



RESEARCH ARTICLE

# Knowledge and attitudes of pharmacy students towards artificial intelligence and the ChatGPT

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## Abstract

**Background:** This study examined pharmacy students' knowledge and attitudes to artificial intelligence (AI) and ChatGPT. **Methods:** A survey was conducted with 258 fourth-year pharmacy students at Kitasato University, Japan, assessing their AI knowledge, ChatGPT impressions, and literacy regarding its appropriate use. Data were analysed descriptively, and participants were divided into two groups based on ChatGPT awareness for further analysis. **Results:** A total of 113 students (43.7%) participated, with 19.5% having prior ChatGPT experience, 4.4% were unaware, and 42.5% could describe it. General AI terms like "machine learning" were more familiar (83.2%) than specific ones like "natural language processing" (2.6%). Positive impressions of ChatGPT included 65.5% finding it efficient and 50.4% mentioning enhanced comprehension. However, only 3.5% correctly identified all inappropriate purposes, and 24.8% selected all precautions for its use. The 48 participants (42.5%) who described ChatGPT and had higher AI knowledge showed more correct answers than the other group (65 participants, 57.5%). **Conclusion:** Students with AI knowledge and the ability to describe ChatGPT demonstrated a better understanding of its appropriate usage. Educating students on AI fundamentals helps them utilise AI tools like ChatGPT effectively. This study offers valuable insights on ChatGPT among pharmacy students, with implications for responsible AI usage and education.

## Introduction

ChatGPT, a large language model developed by OpenAI (San Francisco, California, USA), helps with tasks such as answering questions, generating text, and engaging in diverse conversations. It initially offered free access to users starting in November 2022 and rapidly garnered 100 million users worldwide within two months of its release (Mori & Hayashi, 2023a). According to a report published by Nomura Research Institute (NRI) in May 2023, Openai.com received 7.6 million visitors from Japan in mid-April, ranking third in terms of traffic share after the United States (US) and India (Mori & Hayashi, 2023a).

While ChatGPT's versatility originates from its extensive language understanding and broad knowledge base, its application in education has sparked considerable controversy. Universities worldwide are developing guidelines/policies concerning student utilisation of ChatGPT (Scribbr, 2023). Furthermore, certain institutions have implemented restrictions, prohibiting the use of AI-generated text for report writing without obtaining faculty permission (University of Oxford Academic Support, 2023; Harvard University Information and Technology, 2023). As of July 2023, 251 universities in Japan have released official statements regarding their

utilisation of ChatGPT. In April 2023, Kitasato University (KU) in Tokyo, Japan, prohibited the use of Artificial Intelligence (AI) services like ChatGPT for educational and research reports, and ChatGPT for assignments and dissertations may be considered cheating unless faculty permission is obtained (Kitasato University, 2023).

To facilitate digital transformation (DX) in Japan, there is an urgent need to develop human resources in science, mathematics, data science, and AI, leading to increasing pressure for university education reform. Japanese pharmacy schools adhere to the “*Model Core Curriculum for Pharmaceutical Education*” established by the Ministry of Education, Culture, Sports, Science, and Technology (MEXT). The revised core curriculum for 2022, introduced in February 2023, emphasises the inclusion of AI, big data, and related technologies as essential qualities for pharmacists (Ministry of Education, Culture, Sports, Science, and Technology, 2023a). However, the incorporation of AI education into pharmacy school curricula remains limited.

The rapid pace of developments in AI may significantly influence healthcare and pharmacy practices. AI is already being utilised in healthcare to predict adverse drug reactions (Martin *et al.*, 2022), as well as for patient education (Görtz *et al.*, 2023). The appropriate use of digital health technology can have a positive impact on patient care and treatment outcomes. The American Society of Health System Pharmacists (ASHP) highlights, in its “*Statement on the Use of Artificial Intelligence in Pharmacy*,” that AI can enhance clinical decision support systems and improve patient care; moreover, it can optimise inventory management and product verification within pharmacy operations (Schutz *et al.*, 2020). Therefore, the development of digital human resources in the field of pharmacy should commence without delay. Given that AI education in universities is still in its early stages, the integration of AI education into the curriculum has become crucial, as emphasised in the revised Core Curriculum for Pharmacy Education.

This study aims to investigate pharmacy students' knowledge of AI and their attitudes toward ChatGPT, providing valuable insights for the introduction of AI education. To the best of the author's knowledge, as of July 2023, no previous studies have examined the knowledge and attitudes of pharmacy students regarding AI and ChatGPT.

## Methods

An online survey was conducted at KU with fourth-year student pharmacists who had registered for the Drug Information course during the first term of the 2023–2024 academic year. The Drug Information course is a required one-credit hour course that meets for ten consecutive weeks of 1.5 hours each class during the first term of the fourth year of students' studies of KU's six-year B.S. Pharmacy programme. The course covers the fundamentals of drug information practice, an introduction to various drug information resources, and internet-based information retrieval, as well as precautions to take when using medical information obtained from the internet.

A total of 258 students were invited to participate in the survey. Participation was voluntary, and they were notified on the questionnaire that all data collected would be kept confidential. By the end of the first term, a document comprising an explanation of the survey and a QR code to access the web page of the Google Form was developed, and invitations to access it were posted on the university's website. The QR code was also printed on the last page of the lecture handouts given to the students.

A web programme, Google Forms, was used to develop the online questionnaire, which included a mixture of multiple-choice and Likert-scale questions. The survey consisted of three sections: 1) Assessment of pharmacy students' knowledge of AI by asking for their level of understanding of basic terms such as natural language processing, machine learning, deep learning, and neural networks; 2) Assessment of Pharmacy students' impression of ChatGPT; and 3) Assessment of literacy regarding the appropriate use of ChatGPT (Appendix A).

The questions were formulated based on the study's objectives, referring to AI-related literature (Furukawa & Sakai, 2023), including sources explaining ChatGPT, as well as questions from previous studies on AI regarding impressions of ChatGPT (Mehta *et al.*, 2021; Jha *et al.*, 2022), and OpenAI's usage policy regarding the proper use of ChatGPT (Open AI, 2023a; Open AI, 2023b). To ensure clarity and relevance, educational experts reviewed the questions for any ambiguities in wording. Additionally, an AI research expert provided valuable feedback by answering a prototype version of the questionnaire, helping us refine and organise the questions. To examine the psychometric scale's reliability, the alpha coefficient (Cronbach's alpha) was utilised for each section, assessing the internal reliability of the questionnaire items. An alpha coefficient of 0.7 or greater was considered sufficient for internal reliability.

Data were presented in the form of descriptive statistics and analysed. Additionally, the participants were divided into two groups based on their responses to a question regarding their awareness of ChatGPT. Group 1 comprised participants who indicated that they could describe ChatGPT, whereas Group 2 consisted of participants who indicated that they could not describe ChatGPT or had never heard of ChatGPT. Their characteristics were compared and analysed in terms of their knowledge of AI, their impression of ChatGPT, and their literacy regarding the appropriate use of ChatGPT. Section 1 consisted of four Three-Point-Likert-Scale questions. The scoring criteria were as follows: -1 = "I have no idea," 0 = "I have heard of it, but I cannot explain it," and 1 = "I know the term and can explain it." The median scores were compared between the two groups. Section 2 comprised nine Five-Point-Likert-Scale questions. The scoring criteria were as follows: 2 = "Agree," 1 = "Somewhat Agree," 0 = "Neither Agree nor Disagree," -1 = "Somewhat Disagree," and -2 = "Disagree". The median scores were compared between the two groups. Section 3 included two multiple-choice questions, and the scoring criteria were as follows: selecting the correct answer earned a score of 1, while not selecting the correct answer resulted in a score of -1.

Data collection was carried out using Google Forms, and all analyses were conducted using SPSS Statistics Version 27 software (IBM Corporation, New York, NY, USA). Quantitative data are presented as medians (minimum, maximum), while categorical data are reported as frequencies (percentages). The Mann-Whitney U test was used to assess the knowledge of AI, the impression of ChatGPT, and literacy concerning the appropriate use of ChatGPT among two groups of pharmacy students. To simplify the data, the total score of each section was categorised utilising cut-off values, and Fisher's exact test was employed to assess the two groups of pharmacy students. Statistical significance was determined using two-sided tests with an alpha level of 0.05.

## Results

Cronbach's alpha of 0.770 for Section 1 (Knowledge of AI), 0.832 for Section 2 (Impression of ChatGPT), and 0.818 for Section 3 (Literacy concerning the appropriate use of ChatGPT) confirmed the internal validity of the scale, all exceeding 0.7. Out of the 258 students invited, a total of 113 students (43.7%) participated in the survey. Among the participants, the majority were female, accounting for 91 students (80.5%), while males accounted for 22 students

(19.5%). Regarding their experience with ChatGPT, 22 participants (19.5%) reported having used it, while 91 participants (80.5%) reported never having used it. When asked if they had heard of ChatGPT, only five participants (4.4%) indicated that they had never heard of it. On the other hand, 48 participants (42.5%) stated they could describe it, whilst 60 participants (53.1%) mentioned they had heard of it but were unable to provide a description. Thirty-three students (29.2%) were able to describe ChatGPT despite having no prior experience using it. The narrative summary of the three sections is below.

### Knowledge of AI

In terms of students' knowledge, their familiarity with general terms surpassed that of more specific terms. Specifically, 83.2% of the participants were familiar with the term "machine learning," while only 16.8% of them could describe it. Similarly, 71.7% of the participants were familiar with the term "deep learning," but only 12.4% of them were able to describe it. Regarding the terms "natural language processing" and "neural networks," 26.5% of the participants were familiar with these terms, while only 2.6% of them were able to describe them.

### Impression of ChatGPT

To commence, the general impressions of ChatGPT from participants were gathered. When participants were asked about the reliability of ChatGPT, 24.9% answered "reliable" or "somewhat reliable." Additionally, 65.5% of participants responded "agree" or "somewhat agree" when asked if ChatGPT helps them gather information more efficiently. Furthermore, concerning the comprehension of their research findings, 50.4% of participants indicated that they "agree" or "somewhat agree" that utilising ChatGPT enhances their comprehension. In contrast, 54.8% of participants expressed that utilising ChatGPT improves their learning efficiency, while 43.3% mentioned that it enhances their knowledge and understanding. As for concerns or doubts about using ChatGPT, 40.7% of participants indicated that they had such reservations.

Next, the impact of ChatGPT on education and the profession was explored. When asked if they believed ChatGPT would have a positive impact on education, 32.7% agreed or somewhat agreed, while 32.7% remained neutral. When asked if they believed the responses and information available from ChatGPT were adequate for gathering information on pharmacy-related topics, only 15.9% indicated that they were adequate or somewhat adequate. Moreover, when asked if they believed ChatGPT would assist

pharmacists in improving their work efficiently, 32.0% responded that it would be helpful or somewhat helpful, and 33.6% responded neutrally.

### Literacy concerning the appropriate use of ChatGPT

To check literacy regarding the proper use of ChatGPT, two types of choice questions were created. The first question was designed to ascertain participants' understanding of OpenAI's published ChatGPT usage policies (Open AI, 2023a). Then the participants were asked to identify all inappropriate purposes for the use of ChatGPT. Only four out of 113 participants (3.5%) were able to identify all inappropriate purposes. The item with the fewest number of correct answers, at 18.6%, was "Precise computations involving complex mathematical formulas." The item with the second-lowest number of correct responses was "Automatically extract big data from websites," at 20.4%. Relatively more correct answers were given for "obtaining personal information" and "providing

medical information," at 83.2% and 66.4%, respectively. The second question was asked to confirm participants' understanding of general precautions when using ChatGPT (Open AI, 2023b). Only 28 of 113 participants (24.8%) were able to identify all the appropriate items. Of the three correct responses, 91.2% of the participants were able to select "Sometimes nonsensical," 72.6% were able to select "Limited capability to provide medical, legal, and other professional advice," and 66.4% were able to select "Can be used as learning data."

In the second part of this study, participants were divided into two groups based on their responses regarding their awareness of ChatGPT. Their characteristics were compared and analysed in terms of their knowledge of AI, impressions of ChatGPT, and literacy regarding the appropriate use of ChatGPT. Table I provides a summary of the second part of the study.

**Table I: Comparison of the scores of the two groups on each of the questions in the three sections**

Question	Group 1 (n = 48)			Group 2 (n = 65)			p-value
	n	(%)	Median score [min, max]	n	(%)	Median score [min, max]	
<b>(1) Assessing knowledge of Artificial Intelligence:</b>							
<b>Please tell us about the following terms</b>							
Q1 Natural language processing			-1 [-1, 1]			-1 [-1, 0]	<0.001 <sup>b</sup>
Q2 Machine learning			0 [-1, 1]			0 [-1, 1]	0.022 <sup>b</sup>
Q3 Deep learning			0 [-1, 1]			0 [-1, 1]	0.023 <sup>b</sup>
Q4 Neural networks			-1 [-1, 1]			-1 [-1, 0]	0.049 <sup>b</sup>
<b>Total score of section (1)</b>			<b>-1 [-4, 4]</b>			<b>-2 [-4, 1]</b>	<b>0.002<sup>b</sup></b>
Number of section (1) score was ≥ 0 (cutoff value)	17	(35.4%)		7	(11.1%)		<0.001 <sup>c</sup>
<b>(2) Assessing the impression of ChatGPT</b>							
Q1 Do you think the information obtained using ChatGPT is reliable?			-1 [-2, 2]			0 [-2, 2]	0.306 <sup>b</sup>
Q2 Do you believe that utilising ChatGPT will enhance the efficiency of your information gathering?			1 [-2, 2]			1 [-2, 2]	0.061 <sup>b</sup>
Q3 Do you believe that utilising ChatGPT will improve your comprehension of your research findings?			1 [-2, 2]			0 [-2, 2]	0.027 <sup>b</sup>
Q4 Do you believe that utilising ChatGPT will improve your efficiency in learning?			1 [-2, 2]			0 [-2, 2]	0.075 <sup>b</sup>
Q5 Do you believe that utilising ChatGPT will enhance your knowledge and understanding?			0 [-2, 2]			0 [-2, 2]	0.275 <sup>b</sup>
Q6 Do you have any concerns or queries regarding the usage of ChatGPT?			1 [-1, 1]			1 [-1, 1]	0.859 <sup>b</sup>
Q7 Do you believe that ChatGPT has a positive impact on education?			0 [-2, 2]			0 [-2, 2]	0.111 <sup>b</sup>
Q8 Do you believe that the responses and information provided by ChatGPT are suitable for gathering information on pharmacy-related topics?			-1 [-2, 2]			0 [-2, 1]	0.328 <sup>b</sup>

**Table I: Comparison of the scores of the two groups on each of the questions in the three sections (Continued)**

Question	Group 1 (n = 48)			Group 2 (n = 65)			p-value
	n	(%)	Median score [min, max]	n	(%)	Median score [min, max]	
Q9 Do you believe that ChatGPT can assist pharmacists in improving their work efficiency?			0 [-2, 2]			0 [-2, 2]	0.654 <sup>b</sup>
<b>Total score of section (2)</b>			<b>2 [-16, 17]</b>			<b>1 [-16, 11]</b>	<b>0.384<sup>b</sup></b>
No cutoff values were detected in section (2)	-	-		-	-		-
<b>(3) Assessing literacy regarding the appropriate use of ChatGPT</b>							
<b>Q1 Please identify all inappropriate purposes for utilizing ChatGPT. (True or False)</b>							
A. Using ChatGPT to automatically extract big data from websites	10	(20.8%) <sup>a</sup>		13	(20.0%) <sup>a</sup>		1 <sup>c</sup>
B. Using ChatGPT to provide medical information	34	(70.8%) <sup>a</sup>		41	(63.0%) <sup>a</sup>		0.426 <sup>c</sup>
C. Using ChatGPT for precise computations involving complex mathematical formulas	13	(27.1%) <sup>a</sup>		8	(12.3%) <sup>a</sup>		0.054 <sup>c</sup>
D. Using ChatGPT to obtain personal information	41	(85.4%) <sup>a</sup>		53	(81.5%) <sup>a</sup>		0.622 <sup>c</sup>
E. Elementary school students independently using ChatGPT for self-study	24	(50.0%) <sup>a</sup>		33	(50.8%) <sup>a</sup>		1 <sup>c</sup>
<b>Total score of section (3) Q1</b>			<b>1 [-3, 5]</b>			<b>-1 [-3, 5]</b>	<b>0.219<sup>b</sup></b>
<b>Q2 Please select all the correct statements regarding ChatGPT (True or False)</b>							
A. Sometimes, ChatGPT may generate inaccurate information	45	(93.8%) <sup>a</sup>		58	(89.2%) <sup>a</sup>		0.513 <sup>c</sup>
B. The information entered into ChatGPT may potentially be used as training data	32	(66.7%) <sup>a</sup>		43	(66.2%) <sup>a</sup>		1 <sup>c</sup>
C. There is no need to worry about copyright when using ChatGPT	40	(83.3%) <sup>a</sup>		62	(95.4%) <sup>a</sup>		0.051 <sup>c</sup>
D. It is possible to distinguish between AI-generated text and other information obtained from ChatGPT	35	(72.9%) <sup>a</sup>		50	(76.9%) <sup>a</sup>		0.664 <sup>c</sup>
E. By using ChatGPT, you can verify the most up-to-date information	36	(75.0%) <sup>a</sup>		48	(73.9%) <sup>a</sup>		1 <sup>c</sup>
F. If you ask the same question to ChatGPT repeatedly, you will always receive the same answer	43	(89.6%) <sup>a</sup>		54	(83.1%) <sup>a</sup>		0.418 <sup>c</sup>
G. ChatGPT has limited capacity to provide medical, legal, and other professional advice	40	(83.3%) <sup>a</sup>		42	(64.6%) <sup>a</sup>		0.034 <sup>c</sup>
<b>Total score of section (3) Q2</b>			<b>5 [-1, 7]</b>			<b>5 [-3, 7]</b>	<b>0.544<sup>b</sup></b>
<b>Total score of section (3) Q1 + Q2</b>			<b>4 [-2, 10]</b>			<b>4 [-6, 8]</b>	<b>0.194<sup>b</sup></b>
Number of section (3) Q1 + Q2 scores were ≥ 8 (cutoff value)	18	(37.5%)		9	(13.8%)		0.007 <sup>c</sup>

<sup>a</sup> Number (%) of students selected correct answer; <sup>b</sup> Mann - Whitney U test; <sup>c</sup> Fisher's exact test

Group 1 comprised 48 participants who could describe ChatGPT, while Group 2 consisted of 65 participants who were unable to provide a description, including five participants who had never heard of ChatGPT. In terms of understanding AI, participants in Group 1 displayed higher median scores compared to Group 2 (-1 vs. -2). Notably, Group 1 scores were significantly higher than those of Group 2 across all dimensions of AI knowledge ( $p < 0.001$ ). While participants in Group 1 exhibited a greater familiarity with fundamental AI terminology than their Group 2 counterparts, the median total score for both groups remained negative, indicating a knowledge shortfall. Additionally, in

Section 1, only 35.4% of Group 1 participants achieved a cutoff of zero or higher. Figure 1 illustrates the comparison of scores on basic AI-related terms' knowledge in both groups, with Group 1 representing a larger proportion of positive responses as the number of positive responses increases.

Regarding their impression of ChatGPT, both groups displayed positive median total scores, indicating a favourable impression of ChatGPT. However, no statistically significant differences were identified in the total scores during between-group comparisons, and no cutoff values were established where the trend achieved significance. In Section 2, a notably higher

median for Group 1 was observed for Q3: "Do you believe that utilising ChatGPT will improve your comprehension of your research findings?" Conversely, within Section 2, significantly higher medians for Group 2 were seen in Q1: "Do you think the information obtained using ChatGPT reliable?" and Q8: "Do you

believe that the responses and information provided by ChatGPT are suitable for gathering information on pharmacy-related topics?" Figure 2 compares the scores on positive impressions of ChatGPT in both groups, and no significant differences in the distribution of scores were observed.

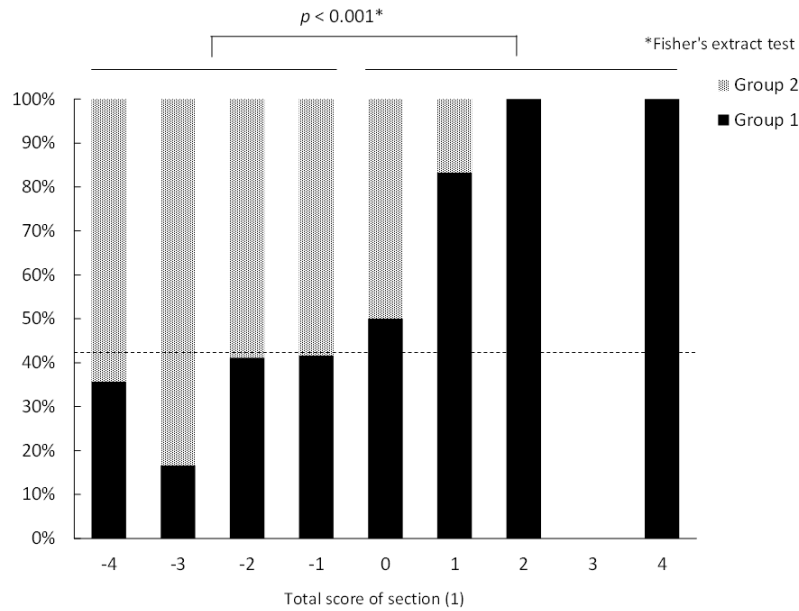


Figure 1: Comparison of scores on knowledge of basic terms related to AI in both groups

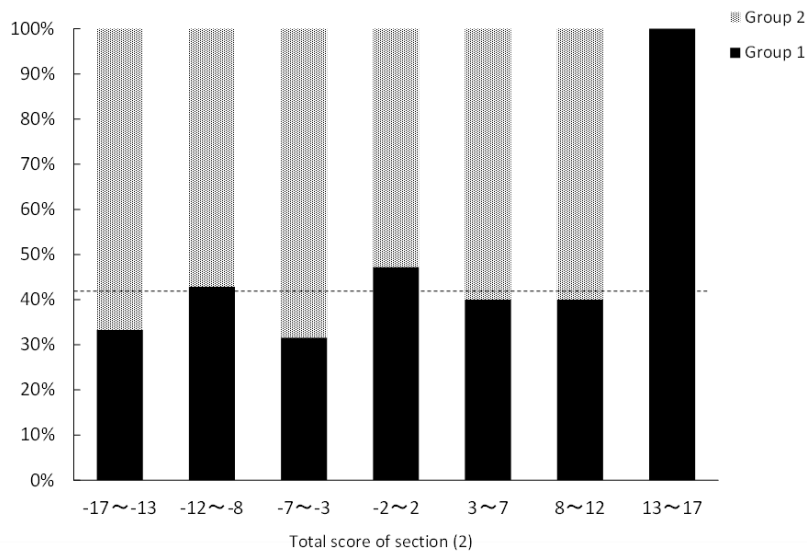


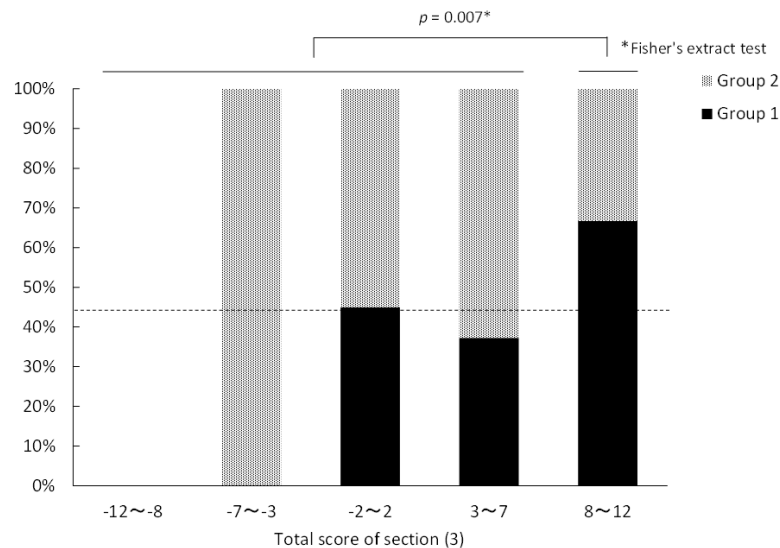
Figure 2: Comparison of scores on positive images for ChatGPT in both groups

In Section 3, both groups exhibited positive median total scores; however, no statistically significant differences were observed between the two groups.

Nevertheless, a notable disparity was evident in the number of individuals in Group 1 who demonstrated high literacy (the total score of Q1 and Q2 was eight or

higher). In Group 1, 18 participants (37.5%) scored above the cutoff, whereas in Group 2, nine participants (13.8%) scored above the cutoff ( $p = 0.007$ ). Figure 3 illustrates the comparison of scores between the two groups regarding their literacy in the appropriate use of

ChatGPT. The score distribution indicates that as the number of correct responses increases, Group 1 represents a larger percentage of the total correct answers.



**Figure 3: Comparison of scores on knowledge of the proper use of ChatGPT in both groups**

## Discussion

To the best of the authors' knowledge, this is the first study aiming to assess pharmacy students' knowledge of AI and their impressions and literacy of ChatGPT. The study found that pharmacy students were more familiar with general terms such as machine learning and deep learning compared to more specific terms. While some of the students who were able to describe ChatGPT demonstrated a high score, the majority stated that they were unable to define these terms. Several studies have investigated familiarity with AI-related terms, and their findings align with the study mentioned (Mehta *et al.*, 2021; Boillat *et al.*, 2022; Jha *et al.*, 2022). For instance, Mehta and authors conducted a survey on medical students' knowledge and attitudes towards AI, ranking students' understanding of AI-related terms from highest to lowest as follows: Understanding the meaning of AI (83.3%), machine learning (65.9%), neural networks (42.3%), and deep learning (18.7%) (Mehta *et al.*, 2021). In another study conducted in the United Arab Emirates, similar scores were observed for AI and machine learning that is higher scores, while deep learning and neural networks scored lower (Boillat *et al.*, 2022).

The KU School of Pharmacy has not incorporated AI education into its curriculum, resulting in students acquiring knowledge about AI mainly through self-teaching, leaving them uninformed about AI. In 2022, Japan had 790 universities, but only a limited number of them offered AI education. To expand opportunities for improving skills in mathematics, data science, and AI, MEXT implemented the "Accreditation System" in 2021. However, as of August 2022, only 96 university programmes were accredited, including only one pharmacy school. This shortage of AI education is particularly evident in pharmacy faculties, where a significant number of students enrol with the goal of pursuing a career in pharmacy. As a result, a substantial portion of their study time is dedicated to mastering the coursework required for national examinations. Consequently, information-related courses in pharmacy schools primarily focus on developing information literacy skills to enhance students' academic training at universities. Doi and colleagues conducted a survey on ICT-related courses offered in pharmacy faculties across 77 universities and 79 faculties, revealing a lack of focus on clinical applications of ICT (Doi *et al.*, 2022). They proposed integrating ICT literacy into existing courses, suggesting the incorporation of ICT-related learning components into relevant subjects (Doi & Tomizawa, 2022). To

prepare for the digital future in healthcare, it is necessary to develop a course that fosters the fundamentals of AI knowledge and its clinical applications.

The lack of AI education in the curriculum is a common problem not only in pharmacy schools but also in medical schools, and it is prevalent not only in Japan but also worldwide. Ejaz and authors conducted research on the state of AI in medical education globally and reported that the number of students who had received teaching on AI was limited, highlighting the importance of incorporating AI education into their curriculum (Ejaz *et al.*, 2022). Moreover, a study conducted in the United Kingdom revealed that only 9.2% of surveyed students received some form of teaching on AI (Sit *et al.*, 2020). A recent systematic review also showed that most students had low knowledge and limited skills in working with AI (Baigi *et al.*, 2023).

Mantel-Teeuwisse and colleagues revealed that students exposed to digital health education in pharmacy schools were 2.5 times more likely to pursue continuous education in this field, highlighting the pivotal role of early introduction (Mantel-Teeuwisse *et al.*, 2021). Therefore, it is essential for universities in the healthcare domain to incorporate AI knowledge and skills into their curriculum. The study also highlighted various challenges in implementing digital health education within the healthcare professions (Mantel-Teeuwisse *et al.*, 2021). These challenges include the absence of necessary standards for digital health education, a dearth of appropriately trained academics, and a lack of collaborators with expertise in scientific fields like AI and machine learning.

Additionally, there is a scarcity of educational materials, case studies, and adequate laboratory space in the digital health field (Mantel-Teeuwisse *et al.*, 2021). In response to the survey results, the International Pharmaceutical Federation (FIP) is offering an educational programme on digital health to its members (International Pharmaceutical Federations (FIP), 2022), although the availability of educational opportunities remains limited. Despite various issues in healthcare universities, such as overcrowded curricula and a lack of human resources capable of providing AI education, it is crucial to devise creative educational methods. These methods could include fostering collaboration among multiple professions and integrating the clinical application of AI into each related subject, nurturing future digital health professionals.

Regarding the impression of ChatGPT, approximately 20% of the participants had experience using it, while 30% of the participants stated they had no experience

but could explain ChatGPT. Some recent reports on the actual use of ChatGPT in Japan have been published (Mori & Hayashi, 2023a; Mori & Hayashi, 2023b; Omori *et al.*, 2023). In June 2023, an online survey was conducted among university students nationwide, with 4,000 participants enrolled (Omori *et al.*, 2023). The survey revealed that 89.8% of the participants were aware of ChatGPT, and 32% had utilised it. Among the students, 45.5% in the departments of science, technology, and agriculture used ChatGPT most, while 21.2% in the fields of Medicine, Nursing, Other Medical Sciences, Dentistry, and Pharmacy used it. The survey conducted by NRI also reported that ChatGPT exhibited a high adoption rate among undergraduate/graduate/professional students (21.6%) and faculty/staff (20.5%) among different occupational groups (Mori & Hayashi, 2023a). However, the usage rate was relatively low among doctors/medical professionals (5.3%). Although the sample size was small, the study results showed that more than 95 % of participants were aware of ChatGPT compared to previous studies (Mori & Hayashi, 2023a; Omori *et al.*, 2023). However, the rate of utilising ChatGPT was found to be low, consistent with the findings from those other studies (Mori & Hayashi, 2023a; Omori *et al.*, 2023).

While only a small number of participants reported having prior experience using ChatGPT, a certain percentage of them were aware of its existence but chose not to utilise it. Interestingly, over half of the participants expressed their belief that ChatGPT could help them gather information more efficiently and enhance their learning efficiency. However, it is important to note that about 40% of the participants exhibited concerns or doubts regarding the use of ChatGPT. Notably, in the study, only 25% of the participants selected ChatGPT as reliable or somewhat reliable. This indicates that doubts about the reliability of the information may significantly influence students' decisions not to use ChatGPT. Conversely, the study suggests that the group unable to explain ChatGPT might be more inclined to rely on the accuracy and expertise of ChatGPT responses. This raises the concern that students might use ChatGPT without fully comprehending its capabilities and limitations. This underscores the importance of promptly providing literacy education.

Regarding literacy on the proper use of ChatGPT, the correct response rate was low for both OpenAI's policy on the use of ChatGPT and the instructions on its proper use. This indicates a need for awareness and education. In the NRI survey, the authors mentioned that one possible explanation for the relatively low adoption of ChatGPT among doctors/medical professionals is the limited scope of its application

within their work, where its usage is still rather restricted (Mori & Hayashi, 2023a). However, the results indicate that few students understand OpenAI's use policy. Instead, the findings suggest that some students might have chosen not to use ChatGPT due to doubts about the reliability of the information or because they are aware of the risks associated with applying unreliable information to medical care.

To assess the characteristics of participants who could describe ChatGPT and those who were unable to do so, they were divided into two groups and compared their scores in three sections. The results indicated that participants who were able to describe ChatGPT displayed a greater understanding of AI concepts, with some of them achieving a higher percentage of correct answers concerning the appropriate use of ChatGPT. This suggests that offering education about fundamental AI knowledge will lead to a better understanding and utilisation of AI tools like ChatGPT. On the other hand, in terms of the impression of ChatGPT, there was no difference between the two groups, and both indicated having a positive impression of ChatGPT. In a recent systematic review, many healthcare students showed positive and promising attitudes towards AI in medicine (Baigi *et al.*, 2023), aligning with the mentioned findings.

### Limitations

This study had several limitations. Firstly, it was conducted in a single course at a lone school of pharmacy in Japan, potentially limiting its generalisability to students' attitudes at other institutions worldwide. Moreover, the obtained responses constituted only 43.7% of the total, raising the possibility of bias in the results. Those who chose to participate in the survey may have already possessed an interest in and knowledge of AI, potentially making them more inclined to engage in the study. Furthermore, due to the limited number of ChatGPT users, group classification was based on participants' familiarity with ChatGPT rather than their experience using the system. Another limitation arises from the self-reported nature of the data; participants' responses were rooted in their perceptions and may not entirely reflect their genuine understanding. To address these limitations, future investigations will involve objective knowledge tests focused specifically on AI and ChatGPT. This approach aims to gain better insights into students' comprehension and improve the accuracy and reliability of the analysis.

### Conclusion

Students who possessed knowledge of AI and could explain ChatGPT demonstrated a better understanding of the proper usage of ChatGPT. On the other hand, many students did not comprehend the appropriate usage of ChatGPT, highlighting the necessity to incorporate AI education into the curriculum. Given the anticipation of ChatGPT's rapid growth in usage and the corresponding increase in opportunities for its application, there is an urgent need for literacy education that encompasses knowledge about the proper usage of AI, including ChatGPT. Furthermore, this education should encompass warnings against relying excessively on the accuracy and expertise of information transmitted by AI. The study provides valuable insights into ChatGPT familiarity, impressions, and understanding among pharmacy students, with implications for responsible AI usage and education.

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### Ethics approval

This study has been reviewed by Kitasato University's Institutional Review Board, and it was determined to be exempt from full review.

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**Appendix A: Survey questionnaire****Survey on ChatGPT among pharmacy students**Gender  Male  FemaleAwareness of ChatGPT  Yes  NoExperience with ChatGPT  Yes  No**(1) Assessing knowledge of Artificial Intelligence: Please tell us about the following terms**

	I have no idea	I have heard of it, but I cannot explain it	I know the term and can explain it
Q1 Natural language processing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Q2 Machine learning	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Q3 Deep learning	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Q4 Neural networks	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

**(2) Assessing impression of ChatGPT**

	Agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Disagree
Q1 Do you think the information obtained using ChatGPT is reliable?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Q2 Do you believe that utilising ChatGPT will enhance the efficiency of your information gathering?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Q3 Do you believe that utilising ChatGPT will improve your comprehension of your research findings?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Q4 Do you believe that utilising ChatGPT will improve your efficiency in learning?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Q5 Do you believe that utilising ChatGPT will enhance your knowledge and understanding?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Q6 Do you have any concerns or queries regarding the usage of ChatGPT?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Q7 Do you believe that ChatGPT has a positive impact on education?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Q8 Do you believe that the responses and information provided by ChatGPT are suitable for gathering information on pharmacy-related topics?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Q9 Do you believe that ChatGPT can assist pharmacists in improving their work efficiency?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

**(3) Assessing literacy regarding the appropriate use of ChatGPT****Q1 Please identify all inappropriate purposes for utilising ChatGPT**

	True	False
A. Using ChatGPT to automatically extract big data from websites.	<input type="checkbox"/>	<input type="checkbox"/>
B. Using ChatGPT to provide medical information.	<input type="checkbox"/>	<input type="checkbox"/>
C. Using ChatGPT for precise computations involving complex mathematical formulas.	<input type="checkbox"/>	<input type="checkbox"/>
D. Using ChatGPT to obtain personal information.	<input type="checkbox"/>	<input type="checkbox"/>
E. Elementary school students independently using ChatGPT for self-study.	<input type="checkbox"/>	<input type="checkbox"/>

**Q2 Please select all the correct statements regarding ChatGPT**

	True	False
A. Sometimes, ChatGPT may generate inaccurate information.	<input type="checkbox"/>	<input type="checkbox"/>
B. The information entered into ChatGPT may potentially be used as training data.	<input type="checkbox"/>	<input type="checkbox"/>
C. There is no need to worry about copyright when using ChatGPT.	<input type="checkbox"/>	<input type="checkbox"/>
D. It is possible to distinguish between AI-generated text and other information obtained from ChatGPT.	<input type="checkbox"/>	<input type="checkbox"/>
E. By using ChatGPT, you can verify the most up-to-date information.	<input type="checkbox"/>	<input type="checkbox"/>
F. If you ask the same question to ChatGPT repeatedly, you will always receive the same answer.	<input type="checkbox"/>	<input type="checkbox"/>
G. ChatGPT has limited capacity to provide medical, legal, and other professional advice.	<input type="checkbox"/>	<input type="checkbox"/>