Society of Medical Education & Research

2022, Volume 2, Page No: 59-71
ISSN: 3108-4850

Annals of Pharmacy Education, Safety, and Public Health Advocacy

Assessment of Knowledge and Perceptions of Generative AI Tools like ChatGPT among Undergraduate Pharmacy Students in Nigeria

Nur Aisyah Rahim[1]*, Farah N. Ismail[1]

[1]Department of Pharmacy Practice, Faculty of Pharmacy, University of Malaya, Kuala Lumpur, Malaysia.

***E-mail** ✉ nuraisyah.rahim@outlook.com

Abstract

Conversational Artificial Intelligence (AI) applications, including ChatGPT®, are increasingly embedded in pharmacy education. Nevertheless, incorporating these technologies into academic curricula is challenged by differences in students' knowledge levels and attitudes. This research sought to assess the knowledge and perceptions of pharmacy students regarding chat-based AI tools at Afe Babalola University, Ado-Ekiti, Nigeria (ABUAD). In addition, it examined students' awareness of these tools and how they are utilized. A cross-sectional web-based survey was carried out between March and April 2024 among undergraduate pharmacy students, who were selected using random sampling techniques. Knowledge levels were classified as either good or poor, while perceptions were categorized as positive or negative. Statistical analysis was performed using Statistical Product and Service Solutions version 27.

The study included 252 respondents, most of whom were female (72.2%). A large proportion of students (88%, n = 222) reported being aware of chat-based AI tools, with ChatGPT® identified as the most frequently used platform (82.8%), mainly for academic assignments and study purposes. Overall, students expressed favorable perceptions, as 85.3% agreed that these tools improve academic performance. However, concerns were noted regarding possible distractions (65.7%) and the potential for academic misconduct (65.1%). Significantly higher knowledge scores were observed among students with prior AI-related education ($p < 0.001$), those in advanced levels of study ($p = 0.011$), and those previously aware of AI tools ($p < 0.001$). Pharmacy students at ABUAD exhibited satisfactory knowledge of chat-based AI technologies and generally positive attitudes toward their application. These findings highlight the importance of incorporating AI-focused instruction into the pharmacy curriculum to bridge knowledge gaps and adequately prepare students for emerging technological developments.

Keywords: Artificial intelligence, Pharmacy education, Student perception, Chat-based AI tools, Nigeria

Introduction

Artificial Intelligence (AI) is increasingly influencing multiple fields, such as healthcare, finance, and education. Technologies including intelligent voice assistants like Siri and Alexa, as well as conversational AI platforms such as ChatGPT®, have become central to contemporary communication and problem-solving processes. By mimicking aspects of human cognition, these systems are transforming task execution and real-time decision-making [1]. Their capacity to deliver customized assistance and interactive learning experiences positions AI as a valuable resource in education, particularly in pharmacy training [2].

With continuous advancements in AI, its adoption within pharmacy education represents a significant technological shift, redefining how future pharmacists acquire knowledge and prepare for professional practice [3]. Chat-based AI tools have demonstrated considerable promise in supporting learning through instant feedback, facilitation of data-informed decisions, and individualized educational support.

Access this article online https://smerpub.com/

Received: 01 November 2021; **Accepted:** 19 January 2022

How to cite this article: Rahim NA, Ismail FN. Assessment of Knowledge and Perceptions of Generative AI Tools like ChatGPT among Undergraduate Pharmacy Students in Nigeria. Ann Pharm Educ Saf Public Health Advocacy. 2022;2:59-71. https://doi.org/10.51847/WsXoJZvIRP

AI-powered adaptive learning platforms customize educational content according to learners' preferences, abilities, and limitations [4]. Such personalization enhances comprehension and long-term retention of complex pharmaceutical topics, thereby promoting more effective learning outcomes. Furthermore, simulation and virtual reality systems driven by AI provide immersive environments that allow pharmacy students to practice clinical competencies in lifelike scenarios, strengthening both skills and confidence [5].

In the context of big data and precision medicine, pharmacists must possess strong data-driven decision-making abilities. AI algorithms are capable of processing extensive datasets and identifying patterns that may not be readily apparent through manual analysis. Integrating AI into pharmacy education equips students with these analytical capabilities, supporting improved decisions related to patient care, drug interactions, and therapeutic outcomes [6]. This competence is increasingly vital as healthcare systems move toward data-intensive and personalized approaches.

In addition to personalized instruction and advanced analytics, AI contributes to the efficiency of educational administration. Tools such as AI-enabled platforms and chatbots can automate grading and feedback, enabling educators to devote more time to individualized student engagement [7]. Since the ultimate aim of pharmacy education is to enhance patient care, AI technologies support future pharmacists in delivering accurate, efficient, and personalized services. For instance, AI can assist in determining optimal medication dosages tailored to individual patients by considering genetic and lifestyle factors, thereby improving clinical outcomes and advancing personalized medicine [6].

Within clinical practice, AI supports healthcare professionals by analyzing patient information to aid diagnosis and treatment selection [8]. AI-based systems such as IBM Watson Health provide treatment recommendations aligned with clinical guidelines and patient-specific characteristics, strengthening clinical decision-making [9]. Additionally, AI plays a crucial role in personalized medicine by aligning therapies with patients' genetic profiles and health data, maximizing treatment effectiveness while reducing adverse effects.

Chat-based AI applications, including ChatGPT® and other conversational AI platforms, are increasingly recognized as important assets in pharmacy education. By mimicking human-like dialogue and delivering instant responses, these technologies provide timely assistance to students across multiple learning activities.

In pharmacy education, the adoption of chat-based AI tools has proven especially useful in promoting active learning. Students are able to pose questions and obtain customized, in-depth explanations of difficult pharmaceutical topics. These systems support learners in resolving uncertainties, tackling academic problems, and performing research tasks, making them beneficial for both solo and collaborative study. For example, pharmacy students frequently rely on tools such as ChatGPT® for completing assignments, revising course materials, and exploring extensive medical information resources [5].

In addition, chat-based AI tools are accessible at all times, offering continuous, 24-hour academic support. This constant availability enables learning beyond scheduled classroom periods and encourages sustained academic engagement. Such tools also assist in addressing knowledge gaps by generating personalized learning routes based on individual student interactions and inquiries [6].

Despite their educational advantages, chat-based AI tools raise concerns regarding distraction and inappropriate use, particularly in relation to academic integrity. The ease of obtaining immediate answers may promote superficial learning strategies rather than critical thinking, prompting debate about the appropriate regulation of these technologies in academic environments.

Although AI tools offer substantial benefits, their incorporation into pharmacy curricula differs considerably among institutions. Many universities have yet to establish standardized frameworks for AI integration, resulting in uneven student exposure [10]. While the development of AI competencies is essential for pharmacy students, obstacles such as inadequate technological infrastructure, limited faculty expertise, and resource constraints continue to restrict widespread implementation [11].

Gaining insight into pharmacy students' attitudes toward and usage of AI tools, including conversational systems, is crucial for successful integration. Studies conducted in Nigeria and other regions indicate that students generally view AI positively, acknowledging its capacity to improve learning outcomes [12]. Nevertheless, persistent concerns related to data privacy, algorithmic complexity, and the demand for further training have been reported [13–15]. These issues emphasize the need for well-

designed educational approaches that balance the advantages and limitations of AI technologies.

Although interest in AI within education is increasing, significant gaps remain in existing research. Many studies emphasize theoretical advantages rather than real-world implementation, particularly within pharmacy education. Empirical evidence on the actual use of AI tools, especially chat-based systems, in pharmacy programs is limited, notably in developing nations such as Nigeria.

Furthermore, investigations into pharmacy students' knowledge and perceptions of chat-based AI tools are still limited. While research from developed countries reports generally favorable attitudes toward AI [12, 14], there is insufficient information on how pharmacy students in developing regions perceive and engage with these technologies. Understanding these perspectives is essential for formulating effective strategies for AI integration in educational curricula.

This study sought to assess pharmacy students' knowledge and perceptions of chat-based AI tools at Afe Babalola University, Ado-Ekiti, Nigeria (ABUAD). It further examined students' awareness of these tools and patterns of use.

Materials and Methods

Study design and setting

This research adopted a cross-sectional observational design. Data were collected online using Google Forms at Afe Babalola University, Ado-Ekiti (ABUAD), situated in Ekiti State in southwestern Nigeria. Ado-Ekiti serves as the state capital. ABUAD is a prominent private institution with a student population exceeding 8,000 [16] and is well known for modern teaching infrastructure, including advanced e-learning systems and electronic instructional boards.

The College of Pharmacy at Afe Babalola University was established in August 2019 as part of the College of Medicine and Health Sciences. It offers a six-year Doctor of Pharmacy (Pharm.D.) degree and is dedicated to excellence in pharmaceutical education and research. The college aims to advance health and wellness through innovative teaching and impactful research, striving to remain a leading institution in the discipline [17]. Data collection took place between March and April 2024.

Participants and sample size

The target population consisted of undergraduate pharmacy students at ABUAD. Participants were randomly drawn from the College of Pharmacy student body. Eligibility criteria included current enrollment in the pharmacy program and willingness to provide informed consent. Students who declined participation were excluded. Sample size estimation was performed using the Raosoft® online calculator. Based on a total population of 730 pharmacy students and a 95% confidence level, a sample size of 252 students was determined. This number was considered adequate to achieve statistical validity and ensure representative findings.

Instrument and scoring of items

Data were gathered from students via a 26-item web-based survey divided into three parts. The initial part collected sociodemographic information through 6 items covering age, academic year, and ethnic background. The middle part evaluated students' awareness, experience, and reasons for employing AI applications in pharmacy training, consisting of 9 items that included both multiple-choice and binary (yes/no) formats. The final part examined students' attitudes toward conversational AI systems. To quantify these attitudes in pharmacy education through average perception scores, a structured method was applied. This part included 11 statements rated on a 5-point Likert scale (from Strongly Disagree to Strongly Agree).

Knowledge levels were determined by assigning points to accurate responses in the middle section. Correct replies earned 1 point each, while incorrect ones scored 0. Students achieving total scores of $\geq 50\%$ were categorized as having good knowledge, whereas those below 50% were classified as having poor knowledge.

Attitude scores were derived by adding the ratings from the 11 Likert items, where responses ranged from 1 (Strongly Disagree) to 5 (Strongly Agree). The total score for each participant was calculated accordingly, with $\geq 50\%$ indicating positive attitudes and $< 50\%$ reflecting negative attitudes.

Data gathering

Participants were chosen randomly by numbering all students at the institution and employing a random number generator to select the necessary sample. The survey link was distributed to chosen individuals through relevant WhatsApp groups. Weekly reminders were issued to the selected group during the entire data

collection phase. Involvement was completely optional, and all responses remained confidential. Participants received information about the study's objectives and design, gave informed consent, and could discontinue participation at any time.

Statistical analysis

Demographic details and responses related to AI knowledge and attitudes were described using basic statistics such as counts, proportions, averages, and standard deviations.

For comparisons, independent t-tests and one-way ANOVA were utilized to examine differences in AI knowledge scores among demographic categories (age, gender, academic year, and previous AI exposure).

The Kolmogorov-Smirnov test confirmed data normality ($p = 0.08$), supporting the application of parametric methods.

Additional comparisons of knowledge and attitude scores were performed across academic years and prior AI training status. Two-group differences were tested with independent t-tests, while one-way ANOVA was used for comparisons involving more than two groups.

Results and Discussion

Socio-demographics

Ages of participants varied between 16 and 27 years, with a mean of 19.17 ± 1.813 years. Most were Christian (86.9%, n = 219), and males constituted 27.8% (n = 70). Ethnically, 41.3% (n = 104) identified as Yoruba and 32.5% (n = 82) as Igbo. Academically, 57.1% (n = 144) were in 100–300 levels, and 42.9% (n = 108) in 400–600 levels. Only 16.3% (n = 41) reported prior training in AI related to pharmacy education, compared to 83.7% (n = 211) who had none. These characteristics are summarized in **Table 1**.

Table 1. Socio-demographics of the study participants

Characteristic		Frequency (N = 252)	Percent (%)
Age (Mean ± SD)		19.17 ± 1.813 years (Range: 16–27 years)	–
Religion			
	Christianity	219	86.9
	Islam	32	12.7
	Others	1	0.4
Gender			
	Male	70	27.8
	Female	182	72.2
Ethnicity			
	Yoruba	104	41.3
	Igbo	82	32.5
	Hausa	5	2.0
	Others	61	24.2
Level of Study			
	100–300 Level	144	57.1
	400–600 Level	108	42.9
Have you received any prior education or training on AI in pharmacy education? (N = 252)			
	Yes	41	16.3
	No	211	83.7

Key: AI: Artificial Intelligence, SD: standard deviation

AI applications and their utilization by university students

More than half of the students (54.8%) indicated familiarity with AI tools in pharmacy education, whereas

6.8% were uncertain **(Figure 1)**. Over 88% (n = 223) confirmed prior use of at least one AI tool **(Figure 2)**. ChatGPT® was the most frequently mentioned (82.8%, n = 202), followed by Grammarly® (41.4%, n = 101) and Siri® (29.9%, n = 73). Additional tools included QuillBot® (27.5%, n = 67) and Snapchat AI® (4.1%, n = 10). Several other applications, such as Admissions IVY ChatBot®, InVideo®, and Superintelligence®, were each reported by only one participant.

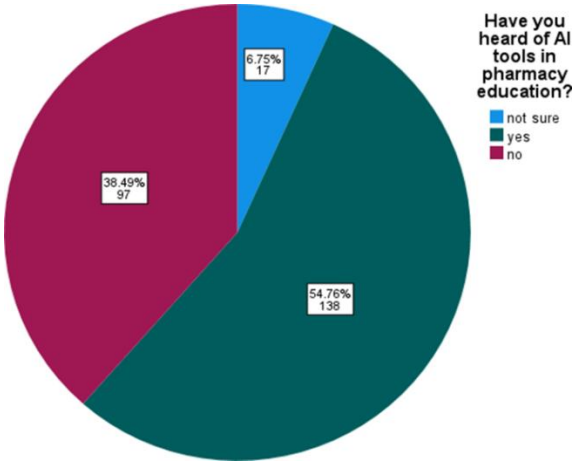

Figure 1. Percentage of students that have heard of AI tools in pharmacy education

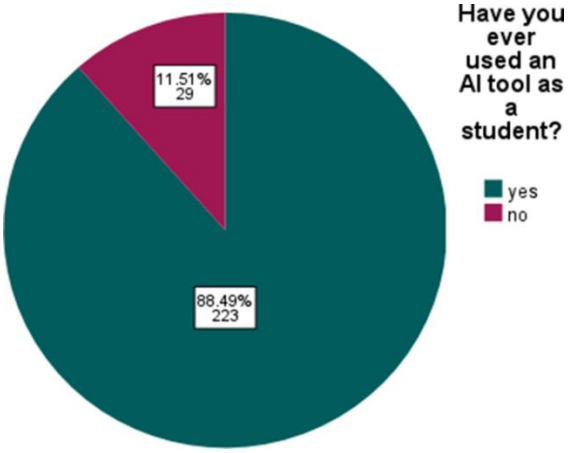

Figure 2. Percentage of students who have used an AI tool

Regarding applications, 80.0% (n = 195) employed AI for assignment completion and 79.6% (n = 194) for study purposes. Other common uses were retrieving drug-related information (51.6%, n = 126), drafting research papers (43.1%, n = 105), and receiving tailored learning suggestions (41.0%, n = 100). Less frequent purposes included generating intelligent content (19.7%, n = 48), engaging in collaborative platforms (13.5%, n = 33), and accessing virtual laboratories (7.0%, n = 17). Further details appear in **Figures 3 and 4**.

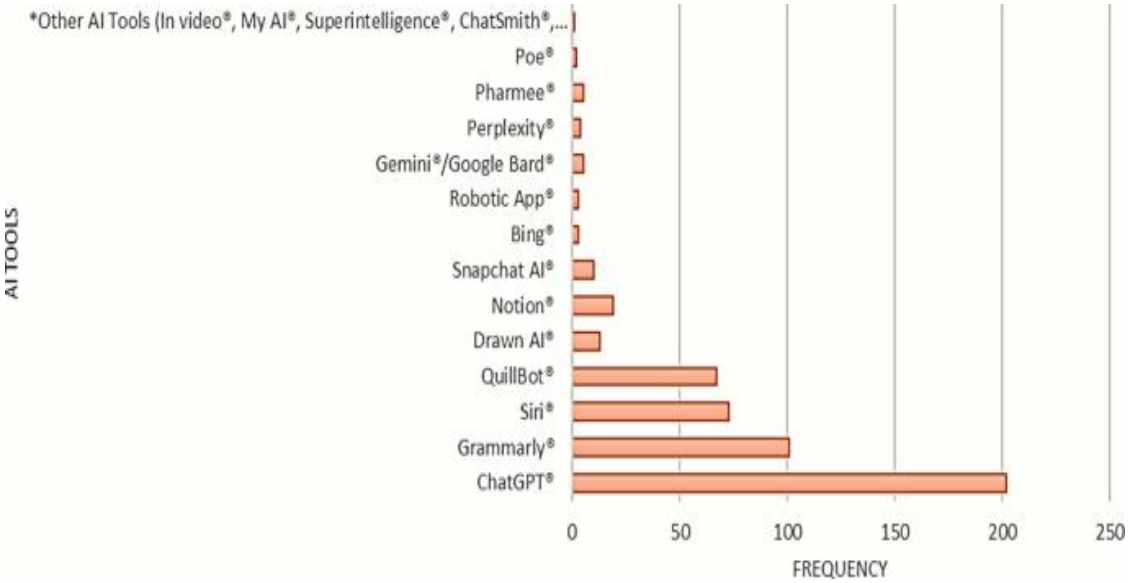

Figure 3. AI tools used among the university students

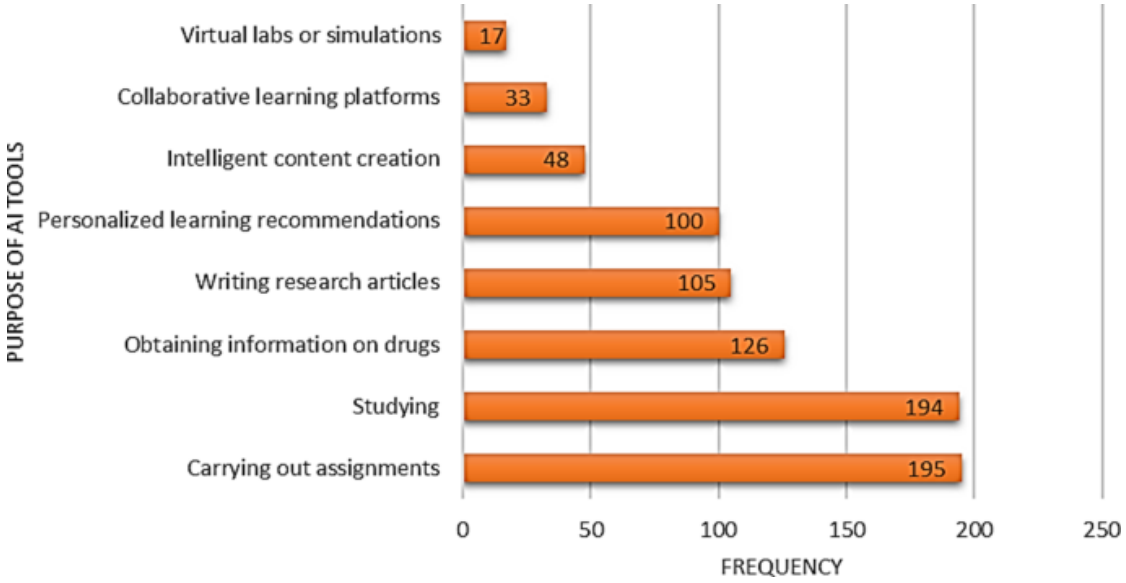

Figure 4. Purpose of AI tools used among the university students

Students' views on conversational AI systems in pharmacy training

The responses showed diverse opinions among participants about integrating conversational AI systems into pharmacy training. Worries about participation and focus were frequent, as 65.7% feared these systems might lower their involvement in class sessions, and 48.2% mentioned that relying on AI in remote classes could result in interruptions from household tasks.

On the brighter side, a large portion (58.3%) regarded conversational AI systems as critical for advancing pharmacy training, while 85.3% felt these systems favorably affected their grades. Maintaining personal restraint was highlighted as important, with 73.9% noting that operating AI systems during lessons necessitates it, and 65.1% warning that such systems could raise the chances of cheating in academics.

Feedback on lesson format was mixed, with 47.6% observing that adding AI systems reduced class organization. Still, 88.1% saw the value in how AI systems could enrich educational encounters, and 88.5% welcomed the broader access to study materials enabled by them. A segment (38.3%) voiced worries over possible drops in assignment productivity from AI systems, but 64.2% advocated for compulsory AI instruction across all pharmacy learners. Altogether, 88.5% displayed favorable views toward conversational AI systems in pharmacy training. This information is compiled in **Table 2**.

Table 2. Perception of students towards chat-based AI tools in pharmacy education

S/N	Statement	Responses, n (%)				
		Strongly Disagree (SD)	Disagree (D)	Neutral (N)	Agree (A)	Strongly Agree (SA)
1.	The use of AI tools decreases student engagement and concentration during lectures	28 (11.1)	53 (21.0)	65 (25.8)	83 (32.9)	23 (9.1)
2.	AI represents the future of pharmacy education	17 (6.7)	21 (8.3)	67 (26.6)	92 (36.5)	55 (21.8)
3.	I believe AI tools make a positive contribution to my academic performance in pharmacy education	-	5 (2.0)	32 (12.7)	103 (40.9)	112 (44.4)
4.	Using AI tools for online lectures increases the likelihood of distraction by home environment factors	17 (6.7)	43 (17.1)	78 (31.0)	84 (33.3)	30 (11.9)

5.	Employing AI tools in class demands greater self-discipline	10 (4.0)	11 (4.4)	45 (17.9)	108 (42.9)	78 (31.0)
6.	Students are more prone to academic dishonesty when AI tools are used in tests or examinations	19 (7.5)	16 (6.3)	53 (21.0)	100 (39.7)	64 (25.4)
7.	Classes become less organized when instructors rely on AI tools for lecture delivery	30 (11.9)	44 (17.5)	80 (31.7)	71 (28.2)	27 (10.7)
8.	AI tools can improve the overall learning experience for students in pharmacy education	3 (1.2)	3 (1.2)	24 (9.5)	115 (45.6)	107 (42.5)
9.	The integration of AI tools in learning increases access to educational resources	4 (1.6)	1 (0.4)	24 (9.5)	110 (43.7)	113 (44.8)
10.	Incorporating AI tools in learning may lead to reduced efficiency in coursework	45 (17.9)	55 (21.8)	78 (31.0)	51 (20.2)	23 (9.1)
11.	Every pharmacy student should be taught about AI during their program	10 (4.0)	15 (6.0)	63 (25.0)	94 (37.3)	70 (27.8)
	Positive Perception (≥ 50% of mean perception score)					223 (88.5)
	Negative Perception (< 50% of mean perception score)					29 (11.5)

Key: AI = Artificial Intelligence; SA = Strong Agree-5; A = Agree-4; N = Neutral-3; D = Disagree-2; SD = Strongly Disagree-1

Participants' comprehension of conversational AI systems in pharmacy training

Participants' comprehension levels concerning conversational artificial intelligence (AI) systems for pharmacy training were examined. Significantly, 64.7% (n = 163) mistakenly thought these systems rely on minimal data manually curated by individuals. Conversely, 37.3% rightly opposed the view that AI adoption intends to eliminate standard teaching practices. On system features, 82.1% (n = 207) appreciated that these systems provide individualized study paths adjusted to unique preferences and progress data. However, just 19.4% (n = 49) correctly challenged the idea that AI-produced details are invariably reliable. All told, 20.6% (n = 52) of learners exhibited limited comprehension of conversational AI systems in pharmacy training. More specifics are in **Table 3**.

Table 3. Knowledge of students on chat-based AI tools in pharmacy education

S/N	Statement	Incorrect, n (%)	Correct, n (%)
1	AI tools operate by relying on a small amount of data that has been pre-processed by humans	163 (64.7)	89 (35.3)
	Responses		
	Yes		163 (64.7)
	No		22 (8.7)
	I don't know		67 (26.6)
2	The main purpose of incorporating chat-based AI tools into pharmacy education is to replace conventional teaching approaches	111 (44.0)	141 (56.0)
	Responses		
	Yes		111 (44.0)
	No		94 (37.3)
	I don't know		47 (18.7)
3	AI tools can be used to develop individualized learning plans for pharmacy students tailored to their specific needs and performance	45 (17.9)	207 (82.1)
	Responses		
	Yes		207 (82.1)
	No		9 (3.6)

	I don't know		36 (14.3)
4	Information generated by AI regarding pharmacy topics is always accurate	49 (19.4)	203 (80.6)
	Responses		
	Yes		49 (19.4)
	No		120 (47.6)
	I don't know		83 (32.9)

Key: AI = Artificial Intelligence

Links among learner profiles, broad views, and comprehension of conversational AI systems in pharmacy training

Connections between profile elements and learners' comprehension of AI systems were investigated. Male learners (27.8%) averaged a comprehension score of 3.60 ± 1.256, versus a somewhat reduced average of 3.51 ± 1.341 for female learners (72.2%). A p-value of 0.632 revealed no notable gender variation in comprehension.

Age groupings showed a p-value of 0.244, signaling no substantial differences, though learners aged 20–23 years edged ahead slightly over those above 23.

Academic progression revealed a clear gap, as upper-year learners posted markedly superior scores ($p = 0.011$). Those with earlier AI instruction likewise showed much stronger comprehension than untrained peers, with strong statistical backing ($p < 0.001$).

Learners acquainted with AI systems in pharmacy training, plus those with hands-on experience, recorded far better comprehension scores than unfamiliar or inexperienced groups ($p < 0.0001$). Findings are consolidated in **Table 4**.

Table 4. Relationship between student demographics, overall perception, and knowledge of chat-based AI tools in pharmacy education

Variable		Mean Score ± SD	Frequency, n (%)	p-value
Gender				0.632[a]
	Male	3.60 ± 1.256	70 (27.8)	
	Female	3.51 ± 1.341	182 (72.2)	
Age				0.244[b]
	16–19 years	3.41 ± 1.318	139 (55.2)	
	20–23 years	3.69 ± 1.305	110 (43.7)	
	Above 23 years	3.67 ± 1.528	3 (1.2)	
Level of Study				0.011[a] *
	100–300 Level	3.35 ± 1.314	144 (70.8)	
	400–600 Level	3.78 ± 1.285	108 (29.2)	
Have you received any prior education or training on AI in pharmacy education?				< 0.001[a] *
	Yes	4.27 ± 1.141	41 (16.3)	
	No	3.39 ± 1.303	211 (83.7)	
Have you heard of AI tools in pharmacy education?				< 0.001[a] *
	Yes	4.23 ± 0.969	138	
	No	2.72 ± 1.170	97	
Have you ever used an AI tool as a student?				< 0.001[a] *
	Yes	3.71 ± 1.204	223	
	No	2.17 ± 1.365	29	
Perception Category				0.497[a]

	Negative Perception	3.38 ± 1.474	29 (11.5)
	Positive Perception	3.56 ± 1.296	223 (88.5)

Key: SD: Standard deviation; a: Independent Sample T-test; b: One Way Analysis of Variance; *: Statistically significant value, $p \leq 0.05$

Artificial Intelligence (AI) is progressively shaping multiple domains, such as healthcare and education. Within pharmacy education, AI presents considerable potential to improve learning outcomes, research efficiency, and professional practice [3]. These technologies can offer individualized learning opportunities, broaden access to knowledge, and promote critical thinking and analytical abilities. In Nigeria, where pharmacy programs are rapidly developing, it is important to understand how students perceive AI and their level of awareness. As AI becomes further integrated into academic programs, evaluating students' understanding and attitudes toward these technologies is critical. This study examined pharmacy students' familiarity and perceptions regarding chat-based AI tools at Afe Babalola University, Ado-Ekiti. The results provide key insights into how AI is viewed within pharmacy education.

Our findings showed that pharmacy students at Afe Babalola University are highly engaged with chat-based AI tools, with more than 88% reporting prior usage. This aligns with Mosleh *et al*. (2023), who reported that among medical and pharmacy students in Jordan, 81% had knowledge of AI programs and 42.1% had used them [18]. Similarly, a cross-country survey in Jordan, Egypt, Saudi Arabia, and Palestine [14] documented widespread AI awareness and use among pharmacy students, reflecting a global trend toward integrating AI in healthcare education. The high engagement observed in our study suggests that students are increasingly incorporating AI into their academic routines, consistent with international patterns.

Regarding the types of AI tools used, ChatGPT® was the most popular, with 80.2% of students reporting usage. This differs from Oluwadiya *et al*. (2023), who found that Grammer Checkers® was the most frequently used AI tool across 10 Nigerian universities, followed by ChatGPT® [13]. The preference for ChatGPT® in our sample may be due to its broad functionality and recognition as a conversational AI capable of supporting multiple academic tasks, from information retrieval to academic writing. This indicates that AI adoption varies by institution, with tool preference influenced by ease of use and versatility.

Many students reported using AI tools for academic purposes, including assignments (77.4%) and studying (77.0%). These figures are higher than those reported by Mosleh *et al*. (2023), in which 44.2% of students used AI for studying and 38.9% for assignments [18]. This suggests that AI is becoming an integral component of pharmacy education, potentially improving efficiency and academic outcomes. However, overreliance on AI may limit the development of independent problem-solving and critical thinking, as students might delegate complex tasks to AI without fully engaging with the material.

In addition, 50.0% of students used chat-based AI for accessing drug information, while 41.7% used it for preparing research articles. This highlights AI's growing role in research and information retrieval in pharmacy education, supporting Tai's claim that AI can enhance both the accuracy and accessibility of drug-related information [19]. However, reliance on AI for critical data emphasizes the need for proper training to assess the validity and reliability of AI outputs to avoid errors in clinical decision-making.

Despite these advantages, several misconceptions were evident. A common misunderstanding was that AI in pharmacy education is intended to replace traditional teaching methods. Such beliefs could hinder AI adoption, as students may fear it will supplant human instructors. Similar concerns were noted by Sit *et al*., who reported that medical students worried AI might reduce the role of human educators [20]. In contrast, Almasri (2024) emphasized that AI should serve as a complement to traditional teaching, providing adaptive and personalized learning experiences [21]. Addressing this misconception requires clear communication about AI's supportive, rather than replacement, role in education.

Another misconception identified was that AI-generated pharmacy information is always reliable, which is concerning given the risk of biased or inaccurate outputs. This aligns with Zhai *et al*. (2024) [22], who found students often overestimate AI reliability, and Nguyen (2023), who highlighted the importance of teaching

students to critically evaluate AI-generated content to prevent misinformation in healthcare settings [23].

Finally, some students believed that using chat-based AI during lectures could reduce engagement and focus, potentially due to improper integration leading to distraction. Taherian and Kim (2022) [24] reported similar observations, while Miao and Ma (2022) [25] suggested that proper integration can increase engagement by providing interactive, tailored learning experiences. These findings emphasize the importance of structured guidance and training for effective AI implementation in educational settings.

The continued presence of these misconceptions can have serious consequences for pharmacy education. If they remain uncorrected, they may obstruct the effective use of AI in teaching and prevent students from taking full advantage of these technologies. Misunderstandings about AI's functions and potential may lead students to depend too heavily on these tools, which can result in shallow learning and limited engagement with course material.

To address these issues, pharmacy programs should integrate detailed AI literacy components that cover the scope, constraints, and ethical aspects of AI in healthcare. Such instruction should emphasize the necessity of human supervision when employing AI tools and encourage students to develop critical thinking skills that allow them to assess AI-generated outputs responsibly. Educators should also convey that AI is intended to supplement rather than replace traditional teaching methods and the human role in healthcare delivery.

By targeting these misconceptions through structured education, pharmacy schools can better equip students to handle the fast-evolving technological landscape in healthcare, leading to improved academic outcomes and readiness for professional practice.

In this study, most students demonstrated strong knowledge of chat-based AI tools in pharmacy education, contrasting with a multinational study in Africa where pharmacy students exhibited only moderate AI knowledge [14]. Nonetheless, a minority of students showed limited understanding, highlighting a need for educational reinforcement. Focused training programs can help bridge these gaps and enhance overall AI literacy.

Knowledge levels also varied according to demographics. Students in higher levels (400–600) and those with formal AI instruction showed greater understanding compared to lower-level students (100–300). This observation is consistent with Hornberger *et al*. (2022) [26], who found that advanced students generally have more opportunities to engage with AI through coursework and practical experiences, resulting in deeper comprehension. Their work underscores the importance of structured educational strategies in improving AI knowledge.

A high proportion of students (88.5%) expressed a positive attitude toward chat-based AI tools in pharmacy education. This is similar to the findings of Busch *et al*. (2024), where 58% of pharmacy students had favorable perceptions of AI integration [10]. Such responses suggest that including AI education in the pharmacy curriculum can strengthen engagement and prepare students for emerging technological trends [3].

Additionally, 58.3% of students viewed AI as the future of pharmacy education, and most believed that AI tools enhance their academic performance. This aligns with findings from Oluwadiya *et al*. (2023) [13] in Nigeria, reflecting growing recognition of AI's potential to transform educational practices. Overall, these results indicate optimism regarding AI's role in improving learning outcomes when effectively incorporated into educational settings.

Students' views on AI tools as potential distractions during online lectures were mixed, with 45.2% agreeing. However, 73.9% acknowledged that proper use requires self-discipline. Betto *et al*. (2023) [27] similarly noted that AI can aid learning but may introduce distractions if not managed effectively. While AI-assisted lectures allow students to learn at their own pace, maintaining concentration can be challenging, emphasizing the importance of self-regulation. Some studies have explored solutions using machine learning to monitor attention via facial and posture cues [27].

Concerns about academic dishonesty were notable, with 65.1% agreement. This mirrors observations among Nigerian students [15], where positive perceptions of ChatGPT® correlated with a greater likelihood of misuse for dishonest purposes. Although chat-based AI offers substantial benefits, its ethical use requires careful oversight. Suggested measures include direct questioning among Nigerian students [28] and list experiments among Vietnamese undergraduates [29], highlighting the need for responsible integration to balance innovation with integrity.

Finally, the majority of students agreed that chat-based AI tools improve learning experiences and increase access to educational resources, supporting Wollny *et al*.

(2021) [30], who emphasized their potential to enhance educational engagement.

Strengths and limitations of the study

A major strength of this research lies in its in-depth analysis of pharmacy students' awareness and attitudes toward chat-based AI tools. The work offers a thorough overview of contemporary educational patterns, illuminating how learners engage with and interpret AI technologies. Incorporating diverse demographic factors—including age, gender, and year of study—adds greater analytical depth, enabling a refined investigation of elements shaping AI comprehension. Furthermore, the study underscores the role of previous training and hands-on exposure to AI tools, stressing the benefits of focused educational strategies to boost students' AI proficiency.

Nevertheless, certain limitations are present. Primarily, the study relied on participants from one university, potentially restricting the applicability of results to pharmacy students elsewhere or in other countries. Although the sample size met statistical requirements, it might not adequately reflect the wider population of pharmacy students in Nigeria or internationally. To enhance broader relevance, subsequent investigations could involve respondents from several institutions to encompass varied contexts and viewpoints.

An additional constraint stems from dependence on self-reported information gathered via online surveys. Such an approach may invite biases, including social desirability effects and memory inaccuracies, which could compromise data reliability. The research also concentrated predominantly on popular AI tools like ChatGPT® and Grammarly®, overlooking other pharmacy-related AI systems, such as those for drug discovery or clinical decision-making support. This narrow emphasis might constrain the applicability of conclusions regarding students' familiarity with the full spectrum of AI.

Furthermore, the digital survey method may have led to selection bias, with tech-savvy students or those particularly interested in AI being more likely to respond, thereby potentially distorting outcomes. Finally, the cross-sectional design records students' awareness and attitudes at one moment only, failing to capture shifts as AI evolves. Longitudinal research would better reveal changes in students' understanding and opinions over time.

Conclusion

This research offers valuable perspectives on pharmacy students' familiarity and views concerning chat-based AI tools within pharmacy education. Results indicate that students typically possess solid knowledge of these tools and regard them as essential elements of current learning approaches. Nonetheless, certain misunderstandings persist regarding AI functions and potential, pointing to the necessity of specific educational initiatives.

With AI tools gaining prominence in healthcare and academia, pharmacy programs must adapt accordingly to equip students effectively for professional practice. Upcoming research should investigate how additional AI applications, extending beyond chat-based systems, might advance pharmacy training and professional activities.

Acknowledgments: None

Conflict of Interest: None

Financial Support: None

Ethics Statement: None

References

1. Qin Y, Xu Z, Wang X, Skare M. Artificial Intelligence and Economic Development: an evolutionary investigation and systematic review. J Knowl Econ. 2023;15:1736–70. 10.1007/s13132-023-01183-2.
2. Chalasani S, Syed J, Ramesh M, Patil V, Pramod Kumar T. Artificial Intelligence in the field of pharmacy practice: a literature review. Exploratory Res Clin Social Pharm. 2023;12. 10.1016/j.rcsop.2023.100346.
3. Weidmann A. Artificial Intelligence in academic writing and clinical pharmacy education: consequences and opportunities. Int J Clin Pharm. 2024;46:751–4. 10.1007/s11096-024-01705-1.
4. Gligorea I, Cioca M, Oancea R, Gorski A, Gorski H, Tudorache P. Adaptive learning using Artificial Intelligence in e-learning: a literature review. Educ Sci. 2023;13(12):1216. 10.3390/educsci13121216.
5. Coyne L, Merritt T, Parmentier B, Sharpton R, Takemoto J. The past, present, and future of virtual

reality in pharmacy education. Am J Pharm Educ. 2019;83(3):7456. 10.5688/ajpe7456.
6. Alowais S, Alghamdi S, Alsuhebany N, Alqahtani T, Alshaya A, Almohareb S, et al. Revolutionizing healthcare: the role of artificial intelligence in clinical practice. BMC Med Educ. 2023;23. 10.1186/s12909-023-04698-z.
7. Labadze L, Grigolia M, Machaidze L. Role of AI chatbots in education: systematic literature review. Int J Educational Technol High Educ. 2023;20(1):1–17. 10.1186/s41239-023-00426-1.
8. Krishnan G, Singh S, Pathania M, Gosavi S, Abhishek S, Parchani A, et al. Artificial Intelligence in clinical medicine: catalyzing a sustainable global healthcare paradigm. Front Artif Intell. 2023;6. 10.3389/frai.2023.1227091.
9. Williamson S, Prybutok V. Balancing privacy and progress: a review of privacy challenges, systemic oversight, and patient perceptions in AI-driven healthcare. Appl Sci. 2023;14(2):675. 10.3390/app14020675.
10. Busch F, Hoffmann L, Truhn D, Palaian S, Alomar M, Shpati K, et al. International pharmacy students' perceptions towards Artificial Intelligence in medicine—A multinational, multicentre cross-sectional study. Br J Clin Pharmacol. 2024;90(3):649–61. 10.1111/bcp.15911.
11. Chaaban Y, Qadhi S, Chen J, Du X. Understanding researchers' AI readiness in a higher education context: Q methodology research. Educ Sci. 2024;14:709. 10.3390/educsci14070709.
12. Iwasawa M, Kobayashi M, Otori K. Knowledge and attitudes of pharmacy students towards Artificial Intelligence and the ChatGPT. Pharm Educ. 2023;23(1):665–75. 10.46542/pe.2023.231.665675.
13. Oluwadiya K, Adeoti A, Nottidge T. Exploring Artificial Intelligence in the Nigerian medical Educational Space: an online cross-sectional study of perceptions, risks and benefits among students and lecturers from ten universities. Nigerian Postgrad Med J. 2023;30:285. 10.4103/npmj.npmj_186_2.
14. Hasan H, Jaber D, Tabbah S, Lawand N, Habib H, Farahat N. Knowledge, attitude and practice among pharmacy students and faculty members towards Artificial Intelligence in pharmacy practice: a multinational cross-sectional study. PLoS ONE. 2024;19(3). 10.1371/journal.pone.0296884.
15. Ofem U, Owan V, Iyam M, Udeh M, Anake P, Ovat S. Students' perceptions, attitudes and utilisation of ChatGPT for academic dishonesty: Multigroup analyses via PLS–SEM. Educ Inform Technol. 2024. 10.1007/s10639-024-12850-5.
16. Afe Babalola University. Published finance report 2019–2020. 2020. https://sdg.abuad.edu.ng/wp-content/uploads/2021/09/University_Published_Finance_2019-2020.pdf. Accessed 1 July, 2024.
17. Afe Babalola University. College of Pharmacy. 2023. https://www.abuad.edu.ng/wp-content/uploads/2023/10/COLLEGE-OF-PHARMACY.pdf. Accessed 1 July, 2024.
18. Mosleh R, Jarrar Q, Jarrar Y, Tazkarji M, Hawash M. Medicine and pharmacy students' knowledge, attitudes, and practice regarding Artificial Intelligence programs: Jordan and West Bank of Palestine. Adv Med Educ Pract. 2023;14:1391–400. 10.2147/AMEP.S433255.
19. Tai M. The impact of Artificial Intelligence on human society and bioethics. Tzu Chi Med J. 2020;32(4):339–43. 10.4103/tcmj.tcmj_71_20.
20. Sit C, Srinivasan R, Amlani A, Muthuswamy K, Azam A, Monzon L, Poon DS. Attitudes and perceptions of UK medical students towards artificial intelligence and radiology: a multicentre survey. Insights into Imaging. 2020;11(1):14. 10.1186/s13244-019-0830-7.
21. Almasri F. Exploring the Impact of Artificial Intelligence in Teaching and Learning of Science: a systematic review of empirical research. Res Sci Educ. 2024. 10.1007/s11165-024-10176-3.
22. Zhai C, Wibowo S, Li LD. The effects of over-reliance on AI dialogue systems on students' cognitive abilities: a systematic review. Smart Learn Environ. 2024;11:28. 10.1186/s40561-024-00316-7.
23. Nguyen ND. Exploring the role of AI in education. Lond J Social Sci. 2023;6:84–95. 10.31039/ljss.2023.6.108.
24. Taherian Kalati A, Kim MS. What is the effect of touchscreen technology on young children's learning? A systematic review. Educ Inf Technol. 2022;27:6893–911. 10.1007/s10639-021-10816-5.
25. Miao J, Ma L. Students' online interaction, self-regulation, and learning engagement in higher education: The importance of social presence to online learning. Front Psychol. 2023;14. 10.3389/fpsyg.2023.1084225.

26. Hornberger M, Bewersdorff A, Nerdel C. What do university students know about Artificial Intelligence? Development and validation of an AI literacy test. Computers Education: Artif Intell. 2022;5. 10.1016/j.caeai.2023.100165.
27. Betto I, Hatano R, Nishiyama H. Distraction detection of lectures in e-learning using machine learning based on human facial features and postural information. Artif Life Rob. 2023;28. 10.1007/s10015-022-00809-z.
28. Ossai M, Ethe N, Edougha D, Okeh O. Academic integrity during examinations, age and gender as predictors of academic performance among high school students. Int J Educational Dev. 2023;100. 10.1016/j.ijedudev.2023.102811.
29. Nguyen H, Goto D. Unmasking academic cheating behaviour in the artificial intelligence era: evidence from Vietnamese undergraduates. Educ Inform Technol. 2024. 10.1007/s10639-024-12495-4.
30. Wollny S, Schneider J, Di Mitri D, Weidlich J, Rittberger M, Drachsler H. Are we there yet? - a systematic literature review on chatbots in education. Front Artif Intell. 2021;4. 10.3389/frai.2021.654924.