over time. Simultaneously, Constructivist Learning Theory, especially Dewey's principles of continuity and interaction, underscores the importance of experiential learning that aligns with learners' prior knowledge and supports future growth. VSPs, by providing tailored feedback and opportunities for reflection, create experiences that are both meaningful and developmentally appropriate.

These pedagogical benefits are amplified by the flexibility and scalability of VSPs, which allow learners to access simulations anytime, anywhere, an advantage especially relevant in today's increasingly digital and distributed learning environments. Although current research in pharmacy education is still evolving, early evidence from related disciplines suggests that LLM-enhanced simulations can effectively improve student confidence and engagement.

To advance this emerging field, future research should explore how VSPs perform across diverse student populations, curricular designs, and communication contexts. Longitudinal studies and comparative trials between standardized patients (HSPs) and VSPs will be essential for determining their relative and combined educational value.

Table 1
Summary of Key VSP Studies.

Study	Design	Sample	Intervention	Confidence Outcome	Limitations
Taglieri et al.,[44]	RCT, quantitative	$N = 76$ pharmacy students	VSP activity before mock HSP encounter	No significant change in self-reported confidence	Short exposure; limited follow-up
Borja-Hart et al.[36]	Mixed-methods	N ≈ 200 first-year students	VSP communication simulation	Significant improvement in 8/10 confidence domains	No control group; based on self-report
Thompson et al.[45]	Qualitative	Pre-reg pharmacy trainees (UK)	VSP vs. non-interactive case studies	Higher confidence and engagement with VPs	Small sample; UK-specific
Chang & Hwang[46]	Mixed-methods	Nursing Student Educators	Chat-GPT 3.5 powered VSP in class (free version)	ChatGPT could enhance the participants' self-confidence in their professional abilities.	Class time was not sufficient, ChatGPT does not always provide accurate information
Holderried et al.[25]	Pilot validation study	Not pharmacy-specific	GPT-4 simulating standardized patients	High user confidence; strong feedback alignment	Early-stage; not validated in pharmacy

Note: Summarized from cited studies.

Fig. 1. "Justina".
Note: Source - Talbot, T., & Rizzo, A. "Skip." (2019). Virtual human standardized patients for clinical training. In A. "Skip" Rizzo & S. Bouchard (Eds.), *Virtual Reality for Psychological and Neurocognitive Interventions* (pp. 387–405). Springer. https://doi.org/10.1007/978-1-4939-9482-3_17

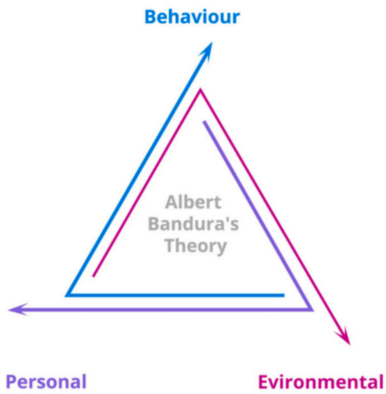

Fig. 2. Bandura's Social Cognitive Theory.
Note: Source - Nickerson, C. (2025, March 31). *Albert Bandura's social cognitive theory*. Simply Psychology. https://www.simplypsychology.org/social-cognitive-theory.html

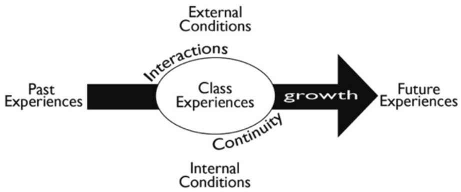

Fig. 3. Dewey's[10] theory of experience.
Note: Source - Dewey, John, 1938. *Experience and education,* Collier Books, 1938.

For scholars, educators, and doctoral researchers, this is an exciting area of inquiry at the intersection of educational design, health professions training, and human-AI interaction, one with the potential to meaningfully shape the future of pharmacy education and contribute to the broader discourse on technology-enhanced learning.

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Ethics / human subjects statement

This manuscript is a narrative literature review. It does not involve primary data collection with human subjects or animals; therefore, ethics approval was not required.

Declaration of competing interest

The author declares no conflicts of interest.

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