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RESEARCH ARTICLE

Integration of artificial intelligence (AI) in skills-based pharmacy courses

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Abstract

Background: Skills-based courses in pharmacy curricula are uniquely poised to integrate artificial intelligence (AI) as part of practical training for practice readiness. The primary objective of this study was to evaluate how pharmacy curricula currently use or plan to use AI within skills-based courses. **Methods:** Invitations to complete an anonymous Qualtrics® XM survey were e-mailed to faculty members of the American Association of Colleges of Pharmacy, requiring identification as a skills-based faculty coordinator for participation. The survey remained open for two months with biweekly reminders. It assessed current and potential AI utilisation within curricula and administrative functions. Data was analysed categorically based on responses. **Results:** Of the 98 pharmacy skills-based faculty coordinator survey responses submitted, only 18% reported currently utilising AI within courses, most commonly through gamification. Additionally, 15% reported using AI for administrative course tasks. About 60% reported considering AI implementation, usually within the next two years. The most common reasons for not yet implementing AI included a lack of familiarity with AI and its unclear role in pharmacy education. **Conclusion:** The reported AI integration in skills-based pharmacy courses and administrative functions is currently low. Although interest seems high, there are barriers to implementing AI, including faculty understanding of the technology and the purpose of its integration into pharmacy education.

Introduction

Advancements in technology continuously change the identity of healthcare and the delivery of services to patients (Sallam, 2023). Historically, it has ultimately been up to the terminal human to interpret and conclude healthcare delivery with the assistance of technology. Artificial intelligence (AI) is adapting to utilise a neural network to mimic the thought process of the human brain. Generative AI programmes, equipped with a plethora of benefits coupled with limitations and opportunities for growth, are poised to be the new frontier.

One well-known AI tool is ChatGPT, which quickly became not only the most popular AI platform but also the fastest-growing application and software on the planet (Mohammad *et al.,* 2023; Sun & Hoelscher, 2023). Healthcare practice is an enterprise for the new technologies afforded by AI systems, such as ChatGPT and the like (Sallam, 2023). Current applications have included optimisation of workflow practices, including chatbot interfaces that interact directly with patients, facilitation of documentation, and enhanced integration of personalised medicine.

Although ChatGPT has gained recent popularity, it is noteworthy that AI technology has been integrated into various tools that can support diverse aspects of education and administrative tasks (Schroer & Whitfield, 2023; University of San Diego, 2023). Some more commonly recognised areas may include gamification with programmes like Kahoot! and plagiarism detection software (Kahoot!, 2024). Additional AI-integrated educational applications include but are not limited to Administrative tasks (e.g., scheduling, record keeping, idea generation), classroom questions (e.g., Brainly), digital image generator (e.g., DALL-E), instructional

design/content application (e.g., Content Technologies), interactive personalised learning (e.g., Age of Learning), language learning (e.g., Duolingo), math tutoring tool (e.g., Carnegie Learning and Thinkster Math), virtual learning assistant (e.g., Cognii and Jill Watson), voice to text (e.g., KidSense), speech recognition software (e.g., Nuance), tracking student progress/engagement (e.g., Open edX Insights), and personalised study guidance (e.g., Knewton and Quizlet Learn).

It must be acknowledged that alongside the advanced applications of AI systems, there are also impediments (Sun & Hoelscher, 2023). Current systems are only able to process limited, potentially outdated information databases, increasing the risk of producing inaccurate or outdated information. For example, the source material for the cost-free version of ChatGPT is currently limited to information available up to September 2021. Additionally, AI programmes cannot process higher-order critical processing or ethical reasoning (Mohammad *et al.,* 2023). Systems like ChatGPT rely on inputted user prompts to obtain responses, which may introduce bias or a limited scope of knowledge. Other limitations include the inability to provide references and citations, potential biases, and image processing. To address the interest, potential benefits, and associated concerns with AI integration within education, the United States Department of Education released a report in May 2023 addressing specific areas of learning, teaching, formative assessment, and research and development, culminating with recommendations for implementation (U.S. Department of Education, 2023).

The Accreditation Council for Pharmacy Education (ACPE) sets accreditation standards that programmes must meet, or be in pursuit of, to be granted accreditation for professional pharmacy degree programmes and continuing pharmacy education. Educational outcomes and student success are achieved through categorised required didactic content centred on advanced pharmacy practice experience (APPE)-readiness objectives (Accreditation Council for Pharmacy Education, 2015). The Academic Affairs Committee of the American Association of Colleges of Pharmacy (AACP) utilised these standards to assist in the creation of the Entrustable Professional Activities (EPAs) that all professional pharmacy degree graduates should be able to perform (Haines *et al.,* 2017). EPAs were broken into three core areas, i.e., professionalism, self-awareness, and communication, the cornerstones of skills-laboratory courses in the curricula. Skills-based education within pharmacy curricula provides students with simulated real-world experiences in various pharmacy practice skills, such as patient consultations, dispensing, documentation, and healthcare provider interactions (Dula & Porter, 2021). Skills-based pharmacy courses additionally teach and assess hands-on application and execution of the Pharmacists' Patient Care Process (PPCP) (Adams & Weaver, 2019).

AI integration into healthcare education is critical to empowering the next generation of providers to embrace the ever-changing landscape of healthcare delivery and research (Mohammad *et al.,* 2023). Educators have experienced an onslaught of technological advancement and incorporation over the past couple of decades, resulting in overall enriched student learning and engagement in and out of the classroom (Eiland & Todd, 2019). These experiences have shown that technology integration is multifaceted across the institution, concluding with the facilitators practising and gaining confidence in the various systems before presenting them to students. AI systems can also be used to facilitate course development, information presentation, and student assessment (Mohammad *et al.,* 2023). AI's utilisation in the future of healthcare delivery is inevitable, and therefore, it is critical to incorporate it into pharmacy and interprofessional education curricula. However, there is currently no extensive information on how AI technology and its critical evaluation will be integrated into pharmacy skills-based courses (Jha *et al.,* 2022).

The primary objective of this exploratory study was to evaluate how pharmacy curricula were currently using or planning to use AI within skills-based courses for student-focused curricular integration or administrative faculty tasks.

Methods

An electronic Qualtrics XM survey was created to evaluate the current or planned use of AI technology within schools and colleges of pharmacy curricula, faculty preferences, and opportunities and/or fears regarding AI integration. Invitations to participate in this optional, anonymous survey were sent to all 6,198 registered faculty members of the AACP as of May 18, 2023. The Qualtrics® XM survey invitation was successfully delivered to 6,106 e-mail addresses. The survey remained open for two months, and biweekly reminders were sent to support response rates. Data were analysed using Microsoft Excel to categorise responses through descriptive statistics. The survey received an IRB exemption from the host institution.

The target population for this survey included pharmacy faculty members who coordinate skills-based courses within an ACPE-accredited school or college of pharmacy. It was anticipated that each of the 143 ACPE-accredited schools and colleges of pharmacy would have at least one and up to six skills-based courses in their

curricula, with at least one faculty coordinator for each, leading to an estimated target population of 143 to 858 faculty members.

Results

A total of 98 pharmacy skills-based faculty coordinators answered the survey. All responses were included in the data analysis, which carried forward partial responses into the final data set. Most respondents coordinated one skills-based course per academic year, served as a skills-based coordinator for more than five years, had a 1-credit hour assignment per skills-based course, and educated over 100 students per class (Table I).

Table I: Curricular demographics (n=98)

Variable	N (%)
Number of skills-based courses faculty coordinated per academic year	
1	50 (51)
2	33 (34)
3 or More	15 (15)
Number of skills-based courses offered throughout didactic curricula	
1	1 (1)
2	2 (2)
3	9 (9)
4	17 (17)
5	6 (61)
6	31 (32)
>6	32 (33)
Institution type	
Private	52 (53)
Public	46 (47)
Average number of students per cohort	
0-25	4 (4)
26-50	24 (24)
51-75	19 (19)
76-100	22 (22)
>100	29 (30)
Number of credit hours assigned per skills-based course	
1	34 (35)
2	23 (23)
3	26 (27)
4	6 (6)
>4	9 (9)

Table II presents the general respondent demographics. A majority of skills-based coordinators were between 35 and 44 years of age at the rank of Assistant Professor and had served as skills-based course coordinators for five years or more.

Table II: Faculty demographics (n=86)

Variable		N (%)
Age (Years)	25-34	17 (20)
	35-44	35 (41)
	45-54	23 (27)
	55-64	10 (12)
	65 and older	1 (1)
Gender	Female	56 (65)
	Male	25 (29)
	Prefer not to say	5 (6)
Race	American Indian	2 (2)
	Asian	9 (10)
	Biracial	1 (1)
	Black/African American	4 (5)
	Hispanic/Latin	7 (8)
	Prefer not to say	4 (5)
	White/Caucasian	59 (69)
Terminal degree(s)	Bachelor's degree	2 (2)
	MS/MBA	3 (3)
	PharmD	59 (69)
	PharmD, M.Ed.	1 (1)
	PharmD, MPH	1 (1)
	PharmD, PhD	1 (1)
	PharmD MS/MBA	4 (5)
	PharmD, PhD, MS/MBA	1 (1)
	PhD	10 (12)
	PhD, MS/MBA	2 (2)
	Other	2 (2)
Years Since graduation from terminal degree	0-5	5 (6)
	6-10	25 (29)
	11-15	16 (19)
	16-20	12 (14)
	>20	28 (33)
Years worked in pharmacy education (Academia)	0-1	5 (5)
	2-5	20 (20)
	6-10	23 (23)
	>10	50 (51)
Years served as course coordinator for skills-based course	0-1	13 (13)
	2	6 (6)
	3	11 (11)
	4	8 (8)
	5 or More	60 (61)
Academic rank	Assistant professor	36 (42)
	Associate professor	25 (29)
	Dean	2 (2)
	Professor	19 (22)
	Other: Director	2 (2)
	Instructor	2 (2)
Pharmacy specialty	Administration	4 (5)
	Ambulatory care	28 (33)
	Cardiology	2 (2)
	Community practice	10 (12)
	Critical care	3 (3)
	Hospital	7 (8)
	Infectious diseases	1 (1)
	Internal medicine	10 (12)
	Nuclear	2 (2)
	Oncology	1 (1)
	Paediatrics	3 (3)
	Transitions of care	1 (1)
	Other	14 (16)

Only 18% of skills-based coordinator respondents utilised AI within their course, mainly gamification (e.g., Kahoot!). The majority reported using AI for more than three years and integrating it four or more times within the course, most commonly for ungraded activities (Table III).

Table III: AI current use within curricula

Question	N (%)
Do you currently integrate the use of AI within your skills-based courses in the curricula? (n=98)	
Yes	18 (18)
No	80 (82)
How many times do you utilise AI within your skills-based course(s)? (n=16)	
1	4 (25)
2	3 (19)
3	3 (19)
4 or more	6 (38)
What AI tools do you currently use in your skills-based courses? Select all that apply.	
Classroom questions (i.e. Brainly)	3
Conversational chatbot (i.e. ChatGPT, Dialogflow)	2
Digital image generator (i.e. DALL-E)	1
Gamification (i.e., Kahoot!)	9
Instructional design/content application (i.e. Content Technologies)	2
Interactive personalised learning (i.e. Age of Learning)	1
Language learning (i.e., Duolingo)	1
Personalised study guidance (i.e. Knewton, Quizlet Learn)	3
Tracking student progress/engagement (i.e. Open edX Insights)	1
Virtual learning (i.e. Cognii, Jill Watson)	1
Other	6
How many years have you been utilising AI within your skills-based course(s)? (n=16)	
0-2	7 (44)
2-3	1 (6)
More than 3	8 (50)
Do you use AI for graded activities within your skills-based course(s)? (n=16)	
Yes	5 (31)
No	11 (69)
Do you currently use AI for administrative tasks within your skills-based course(s)? (n=95)	
Yes	14 (15)
No	81 (85)

Those who selected "Other" for AI use mentioned specific tools, i.e., MyDispense (2), plagiarism checking software (2), SimConverse, and AI with machine learning subsets for biomedical data science analysis. Only 15% reported using AI for administrative tasks (e.g., scheduling, record-keeping, and idea generation).

Furthermore, 60% of participants reported considering incorporating AI into their skills-based courses, mainly focusing on gamification, administrative tasks, and conversational chatbots (i.e., ChatGPT and Dialogflow). The most commonly reported timeline for implementing AI was within the next two years. Among those not planning to implement AI, the most frequently cited reason was unfamiliarity with it and how to use it, followed by uncertainty about its role or benefits in pharmacy education (Table IV).

Table IV: Future use of AI within the curricula

Question	N (%)
Have you considered incorporating AI within your skills-based course(s)? (n=94)	
Yes	56 (60)
No	38 (40)
If not, what is the reasoning?	
Unclear benefit	19
Unclear role/purpose in pharmacy education	20
Unfamiliar with how to use it	21
Concern it will hamper student learning skills	12
Other	7
How have you considered incorporating AI within your skills-based course(s)? Select all that apply.	
Administrative tasks (i.e. scheduling, record keeping, idea generation)	36
Classroom questions (i.e. Brainly)	16
Conversational chatbot (i.e. ChatGPT, Dialogflow)	35
Digital image generator (i.e. DALL-E)	7
Gamification (i.e., Kahoot!)	42
Instructional design/content application (i.e. Content Technologies)	10
Interactive personalised learning (i.e. Age of Learning)	6
Math tutoring tool (i.e. Carnegie Learning, Thinkster Math)	3
Personalised study guidance (i.e. Knewton, Quizlet Learn)	18
Tracking student progress/engagement (i.e. Open edX Insights	4
Virtual learning assistant	3
Other	24
How soon are you considering implementing AI into your skills-based course(s) (n=88)	
Within the next year	26 (30)
Within two years	32 (36)
Within 3 years	3 (3)
Over 3 years or unsure	27 (31)

Discussion

This study analysed 98 pharmacy skills-course faculty survey responses, revealing low AI utilisation in skills-based courses, graded activities, and administrative tasks. Faculty expressed concerns about integrating AI into a skills-based course, citing unclear benefits in pharmacy education, a potential decrease in critical thinking skills, unfamiliarity with AI use, and time constraints for learning how to use it. Respondents showed interest in adopting AI for administrative tasks, conversational chatbots, gamification, instructional design, student progress tracking, and speech recognition software. Most respondents stated they would implement AI within the next two years.

This survey suggests that although most educators have not yet incorporated AI into their curricula, a significant number showed interest in implementing AI in the near future. Further, for those who have already integrated AI into their course, the majority used it for pedagogy or enhanced efficiency rather than as a tool for healthcare delivery. Pharmacy skills-based education is constantly adapting and changing to address innovations in health informatics and patient care needs. Technology and data systems have progressed and evolved in pharmacy education in parallel with societal advancements. Since the rise of electronic health records, drug information resources, and communication channels, pharmacy skills education has adapted and evolved to prepare future clinicians (Dula & Porter, 2021). Further, the advancement of teaching and learning tools, such as learning management systems, assessment platforms, and data management software, has facilitated more robust and engaging instruction. The next step in this progression is to integrate AI and machine learning as the technology develops to prepare student pharmacists for the future of pharmacy.

Considering the overall objective of pharmacy skills courses, which is to offer students the opportunity to practise their skills in a controlled, simulated environment, the integration of AI and new technology becomes a logical innovation. This innovation allows students to practise with cutting-edge technologies in low-stakes scenarios, where they can grasp the concepts and capabilities that can be further developed and applied in clinical practice (Dentzer, 2019; Cobaugh & Thompson, 2020; Papadopoulos *et al.,* 2021; Rhoney *et al.,* 2021; Silva *et al.,* 2022; Cain *et al.,* 2023).

The demand for AI literacy in healthcare education has been previously demonstrated, with approximately 96% of medical students expressing a need for knowledge and skill sets in AI applications (Civaner et al., 2022). Responding to this need, novel educational models have emerged, such as a medical school elective for AI with critical divergent thinking and active learning through application-based activities (Krive *et al.,* 2023). This medical school elective involved various members of the multidisciplinary team, including pharmacists, to incorporate a medication safety case.

The literature has highlighted the considerable resources required for faculty to run a pharmaceutical skills course (Porter et al., 2020; Dula & Porter, 2021), underscoring the necessity to develop and disseminate innovative approaches for this type of class to meet the needs of students (Dula & Porter, 2021). In this context, AI presents a solution to this challenge, offering applications for classroom management, record-keeping, and grading. For example, AI has been utilised to automate assessment scoring in medical education (Tolsgaard *et al.,* 2023).

Strengths and limitations

This study captured a representative response regarding AI integration in pharmacy skills courses from pharmacy faculty with diverse experience levels in pharmacy skills education practising in private and public institutions across the United States. It aimed to provide a foundational understanding of where AI has been integrated into pharmacy skills courses to date, serving as the basis for future research on the implementation and effectiveness of AI in pharmacy education.

However, the study has several limitations. The survey lacked precise definitions of AI within various platforms (e.g., distinguishing between using Kahoot! and its AI-generated question feature). While nine respondents reported AI use in their skills-based course, they could not provide detailed explanations of integration methods. The low response rate is another limitation, as this sample may not reflect the entire Pharmaceutical Skills faculty from the colleges and schools of pharmacy in the United States. While a representative response could be obtained, the exploratory survey did not collect the institution name or respondent location, making it impossible to check for duplicate institutions or assess the scope of the data.

Implications for practice

Future directions for integrating AI into skills-based courses should include education on available AI tools and adequate implementation methods. Providing students with opportunities to engage with AI during skills activities will enhance their practice readiness, particularly as pharmacy practice is expected to integrate AI-based platforms to improve medication use systems and expand precision medicine. These

concepts, already cornerstones of pharmacy skills-based courses, require further research to evaluate learning outcomes and the implementation of AI systems within existing pharmacy practice models (Cobaugh & Thompson, 2022; Cain et al., 2023).

Conclusion

This study revealed that pharmacy skills-based course coordinators reported low AI integration into their courses and for administrative functions. Although there is interest in adopting AI, barriers remain, including the faculty's understanding of the technology and the purpose of its integration into pharmacy education. Future studies should focus on AI training and assess AI use outcomes to address these concerns.

Conflict of interest and source of funding

None of the authors have any financial disclosures or conflicts of interest.

Ethics approval

This study (STUDY005808) received exemption from the Univeristy of South Florida investigational review board (IRB). All participants gave informed consent before taking part in the survey.

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