

RESEARCH ARTICLE

# Assessing ChatGPT's impact on curriculum outcomes and Entrustable Professional Activities (EPAs) during Advanced Pharmacy Practice Experiences (APPEs)

Deanna Goldman<sup>1</sup> , Habiba Ashour<sup>2</sup> , Mandy Zheng<sup>3</sup> , Nicole Bradley<sup>4</sup> , Kimberly E. Ng<sup>4</sup> 

<sup>1</sup> NYU Langone Long Island, Mineola, New York, United States

<sup>2</sup> One Brooklyn Health, Brooklyn, New York, United States

<sup>3</sup> NYU Langone Orthopedic Center, New York, United States

<sup>4</sup> Department of Pharmacy Practice, St. John's University College of Pharmacy and Health Sciences, Queens, New York, United States

## Keywords

Artificial intelligence  
Pharmacy education  
Pharmacy student learning  
Student perception

## Correspondence

Kimberly E. Ng  
St. John's University College of Pharmacy  
and Health Sciences  
Queens  
New York  
United States  
ngk3@stjohns.edu

## Abstract

**Background:** Chat Generative Pre-trained Transformer (ChatGPT) use in higher education has been controversial. The purpose of this study was to evaluate the impact of ChatGPT on pharmacy student achievement of educational outcomes and entrustable professional activities, as outlined by the American Association of Colleges of Pharmacy (AACP), during Advanced Pharmacy Practice Experiences (APPEs). **Methods:** A 20-question electronic survey was distributed to pharmacy students in the Class of 2023 and 2024. The survey evaluated the impact of ChatGPT on educational outcomes and student perceptions of the technology. Results were analysed using descriptive statistics. **Results:** A total of 69 students participated in the survey. Among them, 44% (17/39) used ChatGPT during their APPE rotations. Of those, 82% (14/17) of students agreed or strongly agreed that ChatGPT helped them find, analyse, and integrate foundational knowledge of medications. Similarly, 82% (14/17) agreed or strongly agreed that ChatGPT positively impacted their approach to work and research habits. Additionally, 89% (15/17) agreed or strongly agreed that they will use ChatGPT on future APPEs and in professional practice. **Conclusion:** The use of ChatGPT by pharmacy students during their APPE rotations demonstrates a potential benefit in student achievement of educational outcomes across all three domains during APPEs.

## Introduction

Artificial intelligence (AI) refers to computer technology created using algorithms to develop application systems that stimulate, extend, and expand human intelligence (Liu *et al.*, 2021). In recent years, accessibility to AI applications has grown as the development of different applications has become more available. A study that examined over 3,000 AI tools and their usage showed that the top 50 AI tools attracted over 24 billion visitors from September 2022 to August 2023 (Jackson, 2023), with the five most visited applications being Chat Generative Pre-trained Transformer (ChatGPT), Character.ai, Midjourney, and Hugging Face. The top visited application, ChatGPT,

recorded 14.6 billion visits. This AI model can generate real-time responses based on user requests (Liu *et al.*, 2021). Since its creation in 2022, ChatGPT has become a prominent AI tool, with options for both free and paid-for versions of AI available for users (OpenAI, 2024). Because of this popularity, there is interest in determining the role of ChatGPT in pharmacy practice and higher education (Gilson *et al.*, 2023).

There are many innovative ways in which AI is emerging in pharmacy practice, including treatment plan designing, enabling the drug creation process, analysing vast amounts of healthcare data, and optimising inventory management (Raza *et al.*, 2022). While the use of AI in pharmacy practice continues to expand, the data

regarding its utility in pharmacy education remains scarce. Literature on AI surrounding pharmacy primarily focuses on the potential impact rather than the current impact it has on students. The American Society of Health-System Pharmacists (ASHP) published a statement addressing the utilisation of AI in pharmacy practice (Schutz *et al.*, 2023). The statement highlights the transformative potential of AI and the contributions it will likely produce, whether it be through improvements in informatics, pharmacy operations, or clinical practice. ASHP further emphasised the importance of integrating AI into the pharmacy education curriculum to familiarise students with such technology, equipping them for future use (Schutz *et al.*, 2023). However, not many studies have been performed to assess the use and impact of ChatGPT on pharmacy students and their education. A 2023 scoping review found only seven studies addressing the use of AI in pharmacy education, showing a limited number of publications related to AI in pharmacy education (Jackson, 2023). Five focused on the context of teaching and learning, one tackled the prediction of academic performances with AI, and one explored the benefits and limitations of ChatGPT in pharmacy education. Therefore, it is essential to determine the impact of ChatGPT on pharmacy students' learning to guide educators on how to address and best utilise the technology in the future.

Pharmacy student learning can be assessed by using the American Association of Colleges of Pharmacy (AACCP) Curriculum Outcomes and Entrustable Professional Activities (COEPA) document, which is the fifth version of the Centre for the Advancement of Pharmacy Education (CAPE) education outcomes (Medina *et al.*, 2023). COEPA outlines the principles of pharmacy practice that students should achieve by the end of a programme by listing specific educational outcomes. This study aimed to evaluate the impact of ChatGPT on student

achievement of COEPA educational outcomes during advanced pharmacy practice experiences (APPEs) and student perceptions of use.

## Methods

A 20-question electronic survey was distributed via email to pharmacy students in their fourth professional year enrolled at a NYC College of Pharmacy over a three-month period. Three emails were sent out at the beginning of each month inviting 368 students to participate. The survey, administered via Google Forms, consisted of four sections. Section 1 collected student demographics, including graduation year and previous use of ChatGPT. If the student responded that they did not previously use the AI tool, the survey was automatically brought to an end. Participants who used ChatGPT continued to the second section of the survey, where more information about their use of the platform was collected. Section 3 was only presented to students who had used ChatGPT specifically during their APPE rotations. Finally, the last part inquired about the student's perspective on using ChatGPT in the form of Likert-scale assessments across all three COEPA educational outcome domains of knowledge, skills, and attitude. This section also included additional questions that assessed student perceptions and overall impressions of ChatGPT. Table I details the four sections of the survey and survey questions.

Participation in the survey was voluntary and anonymous. Descriptive statistics were used to analyse the responses, and the Institutional Review Board exemption was obtained from the university. Survey participants also had the opportunity to participate in a gift card raffle. This information was collected separately from the survey.

**Table I: Survey questions for participating students regarding their use of ChatGPT and perceptions of the technology**

Section #	Survey questions
Section 1	Have you ever used ChatGPT? When was or is your expected year of graduation?
Section 2	What activities have you used ChatGPT for? How did you learn about ChatGPT? Have you used ChatGPT during APPE rotations?
Section 3	Which practice setting(s) have you used ChatGPT during your rotations?
Section 4	ChatGPT has helped me find, analyse, and integrate foundational knowledge of medications during my pharmacy rotations (e.g. collect research information, help with journal clubs, answer medication related questions using scientific literature, etc.) (COEPA 1.1) ChatGPT has helped me with critical thinking skills while on an APPE rotation (e.g. assess collected information, create a care plan, answer medication related questions using scientific literature, optimise pharmacotherapy, etc.) (COEPA 2.1)

Section #	Survey questions
	ChatGPT has helped me become a better communicator with other students, professionals, and patients (e.g. assist with written communications, answer medication related questions using scientific literature, deliver medication or health related education, etc.) (COEPA 2.2)
	ChatGPT has helped me provide comprehensive care to individuals as a medication specialist (e.g. assist with step-by-step approach to therapy, implement care plans, recommend prevention and promotion activities, etc.) (COEPA 2.4)
	ChatGPT has helped me perform stewardship activities that optimise patient healthcare outcomes by improving safety and efficacy of medication use systems (e.g. assist with antimicrobial, opioid, renal stewardship activities, monitor the safety and effectiveness of a care plan, etc.) (COEPA 2.6)
	ChatGPT has helped me to engage and contribute as a healthcare team member. (COEPA 2.7)
	ChatGPT has helped me to assess factors that influence the health and wellness of a population and develop strategies to address those factors (e.g. identify populations at risk for prevalent diseases and preventable adverse medication outcomes during my pharmacy rotations, assist with development of medication or health-related education). (COEPA 2.8)
	The use of ChatGPT has positively impacted my approach to work and research habits during my pharmacy rotations.
	The use of ChatGPT has negatively impacted my approach to work and research habits during my pharmacy rotations.
	My preceptors are generally open to or supportive of incorporating the use of ChatGPT into rotation activities with the aim of enhancing my learning during my pharmacy rotations.
	I will use ChatGPT on future APPEs/in my professional practice.
	I would recommend the use of ChatGPT to other pharmacy students or healthcare students during their rotations.
	What other functions have you utilised ChatGPT for during your pharmacy rotations?
	Please provide any additional comments on or suggestions regarding the use of ChatGPT during pharmacy rotations.

\*Section 4, statements 1-12, were evaluated on a 6-point Likert Scale: Strongly Disagree, Disagree, Neutral, Agree, Strongly Agree, and I have not used ChatGPT for this.

## Results

A total of 69 students participated in the survey, yielding a response rate of 18.75%. The majority (76.81%) were predicted to graduate in May 2024, while 17.39% graduated in May 2023, 2.90% were expected in May 2025, and 2.90% at other unspecified times.

Of the participating students, 56% (39/69) had previously used ChatGPT for various activities. Students learned about ChatGPT from several sources, including friends (35.90%), social media (41.03%), news (10.26%), work (2.56%), experiential rotations (2.56%), or other sources not mentioned (7.69%).

Approximately 44% (17/39) had used ChatGPT, specifically during their APPE rotations, and this cohort of students served as the focal point of this study, which explored their perception and use of ChatGPT during rotations. Students used ChatGPT for many different purposes. Students reported using ChatGPT for various purposes, including coding (4%), answering questions (29%), composing e-mails (19%), writing papers or essays (12%), work-related tasks (18%), school-related activities (16%), and other unlisted activities (2%).

Table II summarises the baseline characteristics and responses of the participating students.

**Table II: Participants' baseline characteristics**

Variable	% (n)
Expected graduation year	
May 2023	17.39% (12)
May 2024	76.81% (53)
May 2025	2.90% (2)
Other	2.90% (2)
ChatGPT use previously	
Yes	56.52% (39)
No	36.23% (25)
I don't know what ChatGPT is	7.25% (5)
Learned about ChatGPT through	<b>N=39</b>
Friends	35.90% (14)
Social media	41.03% (16)
News	10.26% (4)
Work	2.56% (1)
During experiential rotations	2.56% (1)
Other	7.69% (3)
ChatGPT use during APPE rotations	
Yes	44% (17)
No	56% (22)
What activities have you used ChatGPT for? <sup>a</sup>	<b>N=17</b>
To code	4% (5)
Answer questions	29% (34)
Compose emails	19% (22)
Compose papers/essays	12% (14)
Work-related activities	18% (21)
School-related activities	16% (19)
Other	2% (2)
Practice settings in which ChatGPT was used <sup>a</sup>	
Inpatient	45% (15)
Ambulatory	21% (7)
Community	6% (2)
Health system	18% (6)
Other	9% (3)

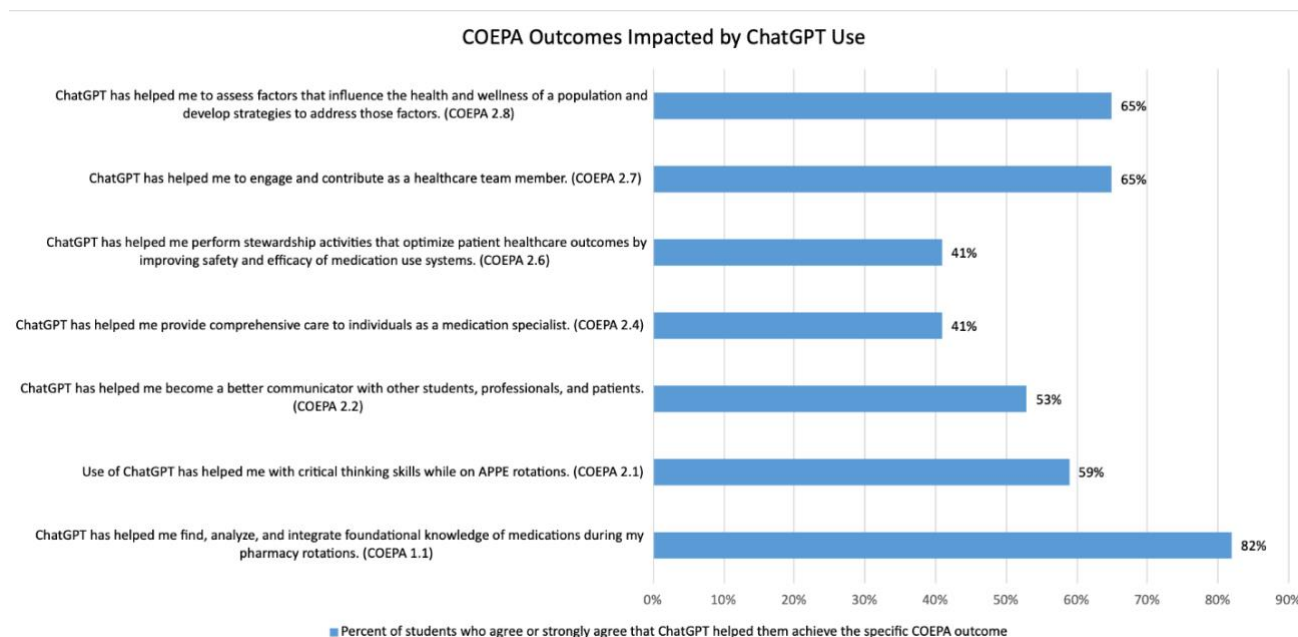
<sup>a</sup> Students could select more than one option for this question.

Students who had used ChatGPT during their rotations were asked to rate their perceptions of how ChatGPT contributed to their attainment of COEPA outcomes

using a Likert scale. The percentages of students who responded "agree" or "strongly agree" on the survey questions are presented in Table III and Figure 1.

**Table III: Percentages of students who agreed or strongly agreed on Section 4 questions**

% of students who agreed or strongly agreed (N=17)	Survey questions
82% (14/17)	ChatGPT has helped them find, analyse, and integrate foundational knowledge of medications during their rotations. (COEPA 1.1)
59% (10/17)	Use of ChatGPT has helped me with critical thinking skills while on APPE rotations. (COEPA 2.1)
52% (9/17)	ChatGPT has helped me become a better communicator with other students, professionals, and patients. (COEPA 2.2)
41% (7/17)	ChatGPT has helped me provide comprehensive care to individuals as a medication specialist. (COEPA 2.4)
41% (7/17)	ChatGPT has helped me perform stewardship activities that optimise patient healthcare outcomes by improving safety and efficacy of medication use systems. (COEPA 2.6)
65% (11/17)	ChatGPT has helped me to engage and contribute as a healthcare team member. (COEPA 2.7)
65% (11/17)	ChatGPT has helped me to assess factors that influence the health and wellness of a population and develop strategies to address those factors. (COEPA 2.8)
82% (14/17)	ChatGPT has positively impacted my approach to work and research habits during their rotations.
35% (6/17)	My preceptors are generally open to or supportive of incorporating the use of ChatGPT into rotation activities.
89% (15/17)	I will use ChatGPT on future APPEs/in my professional practice.
82% (14/17)	I would recommend ChatGPT to other pharmacy and healthcare students on their rotations.



**Figure 1: Percentage of students who agreed or strongly agreed with their corresponding COEPA outcome domain**

**Discussion**

In recent years, the use of AI tools in education and experiential learning has gained attention, with growing interest in understanding their utility, student

and educator perceptions, and potential impact on student learning and outcomes. The findings from this study indicate that using ChatGPT during pharmacy experiential rotations has overall positive outcomes on achieving COEPA and favourable perceptions of its use. Across all COEPA domains assessed, the responses

demonstrate that students benefitted from incorporating ChatGPT into their learning process.

Notably, 82% of students reported that ChatGPT facilitated the search and integration of foundational knowledge of medications during their rotations, highlighting the potential contribution AI may have in pharmacy student development and the application of medication knowledge. ChatGPT and other AI models can offer vast amounts of information on medical topics, which can be useful to pharmacy students who need quick access to foundational clinical information. However, a major limitation of the free version of this type of utility is the lack of updated data beyond 2021 (Khan *et al.*, 2023). This limitation could pose a challenge for students, as accessing more current clinical information would require students to pay for the upgraded version. Nevertheless, ChatGPT still provides accurate clinical information, as seen by the model's ability to pass three United States Medical Licensing Exams in 2022, demonstrating its depth of clinical knowledge (Kung *et al.*, 2023).

Additionally, 59% of students believed that ChatGPT helped them with critical thinking skills while on rotations, indicating that AI may improve students' ability to collect information, create care plans, answer medical questions, and navigate complex patient information. A quantitative research study examined the accuracy of ChatGPT in optimising medication therapy management by having the model devise medication management plans for 39 complex patient cases. The AI tool could accurately provide appropriate plans by identifying medication needs and interactions for all 39 plans, supporting students' perceptions of the capability of AI to help them with this skill (Roosan *et al.*, 2023).

Furthermore, 52.9% of students reported improved communication abilities and skills with other students, professionals, and patients by using ChatGPT. Consistent with these findings, a narrative review explained that ChatGPT could enhance communication among researchers, educators, and students by mitigating communication gaps across diverse medical fields, showing that ChatGPT may help students with their interprofessional communication abilities (Patel *et al.*, 2023). Such results suggest the utility of AI as a tool to enhance students' communication and collaborative skills necessary to be an integrated member of a healthcare team.

The majority of students (65%) believed that ChatGPT has helped them engage and contribute as a healthcare team member and assess and address the factors that may impact the health and wellness of a specific patient population. These perceived benefits correspond to COEPA domains, such as problem-solving,

communication, and interprofessional collaboration. Recent research has assessed the value of ChatGPT for clinical decision support and found that when compared to human-generated suggestions, AI was able to produce understandable and relevant responses, showing the capabilities of AI in assisting students in their clinical problems (Liu S *et al.*, 2023).

Most students (82%) reported that ChatGPT enhanced their approach to work and research habits, suggesting that integrating ChatGPT into pharmacy experiential rotations can foster student learning. This result is reinforced by evidence that AI models have the potential to accelerate scientific research by supporting various aspects of the research process, including the ability to understand and summarise information study results (Cascella *et al.*, 2023).

A cross-sectional analysis of 359 Jordanian pharmacists' perceptions of ChatGPT found a significantly higher percentage of pharmacists who would recommend ChatGPT to other pharmacists than those who would not (Abu Hammour *et al.*, 2023), supporting the observation that a majority of students, 82%, would advocate for the utilisation of ChatGPT and would recommend the tool to other pharmacy and healthcare students on their rotations.

The perceived benefits reported in this study suggest that ChatGPT and other AI technologies could be valuable tools for integration into pharmacy programmes to enhance student learning during their experiential rotations. Despite the positive outcomes students experienced, only 35% reported that their preceptors were supportive of incorporating ChatGPT into rotation activities. This finding reflects the ongoing controversy surrounding the use of AI in healthcare and medical education settings. Educators remain cautious about adopting AI, due to concerns over academic integrity (Gilson *et al.*, 2023). Nevertheless, ChatGPT still appeared beneficial to pharmacy student education in this study.

As technological advancements are made, it is important to assess how students perceive these changes and make use of it during their didactic and practical experiences.

### **Limitations**

Limitations of this study include its small sample size findings from a single university. Additionally, the survey focused solely on student use of ChatGPT, excluding other AI platforms, since ChatGPT was the most accessible tool to students at the time of the study. Further research is warranted to explore the broader impact of integrating other versions of AI into pharmacy education on a larger scale.

## Conclusion

The survey data on ChatGPT use by pharmacy students during their APPE rotations demonstrate a potential benefit in achieving educational outcomes and entrustable professional activities during APPEs. ChatGPT appears to improve student knowledge, their ability to collect and present information, critical thinking skills, and written and verbal communication proficiency. Given the importance of these skills and the potential advantages ChatGPT offers, it may be worthwhile to consider incorporating ChatGPT and other AI technologies into student learning activities to support and foster such benefits.

## Ethics approval and informed consent

IRB exemption was granted by the St. John's University IRB.

## Conflict of interest

The authors declare no conflict of interest.

## Source of funding

The authors did not receive any funding.

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