



Attitudes of medical school students toward artificial intelligence in medical education: A survey study

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Abstract

This study aimed to assess medical students' knowledge and attitudes towards artificial intelligence (AI) models and their potential role in medical education and healthcare. A cross-sectional study was conducted among 398 students of Ondokuz Mayıs University Medical Faculty using an online questionnaire administered through Google Forms. Participants' awareness of AI applications, their usage patterns, and their opinions on AI's role in medical education were evaluated. The study found extensive awareness of AI applications among participants, with ChatGPT being the most recognized (%95). The majority of students believed that AI models could benefit medical education and assist in diagnosis and treatment when collaborating with doctors. However, concerns were raised regarding the potential for incorrect results, patient safety, and ethical issues. While students recognized the potential of AI-supported education to enhance learning motivation, they expressed concerns about its impact on creativity. Significant differences were found between classes regarding the acceptance of the proposition that artificial intelligence models will take over our profession in the future ($p=0.001$). Participants aware of AI applications exhibited a higher agreement rate with the proposition that AI-assisted education is more advantageous than traditional methods ($p=0.022$). Medical students recognize the potential benefits of AI models in clinical practice and medical education but also highlight concerns about ethical considerations and potential limitations. These findings emphasize the importance of a balanced approach to integrating AI into medical education and practice.

Keywords: artificial intelligence, medical education, medical students, surveys and questionnaires

1. Introduction

Artificial intelligence (AI) models are a very new technology that enables computers to have human-like intelligence by utilizing data analysis and learning capabilities (1). AI models are creating new divisions of labor between humans and machines in the working world. The World Economic Forum (WEF) predicts that the increased use of AI since the 2020 pandemic will disrupt 85 million jobs globally by 2025 and create 97 million new job roles, marking this period as the "augmented workforce" era of AI (2).

AI models (such as ChatGPT developed by OpenAI and Bard by Google), which can generate text and visuals based on user commands, provide translation capabilities, analyze and summarize information, and stay up-to-date, are being widely used and adapted by various individuals and organizations in the healthcare system. Healthcare professionals, other professions, and even patients can benefit from AI models (3). AI models, gaining popularity due to their creativity, ease of use, and accessibility, are increasingly playing a significant role in medical education. Integrating AI models into the education process of medical students offers potential benefits such as enriching students' experiences, quickly filtering related results from hard-to-access sources, and presenting relevant information. These developments offer the option of

using AI-based tools alongside traditional learning methods in medical education (4).

AI models can play an important role in developing skills for medical students during their education, including case studies, clinical comparisons between similar cases, literature reviews from sources inputted by physicians, diagnosis, guidance in practical applications, and creating treatment plans (5). Additionally, these models can assist students in integrating theoretical knowledge with practical applications through simulation projects and support clinical decision-making processes (6). However, the role of AI models in medical education must align with the fundamental principles of medical education, including the importance of ethical values, maintaining the doctor-patient relationship, and the significance of human judgment (7). The possibility of developing AI models that support physicians' roles and perform these tasks, alongside considering the future of medicine as a human profession, is also an aspect that needs evaluation (8). Despite the increasing use of AI models in medical education in recent years, sufficient data regarding their use in our country is lacking. The aim of our study is to assess medical students' knowledge levels regarding AI models and evaluate their behaviors regarding its potential role in

medical education.

2. Materials and Methods

This cross-sectional study was conducted through an online questionnaire using Google Forms from March 7th to March 24th, 2024. The study population was students of Medical Faculty of Ondokuz Mayıs University. The study protocol was approved by the Ondokuz Mayıs University Clinical Research Ethics Committee (protocol code: OMU-KAEK 2024/39.).

Since the number of individuals in the population was unknown and there was no known prevalence in the literature regarding the research topic, a sample size calculation was made for 50% prevalence, determining that at least 385 participants needed to be reached. Considering potential data loss, a total of 398 medical faculty students were contacted. The students of the Ondokuz Mayıs University Medical Faculty were contacted via social media applications (WhatsApp, Instagram, LinkedIn) and face-to-face interactions; those who agreed to participate in the study were asked to answer the survey questions online. Participants were not asked to state their names. The first part of the survey consisted of six questions querying sociodemographic characteristics and participants' knowledge levels about AI applications. In the second part, participants were asked to mark one of the options "agree," "undecided," or "disagree" according to their agreement status regarding 10 propositions related to AI and its relationship with medical education/practice.

Statistical analysis was performed using the IBM SPSS v21 software. In data analysis, measurement data were expressed as mean-standard deviation, and frequency data were expressed as numbers and percentages. To compare the answers given by the participants to the statements about AI according to the class, gender and artificial intelligence usage; the χ^2 test and linear by linear χ^2 analysis were used. The statistical significance level was set at $p < 0.05$.

3. Results

The mean age of the 398 medical students who participated in the study was 22.1 ± 2.5 years. 57.3% of the participants were female. The most common participants were in Class 2 (21.1%) and Class 4 (21.9%). The sociodemographic characteristics of the participants are presented in Table 1.

Table 1. Distribution of the sociodemographic characteristics of the participants (n=398)

Sex, n (%)	
Male	170 (42.7)
Female	228 (57.3)
Age, year, (mean \pm SD) (min-max)	22.1 \pm 2.5 (17-41)
Class, n (%)	
Class 1	41 (10.3)
Class 2	84 (21.1)
Class 3	63 (15.8)
Class 4	87 (21.9)
Class 5	77 (19.3)
Class 6	46 (11.6)

Only 5 (1.3%) students were unaware of artificial intelligence applications. 95% of the participants were aware of ChatGPT, while 38% were aware of other AI applications (Bard, YouChat, Jasper, Bing, Leonardo AI, CoPilot). There was no statistically significant difference in awareness of ChatGPT based on gender and class. The percentage of males aware of AI applications other than ChatGPT was statistically significantly higher than females (44.7% and 33.3%; respectively) ($p < 0.05$).

85.0% of the participants stated that they used ChatGPT, 23.6% used other applications, and 10.6% did not use any artificial intelligence applications. The use of artificial intelligence was statistically significantly higher in male students compared to females (87.6% and 78.1%; respectively) ($p < 0.05$). While Class 6 students were the most frequent users of AI applications (93.5%), Class 5 students were the least frequent users (66.2%). There was a statistically significant difference in the frequency of artificial intelligence use among classes ($p < 0.05$), which was attributed to the difference between Class 6 and Class 5 students.

74.8% of the participants stated that they used artificial intelligence applications for studying, doing homework; 40.9% for literature review; 24.1% for learning languages; and 4.02% for other purposes (entertainment, translation, text summarization, software, visual creation, etc.).

Among the propositions given in the study, the statement "I think artificial intelligence models are beneficial in medical education" had the highest agreement rate at 80.2%, while the lowest agreement rate was 24.4% with the statement "I think artificial intelligence models will take over our profession in the future." The frequencies of participants' responses to the propositions are shown in Table 2.

The frequency of those who disagreed with the proposition "The use of artificial intelligence models may reduce our creativity" was statistically significantly higher in females compared to males ($p = 0.006$).

The highest agreement with the proposition "I think artificial intelligence models will take over our profession in the future" came from Class 3 and Class 4 students (41.3% and 39.1% respectively). The disagreeing parties were Class 4 and Class 2 students (48.3% and 45.2% respectively). There was a statistically significant difference between the agreement rate to this proposition and the class of the participants ($p = 0.001$).

82.9% of Class 1 students and 47.8% of Class 6 students agreed with the proposition "Artificial intelligence models can be used in collaboration with doctors for diagnosis and treatment." There was a statistically significant difference between the agreement rate to this proposition and the class of the participants ($p = 0.012$).

Table 2. Distribution of participants' answers to propositions about artificial intelligence(%)

	Agree	Disagree	Undecided
I think AI models are beneficial in medical education.	80.2	3.8	16.1
I think AI models can produce incorrect results.	69.1	4.8	26.1
I think AI models will take over our profession in the future.	24.4	37.4	38.2
AI models can be used in collaboration with doctors for diagnosis and treatment.	72.9	5.5	21.6
The use of AI models can raise ethical issues.	57.0	10.3	32.7
The use of AI models may reduce our creativity.	52.8	14.6	32.7
In a hospital setting, the utilization of artificial intelligence models may pose a problem in terms of patient safety.	51.3	13.8	34.9
AI-supported learning is more advantageous than traditional education methods.	48.5	15.6	35.9
AI-assisted education can increase medical students' learning motivation.	58.8	12.1	29.1
The use of AI models can decrease doctors' professional responsibility.	54.3	13.1	32.7

The agreement rate with the proposition "Artificial intelligence-assisted education is more advantageous than traditional education methods." was statistically significantly higher among those who were aware of artificial intelligence applications compared to those who were not ($p=0.022$)

The agreement rates with the propositions "I think artificial intelligence models are beneficial in medical education." "Artificial intelligence models can be used in collaboration with doctors for diagnosis and treatment." "Artificial intelligence-supported learning is more advantageous than

traditional education methods." and "Artificial intelligence-assisted education can increase medical students' learning motivation." were statistically significantly higher among users of artificial intelligence applications compared to non-users ($p<0.05$).

There was no statistically significant difference in the agreement rates with other propositions based on participants' gender, class, knowledge about AI, and usage. The responses of the participants to the propositions based on these characteristics are shown in Table 3.

Table 3. The comparison of participants' responses to propositions about artificial intelligence according to some groups (%)

	Agree	Disagree	Undecided	p value
<i>I think AI models are beneficial in medical education.</i>				
Sex				0.203
Female	82.9	2.6	14.5	
Male	76.5	5.3	18.2	
Class				0.168
Class 1	80.5	2.4	17.1	
Class 2	75.0	3.6	21.4	
Class 3	87.3	3.2	9.5	
Class 4	82.8	3.4	13.8	
Class 5	71.4	3.9	25.7	
Class 6	89.1	6.5	4.3	
Awareness of artificial intelligence				<0.001
Yes	80.9	3.1	16.0	
No	20.0	60.0	20.0	
Use of artificial intelligence				<0.001
Yes	83.1	2.0	14.9	
No	54.8	19.0	26.2	
<i>I think AI models can produce incorrect results.</i>				
Sex				0.443
Female	68.0	3.9	28.1	

Male	70.6	5.9	23.5	
Class				0.592
Class 1	68.3	2.4	29.3	
Class 2	61.9	6.0	32.1	
Class 3	73.0	6.3	20.6	
Class 4	67.8	3.4	28.7	
Class 5	72.7	2.6	24.7	
Class 6	73.9	8.7	17.4	
Awareness of artificial intelligence				0.818
Yes	69.0	4.8	26.2	
No	80.0	0.0	20.0	
Use of artificial intelligence				0.197
Yes	68.0	5.3	26.7	
No	78.6	0.0	21.4	
<i>I think AI models will take over our profession in the future.</i>				
Sex				0.4442
Female	23.7	36.4	39.9	
Male	25.3	38.8	35.9	
Class				0.001
Class 1	19.5	31.7	48.8	
Class 2	13.1	45.2	41.7	
Class 3	41.3	22.2	36.5	
Class 4	20.7	48.3	31.0	
Class 5	20.8	40.3	39.0	
Class 6	39.1	23.9	37.0	
Awareness of artificial intelligence				0.714
Yes	24.5	37.0	38.6	
No	22.7	45.5	31.8	
Use of artificial intelligence				0.899
Yes	24.8	37.0	38.2	
No	22.5	39.4	38.0	
<i>AI models can be used in collaboration with doctors for diagnosis and treatment.</i>				
Sex				0.228
Female	71.5	4.4	24.1	
Male	74.6	7.1	18.2	
Class				0.012
Class 1	82.9	4.9	12.2	
Class 2	73.8	6.0	20.2	
Class 3	76.2	0.0	23.8	
Class 4	72.4	6.9	20.7	
Class 5	79.2	5.2	15.6	
Class 6	47.8	10.9	41.3	
Awareness of artificial intelligence				0.177
Yes	73.3	5.3	21.4	
No	40.0	20.0	40.0	
Use of artificial intelligence				0.046
Yes	74.7	5.3	19.9	
No	57.1	7.1	35.7	
<i>The use of AI models can raise ethical issues.</i>				
Sex				0.096
Female	58.8	7.5	33.8	
Male	54.7	14.1	31.2	
Class				0.383
Class 1	58.5	7.3	34.1	
Class 2	53.6	7.1	39.3	
Class 3	55.6	12.7	31.7	
Class 4	56.3	11.5	32.2	
Class 5	68.8	10.4	20.8	
Class 6	45.7	13.0	41.3	
Awareness of artificial intelligence				0.538
Yes	56.7	10.4	32.8	
No	80.0	0.0	20.0	
Use of artificial intelligence				0.260
Yes	55.9	10.1	34.0	
No	66.7	11.9	21.4	
<i>The use of AI models may reduce our creativity.</i>				
Sex				0.006

Female	53.1	10.1	36.8	
Male	52.4	20.6	27.1	
Class				0.910
Class 1	46.3	17.1	36.6	
Class 2	56.0	15.5	28.6	
Class 3	57.1	11.1	31.7	
Class 4	50.6	13.8	35.6	
Class 5	57.1	14.3	28.6	
Class 6	43.5	17.4	39.1	
Awareness of artificial intelligence				0.139
Yes	52.7	14.2	33.1	
No	60.0	40.0	0.0	
Use of artificial intelligence				0.527
Yes	53.7	14.0	32.3	
No	45.2	19.0	35.7	
<i>In a hospital setting, the utilization of artificial intelligence models may pose a problem in terms of patient safety</i>				
Sex				0.136
Female	47.8	13.2	39.0	
Male	55.9	14.7	29.4	
Class				0.416
Class 1	43.9	17.1	39.0	
Class 2	44.0	13.1	42.9	
Class 3	52.4	11.1	36.5	
Class 4	51.7	11.5	36.8	
Class 5	55.8	19.5	24.7	
Class 6	60.9	10.9	28.3	
Awareness of artificial intelligence				0.399
Yes	50.9	14.0	35.1	
No	80.0	0.0	20.0	
Use of artificial intelligence				0.270
Yes	52.2	12.9	34.8	
No	42.9	21.4	35.7	
<i>AI-supported learning is more advantageous than traditional education methods.</i>				
Sex				0.053
Female	43.9	15.4	40.8	
Male	54.7	15.9	29.4	
Class				0.054
Class 1	31.7	17.1	51.2	
Class 2	34.5	17.9	47.6	
Class 3	55.6	12.7	31.7	
Class 4	57.5	14.9	27.6	
Class 5	54.5	15.6	29.9	
Class 6	52.2	15.2	32.6	
Awareness of artificial intelligence				0.022
Yes	48.9	15.0	36.1	
No	20.0	60.0	20.0	
Use of artificial intelligence				0.015
Yes	50.8	14.3	34.8	
No	28.6	26.2	45.2	
<i>AI-assisted education can increase medical students' learning motivation.</i>				
Sex				0.175
Female	61.8	9.6	28.5	
Male	54.7	15.3	30.0	
Class				0.364
Class 1	53.7	12.2	34.1	
Class 2	57.1	9.5	33.3	
Class 3	65.1	7.9	27.0	
Class 4	62.1	9.2	28.7	
Class 5	61.0	14.3	24.7	
Class 6	47.8	23.9	28.3	
Awareness of artificial intelligence				0.092
Yes	59.3	11.7	29.0	
No	20.0	40.0	40.0	
Use of artificial intelligence				<0.001
Yes	62.4	11.0	26.7	
No	28.6	21.4	50.0	
<i>The use of AI models can decrease doctors' professional responsibility.</i>				

Sex				0.477
Female	56.1	11.4	32.5	
Male	51.8	15.3	32.9	
Class				0.288
Class 1	48.8	12.2	39.0	
Class 2	47.6	16.7	35.7	
Class 3	66.7	11.1	22.2	
Class 4	58.6	9.2	32.2	
Class 5	46.8	13.0	40.2	
Class 6	58.7	17.4	23.9	
Awareness of artificial intelligence				0.795
Yes	54.5	13.0	32.5	
No	40.0	20.0	40.0	
Use of artificial intelligence				0.242
Yes	55.6	12.4	32.0	
No	42.9	19.0	38.1	

p value according to χ^2 analysis

4. Discussion

In this study, our aim was to investigate the attitudes of medical students toward artificial intelligence, which is increasingly gaining importance in our lives, and to examine how they perceive its positive and negative effects on their professional lives.

The majority of participants in our study (80.2%) believed that artificial intelligence applications were beneficial in medical education. Similarly, in a study conducted among medical students and doctors in Korea, about half of the participants reported that they would use artificial intelligence more intensively in the future, and they indicated that the most useful areas would be diagnosis and treatment planning (9). Another study conducted in our country revealed that the majority of students believed that hospitals using artificial intelligence were more advantageous both in diagnosis and treatment, and they expressed their desire to use artificial intelligence in their future medical careers, suggesting a trend towards more intensive use of artificial intelligence applications in medicine(6). In the literature, it is considered necessary to incorporate artificial intelligence into medical education (10,12).

The increasing accessibility of data in healthcare and the rapid development of analytical methods have made successful applications of artificial intelligence possible in healthcare. Powerful artificial intelligence models guided by relevant clinical questions can direct physicians towards potential diagnoses. In our study, 72.9% of the participants believed that artificial intelligence models could be used collaboratively with physicians in diagnosis and treatment. Similarly, Esteva and colleagues have shown that training artificial intelligence applications to diagnose skin cancer is comparable to dermatologists' skin cancer classification (12). In another study, the majority of participants believed that artificial intelligence could potentially detect pathologies in radiological examinations (10).

In our study, only 48.5% of the participants believed that artificial intelligence-supported education would be more advantageous than traditional educational methods. However,

considering that the amount of information in medical literature doubles every three years, it is estimated that a physician would need to spend 29 hours a day reading books if they wanted to stay completely up-to-date (13). The belief that artificial intelligence-supported education would be advantageous compared to the traditional method was statistically significant among those who had knowledge of and used artificial intelligence, compared to those who did not. One of the reasons for this could be the concern among those who think that it could create ethical issues (57%). There are some ethical issues in the application of artificial intelligence in healthcare, patient care, and medical research. Issues such as the absence of informed consent forms, reliability of information, and lack of emphasis on patient privacy, as well as uncertainty about who would be blamed in case of an error, can lead to ethical problems (3,14). Furthermore, it should be transparent and free from discrimination (18). In addition to ethical issues, 69.1% of participants believed that artificial intelligence models could produce incorrect results. Among these concerns are cases of providing incorrect references, indicating the necessity for human verification of the accuracy of the information provided (15).

Approximately 59% of the participants believed that artificial intelligence-supported education could increase medical students' learning motivation. There are several advantages to using artificial intelligence in medical education, including providing a wide range of information sources, supporting the learning process, enhancing language skills, offering personalized learning experiences, and providing 24/7 access with problem-solving and analytical abilities (3). These advantages can not only support and enhance students' learning processes but also boost their motivation. Personalized content delivered through artificial intelligence technology, engaging experiences, and instant feedback can capture students' attention and make the learning process more effective. Offering content tailored to students' interests and ensuring easy access can also increase their participation in the learning process. Therefore, using artificial intelligence can enhance students' motivation and make their learning experiences more enjoyable. Participants in Yılmaz et al.'s study also believe that

they can provide better healthcare to patients by using artificial intelligence (16). In our study, it is also believed that artificial intelligence-supported education can increase learning motivation.

The majority of students participating in our study believe that the use of artificial intelligence models can reduce the professional workload of physicians. A study suggests that with the advancement of artificial intelligence technology, it can be used to compensate for shortages, especially in areas where there is a shortage of doctors and healthcare workers, and it can be beneficial in diagnosis and treatment. However, it has been noted that along with the decrease in responsibility, doctors fear becoming unemployed (13). In fact, in another study, one-sixth of participants who initially considered radiology as their first choice do not consider radiology due to concerns about artificial intelligence (17). In our study, only 37.4% of participants believe that it could take away their profession.

Artificial intelligence technology has the potential to reduce the number of errors in clinical settings and minimize differences in opinions among doctors. Moreover, through the analysis of large datasets obtained from clinical practices by artificial intelligence applications, new models discovered may lead to the development of beneficial markers for diagnosis and treatment (10). However, just as drugs and other medical devices need to undergo thorough verification of safety and efficacy before being used on patients, artificial intelligence technology also needs to undergo comprehensive clinical validation to determine its accuracy and ensure that it can provide care to patients without causing harm. In addition, the extent to which artificial intelligence ensures patient safety is also subject to debate. Processing, storing, and even altering information such as patients' identities, medical histories, lifestyles, and habits can lead to confusion about how much and under what circumstances artificial intelligence will access this information (3). Participants in our study, at 51.3%, also believe that the use of artificial intelligence models may pose problems in terms of patient safety.

In today's fast-paced world where everything is consumed rapidly and our attention spans are decreasing, it is possible to access information quickly through artificial intelligence. The ability of artificial intelligence to provide examples within specific patterns and generate new content leads to more than half of students believing that the use of artificial intelligence models will reduce our creative thinking abilities.

Our study has several limitations. Firstly, it was conducted solely among students of Ondokuz Mayıs University Faculty of Medicine, thus the findings cannot be generalized at a national level. Another limitation is that participation in the study was voluntary, potentially resulting in a bias towards individuals more interested in AI.

In conclusion, the students participating in our study

expressed awareness of AI applications, with all those knowledgeable about such applications indicating familiarity with ChatGPT. They believe that the use of AI models in medical education could be beneficial, potentially reducing the workload of physicians and aiding in diagnosis and treatment when collaborating with doctors. However, they also acknowledge the potential for these models to produce incorrect results and raise concerns about patient safety and ethical issues. Regarding education, they agree that AI-supported education could enhance medical students' learning motivation but express concerns that the use of AI models may diminish their creative thinking abilities. Overall, while the students acknowledge the advantages of using AI models in clinical settings and medical education, they also highlight shortcomings, particularly in ethical considerations.

Conflict of interest

The authors declared no conflict of interest.

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Authors' contributions

Concept: B.D., Ö.Z.T., Design: B.D., H.B.Ç., Data Collection or Processing: G.N.A., M.Ü., C.T.Ü., E.Ş., B.Y., G.Z.A., L.K., Analysis or Interpretation: Ö.Z.T., B.D., Literature Search: All authors, Writing: All Authors.

Ethical Statement

Approval was obtained from Ondokuz Mayıs University Clinical Research Ethics Committee, the study started. The ethics committee decision date is 31/01/2024 and the number of ethical committee decisions is 2024/39.

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