ORIGINAL ARTICLE

Perception of First Year Medical Students Menoufia National University towards Artificial Intelligence and its Application in Medical Education

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Introduction	The swift advancement of artificial intelligence (AI) holds the promise of transforming multiple aspects of medical education and practice. While AI is increasingly integrated into medicine, we still need to investigate the perceptions and understanding of AI among medical students.
Aim	The objective of this research is to examine the perception, knowledge, and attitudes regarding AI and its applications in medical education and practice among first-year medical students at Menoufia National University (MNU). Methods: A cross-sectional study was performed on first-year medical students at MNU utilizing an online questionnaire.
Methods	A cross-sectional study was performed on first-year medical students at MNU utilizing an online questionnaire.
Results	350 medical students were involved in the study, with a mean age of 18.74 ± 0.69 years. Males represented 56.3 % while females represented 43.7 %. Over 90 % of students expressed good (54.9 %) to moderate (41.1 %) knowledge of AI and its use in medical education. At the same time, more than 80 % of them expressed moderate (50.6 %) to good (43.9 %) perceptions towards AI and its use in medical practice. Additionally, over 70 % of students believed in AI's ability to improve the quality of medical education. Furthermore, over 60 % of students agreed that AI can improve patient outcomes in Egypt. Accordingly, about 70 % of students desired to learn about AI's medical applications.
Conclusions	The results highlighted the necessity of integrating AI tools in medical education and practice to ensure our students are well-equipped to face future technological challenges in their medical careers as physicians.
Keywords	Artificial Intelligence, Medical Education, Medical Practice.

INTRODUCTION

Although artificial intelligence (AI) has been used for over 50 years, a booming evolution has occurred only recently, thanks to advances in its subsets, particularly machine and deep learning[1].

Artificial intelligence is transforming medical education by enhancing learning experiences and improving outcomes. AI-driven tools, such virtual tutors and adaptive learning platforms, offer customized training suited to the specific needs of each learner. Additionally, AI enables realistic simulations, predictive analytics for academic performance, and streamlined access to vast medical knowledge, preparing future healthcare professionals for dynamic clinical challenges.

It can be defined in many ways, as machines can replicate and execute cognitive functions, such as speech and image recognition, by analyzing vast data to predict future trends[2]. The spectrum of AI applications in the medical field is exceptionally extensive. It is anticipated that nearly all categories of clinicians would imminently employ AI for diverse applications[3, 4]. Besides its capability for diagnostic and therapeutic purposes[5], the potential application of AI technologies also encompasses medical education at its three major levels: undergraduate, postgraduate and the continuing development of established professional clinicians[6]. The Egyptian undergraduate medical education system has increasingly embraced integration, student-centered approaches and early clinical exposure, with some universities pioneering these educational strategies decades ago[7, 8]. Examples of possible applications of AI in medical education include improving curriculum design, facilitating active learning strategies, allowing distance and asynchronous learning models, providing clinical setting simulators, maximizing cost-effectiveness, ensuring transparency, maintaining stress-free educational environments and providing customized feedback and guidance[2]. Furthermore, parallel innovations in virtual reality technologies can substantially transform the teaching experience in certain fields, such as anatomy and surgery[9]. In this context, AI technologies have the potential to be extensively implemented in undergraduate medical education[10].

Along with such growing integration, challenges are expected to emerge, including the need to develop an appropriate infrastructure and technological framework, the lack of structured and digitalized curricula, the anticipated rise in cheating and plagiarism rates and the ethical dilemma, especially in clinical and case-based settings[11 – 14].

Numerous researches have investigated the attitudes of medical students and staff about the integration of AI in medical education across diverse levels and global regions, with varying outcomes[15 – 17]. AI is gaining ground every day in the field of medical education and medical practice, with medical students having variable perceptions of its importance and limitations. Menoufia National University (MNU), a recently established university, in the vicinity of different governates in Egypt, making it a meeting point for students from different cultural backgrounds. So, evaluating the perception of first-year medical students in this university towards AI and its applications in medical education allowed us to assess this cultural variation and formulate a plan for their two courses of AI in medicine being an essential part of the medicine and surgery program at its fourth year. The two obligatory courses, 2 credit hours each, in the seventh and eighth semesters of the program, named "Artificial Intelligence in Medicine 1 and 2). the first course provides the students with an introduction to the basic principles of artificial intelligence and the rules of its judicious use. The second course provides the students with an overview about the different applications of artificial intelligence in medicine with real life examples.

The novelty of this study lies in its focus on understanding the perceptions of first-year medical students at MNU, Egypt, regarding AI and its potential applications in medical education. While AI is increasingly being integrated into healthcare and education globally, there is limited research exploring the awareness, attitudes, and readiness of medical students in Egypt, particularly at the undergraduate level. This study addresses this gap by providing insights into how future healthcare professionals in a developing country perceive AI, which is critical for shaping AI-related curricula and training programs tailored to the Egyptian context.

Furthermore, this research is among the first to specifically target first-year medical students in Egypt, capturing their initial perspectives before extensive exposure to clinical training. This early insight is valuable for identifying educational needs and potential barriers to AI adoption in medical education. The findings could serve as a foundation for future studies and inform policymakers and educators in Egypt and similar settings about the importance of integrating AI literacy into medical curricula.

Our study seeks to elucidate the opinions of first-year medical students at MNU concerning AI and its implementation in medical education.

Materials and Methods:
Ethical concerns:
To ensure compliance with ethical norms, the study obtained approval from the research ethics committee at the Tanta Faculty of Medicine, reference number (36264PR734/6/24). All participants provided informed consent, which was explicitly stated at the beginning of the questionnaire, clarifying that participation in the questionnaire was optional and indicated consent for using data in research. Confidentiality and privacy of the participants were rigorously upheld throughout the research process by making code numbers for every participant.

Study Design:

A cross-sectional questionnaire study was done to evaluate the perceptions of first-year medical students at MNU regarding AI and its application in medical education.

Inclusion criteria:

Preclinical first-year medical students at MNU (Medicine and Surgery Bachelor Program-credit hours /5+2)) participated in the study (academic year 2023 - 2024). The study did not pre-assess or control for participants' prior knowledge of AI.

Exclusion criteria:

Students who did not complete the questionnaire properly were not included.

Sample size:

The Open-Epi online sample size calculator estimated a sample size of 116 participants. The anticipated frequency was decided according to a previous Egyptian study[18], which displayed a percentage of 89 % for medical students exhibiting a belief in the significance of AI. The calculator was set at 95 % confidence interval and ± 0.05 margin of error. The total population size was 450 students. However, the questionnaire recorded 350 responses, which is about thrice the estimated sample size. All students finished the questionnaire.

Data collection:

A pre-validated questionnaire in English Language[17] was uploaded to a google form, was sent to students by email and social media apps (WhatsApp – Facebook Messenger). Only completed responses were included in our results.

The questionnaire comprised three sections: demographic information, such as age and sex; perceptions regarding AI and its use in medical education; and perceptions concerning AI and its utilization in medical practice. A five-point Likert scale was encoded as follows: Strongly agree = 5, Agree = 4, Neutral = 3, Disagree = 2, and Strongly disagree = 1. The aggregate score reflecting medical students' perceptions of AI and its use in medical education and practice was subsequently computed, and students whose scores were > 75 % of the total score were considered to have good perception levels. In contrast, those with scores ranging from 50 % - 75 % of the total score were considered to have moderate perception levels. Similarly, students with scores < 50 % of the total score were considered to have poor perception level.

Statistical analysis:

The data was compiled and analyzed statistically utilizing SPSS, version 20 (SPSS Inc., Chicago, IL). Quantitative data was defined by its mean and standard deviation (SD). The qualitative data was presented using frequencies (No) and percentages (%). The Chi-square test was utilized to assess the influence of the categorical variable "Sex" on the level of perception of AI and its application in medical education (also a categorical variable). The study employed a One-way ANOVA test to evaluate the impact of the degree of perception towards AI and its use in medical education and practice (categorical variable). Z-test was employed to detect significance among different perception categories. A *p*-value lower than 0.05 was considered statistically significant.

RESULTS

The survey had robust internal consistency, evidenced by a Cronbach's alpha coefficient of 0.94. The Cronbach's alpha coefficient for perceptions of AI integration in medical education was shown to be 0.92. Likewise, the Cronbach's alpha coefficient for perceptions on AI and its application in medical practice was 0.78. The study included a cohort of 350 first-year medical students from MNU, exceeding the specified sample size. All participating students fulfilled the inclusion criteria, and no students were excluded. The students had a mean age of 18.74 ± 0.69 years, with 197 (56.3 %) male and 153 (43.7 %) female.

As shown in Table 1, students' perception scores regarding AI and its application in medical education and practice were not influenced by their sex, as indicated by statistical analysis (*P* > 0.05).

Table 1: The impact of students' sex on perception towards artificial intelligence and its application in medical education and practice:

		Perception level towards AI and its use in medical education						*p*-value
		Good		**Moderate**		**Poor**		
		No	**%**	**No**	**%**	**No**	**%**	
Sex	**Male**	104	29.7 %	81	23.1 %	12	3.4 %	0.071
	Female	88	25.1 %	63	18 %	2	0.6 %	
		Perception level towards AI and its use in medical Practice						*p*-value
		Good		**Moderate**		**Poor**		0.719
		No	**%**	**No**	**%**	**No**	**%**	
		Good		**Moderate**		**Poor**		0.719
		No	**%**	**No**	**%**	**No**	**%**	
Sex	**Male**	85	24.3 %	99	28.3 %	13	3.7 %	
	Female	68	19.4 %	78	22.3 %	7	2 %	

As shown in Table 2, more than 90 % of students demonstrated a good to moderate perception regarding AI and its implementation in medical education. The percentage of students with good perception of 54.9 %

was higher than that of students with moderate perception of 41.1 % ($P < 0001$). Additionally, the percentage of students who showed poor perception of 4 % was significantly lower than moderate and good perception ($P < 0.001$). Approximately two-thirds acknowledged their familiarity with AI in medical education and expressed comfort in utilizing AI for medical educational purposes. A percentage of 62.6 and 61.4 of the student population displayed familiarity with the diverse AI tools utilized for educational objectives and exhibited concerns regarding the ethical implications accompanying the integration of AI in medical education correspondingly. Additionally, over 70 % of students believed in the potential of AI to improve the quality of medical education. The percentage was markedly ($P < 0.001$) more than that of students who expressed neutral or disapproving views regarding this assertion. In contrast, students with neutral opinions were

significantly higher ($P < 0.001$) than those who exhibited refusal. Also, the same percentage of students exhibited an eagerness to explore novel AI technologies for educational pursuits, displayed confidence in their capacity to utilize AI technologies for learning purposes, perceived AI as advantageous for medical research, acknowledged the significance of integrating AI technologies into their university education, and emphasized the importance of universities offering training on AI tool utilization and educating students on the ethical implications of AI. Additionally, most students (> 50 %) expressed approval for AI's role in grading academic work and potentially supplanting conventional teaching methodologies. Concerns regarding AI replacing human instructors were less pronounced, with approximately 30 % of students expressing apprehension.

Table 2: Description of medical students' perception towards artificial intelligence and its application in medical education:

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
	No (%)	No (%)	No (%)	No (%)	No (%)
Are you familiar with the concept of AI in medical education	15 (4.3 %)	25 (5.7 %)	79 (22.6 %)	171 (48.9 %)	60 (17.1 %)
Are you familiar with the various AI tools available for educational purposes?	12 (3.4 %)	20 (5.7 %)	99 (28.3 %)	161 (46 %)	58 (16.6 %)
Do you believe that AI can improve the quality of medical education?	15 (4.3 %)***	10 (2.9 %) ***	73 (20.9 %)***	145 (41.4 %)	107 (30.6 %)
Do you believe that AI will revolutionize the way we learn in the future medical education?	14 (4 %)	14 (4 %)	76 (21.7 %)	169 (48.3 %)	77 (22 %)
Are you willing to try out new AI technologies for medical educational purposes?	12 (3.4 %)	11 (3.1 %)	74 (21.1 %)	170 (48.6 %)	83 (23.7 %)
Are you confident in your ability to use AI technologies for learning purposes?	11 (3.1 %)	15 (4.3 %)	79 (22.6 %)	165 (47.1 %)	80 (22.9 %)
Are you comfortable with using AI in your education?	10 (2.9 %)	13 (3.7 %)	91 (26 %)	159 (45.4 %)	77 (22 %)
Are you comfortable with the idea of AI grading your academic work?	18 (5.1 %)	34 (9.7 %)	106 (30.3 %)	142 (40.6 %)	50 (14.3 %)
Are you concerned about the ethical implications of using AI in medical education?	11 (3.1 %)	21 (6 %)	103 (29.4)	167 (47.7 %)	48 (13.7 %)
Do you think that AI can aid in medical research?	6 (1.7 %)	15 (4.3 %)	64 (18.3 %)	163 (46.6 %)	102 (29.1 %)
Do you think that it is important for universities to integrate AI technologies into their education?	12 (3.4 %)	10 (2.9 %)	76 (21.7 %)	169 (48.3 %)	83 (23.7 %)
Do you think that it is important for universities to provide training on how to use AI tool?	12 (3.4 %)	12 (3.4 %)	74 (21.1 %)	148 (42.3 %)	104 (29.7 %)
Do you think it is important for universities to teach students about the ethical implications of AI?	9 (2.6 %)	15 (4.3 %)	75 (21.4 %)	152 (43.4 %)	99 (28.3 %)
Do you think AI can replace traditional teaching methods?	23 (6.6 %)	41 (11.7 %)	97 (27.7 %)	134 (38.3 %)	55 (15.7 %)
Are you concerned about the potential for AI to replace human teachers?	40 (11.4 %)	63 (18 %)	94 (26.9 %)	118 (33.7 %)	35 (10 %)
Perception score towards AI and its application in medical education Mean ± SD (min – max)	55.89 ± 10.09 (15 - 75)				
Perception level towards AI and its application in medical education	NO (%)				
Good	192 (54.9 %)				
Moderate	144 (41.1 %) #				
Poor	14 (4 %) *#				

"# denotes $P < 0.05$ compared to the 'Good perception; * denotes $P < 0.05$ compared to the 'Moderate' perception; \$\$\$ denotes $P < 0.001$ compared to the 'Agree'; @@@ denotes $P < 0.001$ compared to the 'Strongly Agree'.".

In Table 3, over 80 % of students demonstrated a moderate to good awareness of AI and its utilization in medical practice. The proportion of students exhibiting poor perception was markedly ($P < 0.001$) lower than that of those demonstrating good and moderate perceptions.

Almost 70 % of students showed interest in learning about the applications of AI in medicine and positive opinions about how important it is for medical professionals to understand how AI works. Moreover, about 50 % did not mind being operated upon by AI. Over 60 % of students agreed that AI can improve patient outcomes in Egypt. Conversely, students agreed least (~ 40 %) with the concept of AI substituting human medical experts in the future.

Table 3: Description of medical students' perception towards artificial intelligence and its application in medical practice:

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
	No (%)	No (%)	No (%)	No (%)	No (%)
Are you willing to learn about the applications of AI in medicine?	7 (2 %)	11 (3.1 %)	78 (22.3 %)	177 (50.6 %)	77 (22 %)
Do you think that it is important for medical professionals to understand how AI works?	11 (3.1 %)	13 (3.7 %)	77 (22 %)	165 (47.1 %)	84 (24 %)
Are you willing to be operated upon by an AI machine?	25 (7.1 %)	41 (11.7 %)	105 (30 %)	133 (38 %)	46 (13.1 %)
Do you think that AI can improve patient outcomes in Egypt?	15 (4.3 %)	23 (6.6 %)	86 (24.6 %)	165 (47.1 %)	61 (17.4 %)
Do you believe that AI will replace human medical professionals in the future?	64 (14.9 %)	64 (18.3 %)	90 (25.7 %)	104 (29.7 %)	40 (11.4 %)
Perception score towards AI and its application in medical practice Mean ± SD (min – max)	17.82 ± 3. 73 (5- 25)				
Perception score towards AI and its application in medical education	NO (%)				
Good	153 (43.7 %)				
Moderate	177 (50.6 %)				
Poor			20 (5.7 %)*#		

# denotes $P < 0.05$ compared to the 'Good perception; * denotes $P < 0.05$ compared to the 'Moderate' perception.

As demonstrated in Figure1, we assessed the students' awareness of various AI methods in medical education. More than 60 % of the students recognized "Personalized learning platforms" as an AI method within medical education that were significantly ($P < 0.001$) higher than gamification tools, interactive smartboards and automated exam grading system ($P < 0.001$, $P < 0.05$, and $P < 0.01$, respectively). Likewise, over half of the students were acquainted with "Interactive smartboards," closely trailed by "Automated exam grading systems." The students demonstrated the lowest awareness regarding "Gamification tools," which showed a lower percentage compared to interactive smartboards and automated exam grading system ($P < 0.01$ and $P < 0.05$, respectively).
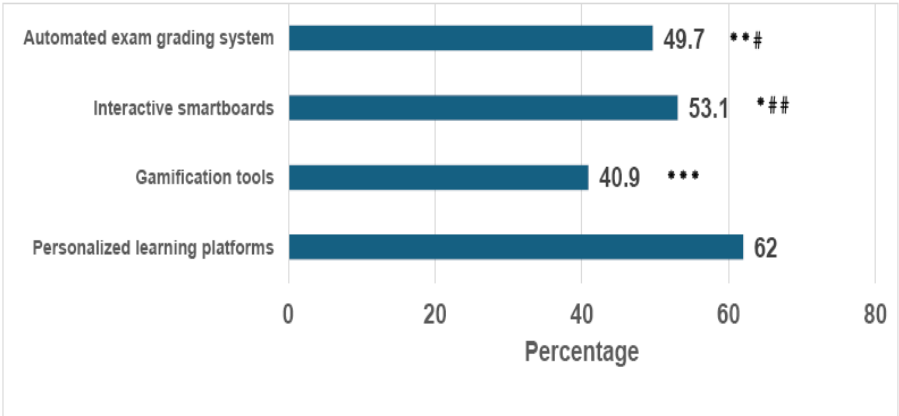

Figure 1: Medical students' awareness of Artificial intelligence methods in medical education.

*= $P < 0.05$, **= $P < 0.001$ and $P < 0.001$ vs personalized learning platforms; #= $P < 0.05$ and ## = $P < 0.01$ Vs gamification tools.

Table 4 showed a significant weak positive correlation ($r = 0.112$, $P = 0.0309$) between medical students' awareness of artificial intelligence methods and their perception towards application of artificial intelligence in medical education. However, a non-significant weak positive correlation was detected between medical students' awareness of artificial intelligence methods and their perception towards application of artificial intelligence in medical practice ($r = 0.035$, $P > 0.05$).

Table 4: Correlation between medical students' awareness of artificial intelligence methods in medical education and practice and students' awareness of various AI methods:

Variable	r	*p*-value
Student perception towards application of artificial intelligence in medical education.	0.112	0.036
Student perception towards application of artificial intelligence in medical practice.	0.035	0.509

DISCUSSION

The current study evaluated MNU first-year medical students' perceptions of AI applications in medical education and clinical practice using a survey with strong internal consistency.

The current investigation revealed no significant differences in age and gender concerning the perception of AI and its application in medical education ($P = 0.499$ and 0.071, respectively) and practice ($P = 0.067$ and 0.719, respectively). These results may be attributed to the fact that only first-year medical students were included in the study with no wide range of age. These findings match the results of Ahmer *et al.,*[19], who indicated that there were no significant gender differences in medical students' knowledge and perceptions of the value and uses of AI in medicine. However, our findings contradict Armutat *et al.,*[20], who determined that males are more inclined to possess a favorable perception of AI applications, exhibit greater confidence in technology and evaluate their AI competencies more positively. Furthermore, the cross-sectional study by Jebreen *et al.,*[21] indicated that male students achieved significantly higher scores on perception tests compared to female students. The equal technology exposure among males and females in our community could explain this difference in our results. The widespread use of electronic devices like tablets and smartphones facilitates the availability of AI-based applications among students of both genders in this age group.

The current study examined first-year medical students' perceptions of AI and its applications in medical education, revealing that over 90 % exhibited good to moderate perceptions, with a statistically significant difference ($P < 0.001$) compared to those with poor perceptions. Percentages of 62.6 and 61.4 of the student population displayed familiarity with the diverse AI tools utilized for educational purposes. They exhibited concerns regarding the ethical implications of integrating AI into medical education including lack of fairness among students, inaccuracy of data with poor data reliability, and unequal access to AI tools among students. Our results aligned with those of Khater *et al.,*[17], who employed a self-administered questionnaire in a cross-sectional study to evaluate over 400 Egyptian medical students concerning AI and its implementation in medical education. Most of their students showed moderate to good understanding and attitudes towards AI, with more than 80 % stressing the importance of incorporating AI instruction into their medical curriculum and believing that AI would soon transform education. Also, in a study by Alghamdi and Alashban[22], who investigated the views of more than 1200 medical students from 32 (out of 39) Saudi Arabian universities, they reported that about 74 % of their participants thought that learning about AI would help them advance in their careers.

Additionally, Al Saad, et al. evaluated the perspectives of 900 Jordanian medical students concerning AI and Machine Learning, revealing that 47 % of the students comprehended the fundamental principles of AI, while 68.4 % asserted that medical students should acquire knowledge about AI. Moreover, a cross-sectional approach that included both quantitative and qualitative investigation by Jebreen *et al.,*[21] and evaluated more than 350 Palestinian undergraduate medical students reported that approximately two-thirds of those students agreed or strongly agreed that AI would become a widespread tool soon expressing hope for the application of AI in medicine and affirming the need to include it in medical curricula. Similarly, Ahmed *et al.,*[23], who used an online questionnaire-based survey to conduct a cross-sectional study on the demographics, knowledge, perception, and use of AI in a population including medical students and physicians, found that 76.7 % of doctors and medical students, supported the inclusion of AI in curricula and that 68.8 % of medical students knew the basics of that technology.

On the other hand, Umer *et al.,*[24] indicated a deficient level of general AI knowledge following a survey of over 350 people. Among undergraduate medical students, house officers, postgraduate residents, and practitioners studying or practicing in Pakistan, just 16 % reported proficiency in the application of AI in medicine; however, the low perception in that study could be explained by the social restrictions being conducted in a conservative country like Pakistan. Also, Wood *et al.,*[25], examined the views of medical students and faculty towards AI and discovered that merely 30 % of students and 50 % of faculty were aware of AI applications in medicine. They ascribed this to the

substantial volume of biomedical and clinical knowledge, which permitted very minimal time and resources for instructing on novel and advanced technologies, such as AI.

This study examined first-year medical students' perceptions of AI and its uses in medical practice. Our findings indicate that more than 80 % of students demonstrated a moderate to good view, with a statistically significant difference ($P < 0.001$) as compared to those with low perception. Over 60 % of students agreed that AI can improve patient outcomes in Egypt. The results corresponded with the findings of Khater *et al.,*[17], who discovered that students exhibited moderate to good understanding and attitudes on AI and its application in medical practice. Moreover, a study conducted by Saad *et al.,*[18] revealed that over 80 % of participants demonstrated a desire to acquire further knowledge on the application of AI in medicine and acknowledged its significance in the medical field. According to Sravani *et al.,*[26], most medical students believed that AI would reduce errors in clinical practice, help physicians make appropriate decisions while diagnosing and treating various diseases and help patients make the best medical decisions. However, one-third of their participants believe AI could damage patient-doctor relationships by undermining confidence. Moreover, a small percentage of participants raised concerns regarding ethical dilemmas, secrecy, empathy and sympathy—all regarded as the cornerstones of medical practice. These concerns were supported by our results, which showed that 40 % of our participants reported concerns regarding AI replacing human doctors.

Similarly, in a cross-sectional study conducted by Jackson *et al.,*[27] approximately half of the participating students perceived that AI may enhance the accuracy of medical decisions, help reduce medical errors and make healthcare more accessible, respondents expressed concerns about AI replacing doctors, medicine becomes less humanistic, breaching professional secrecy, patient-physician relationship and difficulties with trust. According to Umer *et al.,*[24], nearly half of their participants disagreed that AI would surpass doctors in the crucial areas of professionalism. Only 20 % of interviewees thought AI could diagnose problems better than a doctor. About two-thirds voiced apprehensions over complete dependence on AI for decision-making or the ability to recreate the doctor-patient connection. Participants believed that AI would assist with administrative tasks but did not perceive it as a replacement for their roles.

Civaner *et al.,*[28] conducted a cross-sectional multi-center study with over 3000 medical students in Turkey, revealing that the majority considered AI as an assistive tool capable of enhancing physicians' access to information,

improving patient access to healthcare, and minimizing errors. Nonetheless, fifty percent of the participants expressed concern regarding a potential decrease in physicians' services, which may result in unemployment.

On the other hand, Buabbas *et al.,*[15], in their cross-sectional study involving over 350 medical students at Kuwait University, found that the majority of students held a favorable view of AI's role in the future of medicine, with a consensus that AI-based medical practice will be necessary and that AI will not supplant physicians. This could be explained by the increased dependence of their community on technology and its applications, making it acceptable to be a part of their professional life. Similarly, Bisdas *et al.,*[29] performed an international, multi-center survey with over 3000 medical and dentistry students across 63 nations on all continents. The majority of students viewed AI as a collaborator rather than a competitor, believing that advancements in AI will enhance the fields of medicine and dentistry, fostering enthusiasm for its integration into their future practices.

AI tools revolutionize medical education by providing innovative ways to enhance learning and practice. AI-assisted learning management systems, smart boards, chatbots, and virtual assistants facilitate quick access to medical knowledge and support student inquiries. Additionally, AI-based automatic grading systems for assessment and AI-based data analytics help educators track student performance and refine curricula to meet learning objectives effectively. Gamification tools are effective in education, changing learning into an enthusiastic and interactive process. These tools improve skill acquisition and prepare future healthcare professionals for integrating AI into clinical practice[30].

In the current study, the correlation between students' awareness of various AI methods in medical education showed a significant positive correlation with perception towards AI applications in medical education and a non-significant correlation with perception towards AI application in medical practice. This could be explained by the fact that all the proposed AI methods are specific for medical education with no clear role in medical practice. Over 60 % of students identified "Personalized learning platforms" as an AI approach in medical education, exhibiting a statistically significant difference ($P < 0.001$) when compared to interactive smartboards, followed by automated exam grading systems, and finally, gamification tools. This could be explained by the widespread dependence of these students on learning platforms, including learning management systems and chatbots, as sources for their needed scientific knowledge. Despite the widespread use of smart boards in the university, the students have not used them to their maximum potential

with their different applications. Our medicine and surgery bachelor program is adopting electronic exams as an integral part of its assessment strategy, including student coursework and practical and final exams, making automated grading systems the standard way for grading multiple-choice questions. Gamification tools have been infrequently used in some modules, i.e., pharmacology, making them less recognizable by the students. Similarly, Doumat *et al.,*[31] and Rahul *et al.,*[32] noted a substantial deficiency in formal AI education within medical curricula, with the majority of students gaining information from media sources rather than academic programs highlighting the necessity to enhance medical students' awareness of various AI tools applicable to their education.

The limitations of our study included the restriction of our study population to first year medical students limiting the effect of the age of participants. This could be explained by the fact that MNU is a newly established university having only first year medical students at the time of study. Despite this limitation, this study may be the first one in a series of studies evaluating the perception of these students throughout the years of the program considering that they will have two obligatory courses about AI in medicine in their fourth year. The current study would help the program administration in the future planning of these courses. A potential limitation of this study was the variability in students' prior knowledge of AI, which may have influenced their perceptions. Future studies could consider assessing baseline knowledge to better understand its impact on students' attitudes and readiness for AI integration in medical education. Another limitation was the limited knowledge of the study participants about medical practice, making their responses about their perception towards the application of AI in medical practice questionable. However, the questionnaire included general questions about the attitude of study participants towards the role of AI in medical practice without details of such practice.

CONCLUSION

Our students have demonstrated moderate to strong awareness and a willingness to explore AI applications in medicine. Consequently, there is an imperative necessity to incorporate AI-driven educational strategies into medical curricula to adequately prepare future physicians for the changing dynamics of healthcare.

DECLARATIONS
ETHICAL CONSIDERATIONS

The research received approval from the ethical committee of Tanta Faculty of Medicine (code: 36264PR734/6/24). Students willingly engaged in the questionnaire, and their informed consent was secured at the outset of the questionnaire form.

CONFLICTS OF INTEREST

There are no conflicts of interest.

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