Research Article

Artificial Intelligence Literacy among Medical Students: A Cross-Sectional Study of Knowledge, Usage, and Ethical Awareness

Hayder H Bohan[1], BASMA ABDULJABBAR JASIM[2], Nsaif G. Nsaif [3], Nada A. Muneam*[4], Hanaa A. Jassim[3], Mihad Shakir Nsaif [4], Suha A. Muneam[5], Ruqaia Sabbar Salman[6], Asma S. Atteah[4]

[1]Department of Surgery, College of Medicine / Al-Iraqia University/ Baghdad, Iraq.
[2] College of dentistry / Al-Iraqia University/ Baghdad, Iraq.
[3] College of Medicine Al-Iraqia University/ Baghdad, Iraq.
[4]Department of Physiology, Al-Iraqia University/ College of Medicine -Baghdad, Iraq.
[5]Department of Chemistry and Biochemistry, Al-Iraqia University/ College of Medicine -Baghdad, Iraq.
[6]Department of Microbiology, College of Medicine, AL-Iraqia University, Baghdad, Iraq

Abstract

The time of artificial intelligence (AI) is now in training and altering both medical education and healthcare; thus, the demand for a thorough knowledge of how future doctors see and deal with this new technology is increasing. This study was carried out to determine medical students' attitudes, self-reported knowledge, usage patterns, and training needs regarding AI in the context of undergraduate medical education.

A cross-sectional descriptive study was done at the College of Medicine, Al-Iraqia University, with a self-administered questionnaire drawn from a review of current literature being distributed to undergraduate medical students across all academic years. Data were analyzed using SPSS version 29. Descriptive statistics and chi-square tests were applied to explore relationships between variables.

Out of 850 invited students, 199 completed the questionnaire (response rate: 23.5%). Most respondents were female (57.3%), while the mean age was 20.73 years (SD ±1.85). It is worth mentioning that 45.2% of students had a background knowledge of AI, but only 10.1% could deliver a detailed explanation. AI tools were utilized by 89.9% of the participants at least once per month. High interest rates of students in AI-related training topics were recorded mainly in clinical, legal, and educational fields. The ethical concerns raised, such as data bias and unclear legal liability, were also significant.

Even though medical students have shown a remarkable amount of interest and have a moderate familiarity with AI, a considerable evidence-based knowledge gap and absence of training persist. These findings emphasize a requirement for curriculum reform that should cover interdisciplinary, ethical AI education to prepare students for working in technology healthcare environments.

Keywords: Artificial Intelligence, Medical Education, Medical Students, Curriculum Development, Digital Competence, Perception.

Introduction

Healthcare and medical education have witnessed artificial intelligence (AI) emerging as a transformative force that changes how future doctors are trained and patient care is delivered. AI tools like machine learning algorithms, natural language processing, virtual reality simulators, and automated diagnostic devices are utilized to a greater extent in the medical curricula. These technological advances help enhance obstetrician's or gynecologists' diagnostic skills, personalize patient care, and improve their learning experiences by addressing traditional problems like insufficient clinical exposure and the lack of specialist instructors (1, 2, 3). Simulated-based learning is a significant AI technology in medical education that allows students to participate in complicated clinical situations in a secure environment. This technique fosters critical thinking and decision-making abilities. Studies have indicated that AI-simulated learning improves students' diagnostic accuracy and clinical reasoning more than the traditional training methods, i.e., the control groups used for comparison. In addition, these tools deliver the feedback required to provide the effect of time on learning and skill improvement (4, 5). In general, students consider AI an extra driver in their medical education. Research indicates that most students identify AI as a tool that increases the patient's results and the efficiency of clinical work.

However, many of the students are left with a significant gap in their offer of practical knowledge of the application of AI. Many students often mention their discomfort using these tools (6, 7). Despite the positive perceptions among the students, the efficiency of AI integration in education practices is affected by various factors. Ethical governance in the form of data privacy, algorithmic bias, and the possible reduction of human clinical judgment are widespread. Students are also worried about becoming dependent on AI systems and emphasize the importance of learning AI's ethical and legal implications in healthcare.

The institutional barriers include the limited availability of AI technologies, the absence of a standardized curriculum, and the inadequacy of faculty, making teaching AI in the medical training environment complex (8, 9, 10). Experts support the early incorporation of AI education into medical prescribing to ensure students acquire theoretical knowledge and relevant skills. The interdisciplinary course, which focuses on computer science, clinical applications, and ethics, will contribute to bridging the knowledge gaps and help the students become better prepared for a technologically evolving healthcare setting.

Interaction with AI-driven diagnostic platforms and clinical-decision support systems (DSS) has been found to have a significant impact on students' confidence and competency in applying these technologies (11, 12).AI has the enormous capacity to transform the training of medical personnel. Nonetheless, this achievement necessitates the students to know the technology, practice, and ethics. There need to be alterations in the structure of the curricula, and both technical training and ethical discussions should be included to ensure that student doctors can effectively and responsibly

use AI. These practices will result in the coming generation of medical professionals being adept in using technology and able to confront the ethical challenges that arise from using AI in the clinical setting. (13, 14, 15).

Subjects and methods:

Study Design

A descriptive cross-sectional study on medical students' attitudes and practices under artificial intelligence (AI) contributes to medical education design. This study design was appropriate as it allowed the authors to evaluate data at one point and ascertain associations between variables without manipulating the study. A structured questionnaire was used as the primary tool for data collection, which was systematically prepared after an in-depth review of reliable and pertinent literature.

Study Setting and Participants

The research was carried out at the College of Medicine, Al-Iraqia University, with the involvement of undergraduate medical students from first-year to final-year levels to ensure a broad representation of educational stages. The single-center, cross-sectional, questionnaire-based study aimed to evaluate students' knowledge and prior experience related to AI in the medical field. Out of the total respondents, 199 valid responses were included in the analysis. One participant was excluded due to a missing response to the key item evaluating AI knowledge. The mean score for the self-assessed understanding of AI was 3.38 on a 5-point Likert scale, which suggests a moderate level of perceived knowledge. The standard deviation was 0.86, indicating a moderate variability in the responses.

Ethical consideration: This study was conducted using ethical research principles. No formal ethics approval was required, as the study was based on voluntary, anonymous participation with no personal or sensitive data collected.

Statistical Analysis

Questionnaire responses were all entered into IBM SPSS Statistics, v29.0 (IBM Corporation, Armonk, NY, USA) for analysis purposes immediately. The data were found to be summarized by employing Descriptive statistics. Quantitative variables were described as their means and standard deviations (Mean $\pm$ SD). Also, the median was calculated for some variables to facilitate the comparison among the groups.

Traditional thresholds such as < 0.05 (significant), Populations < 0.01 (highly important), and Populations < 0.001 (very highly significant) were used to evaluate the statistical significance.

Results

From the total number of medical students, 199 out of 850 students invited to participate in the survey took part, resulting in a response rate of 23.5%. Of the respondents who answered the question, 114 were girls, and 85 were boys. One questionnaire was removed from the final analysis because it did not meet the inclusion criteria. The participating students had a mean age of 20.73 years, a standard deviation (SD) of ±1.85, and a minimum recorded age of 19 years.

The Figure (1) depicts medical students' self-assessed knowledge of artificial intelligence (AI) technology learned through a five-point

Likert scale. Most students (45.2%) opined that they " understand it." This shows that although they have a basic understanding of AI concepts, they still do not entirely grasp them. Moreover, 31.7% of them provided the response, "I can explain it roughly," which indirectly indicates that they have a moderate grasp of the subject. A mere 10.1% of the participants mentioned that they can "explain it in detail;" thus, their percentage of students with advanced AI literacy is relatively low.
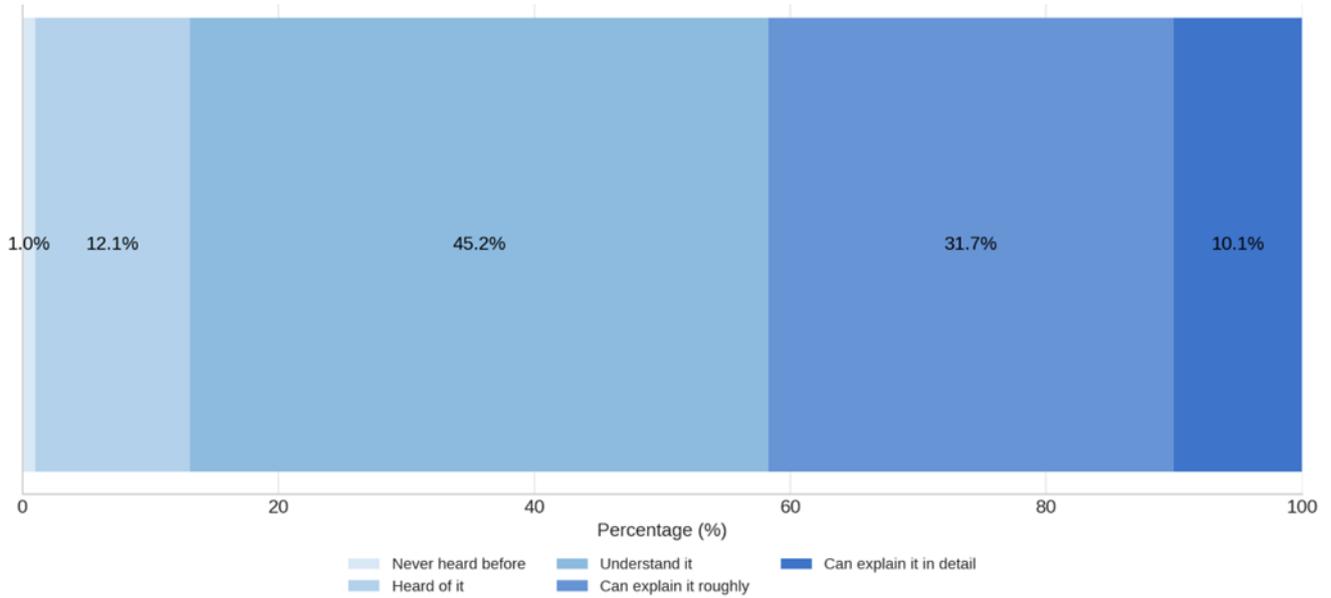

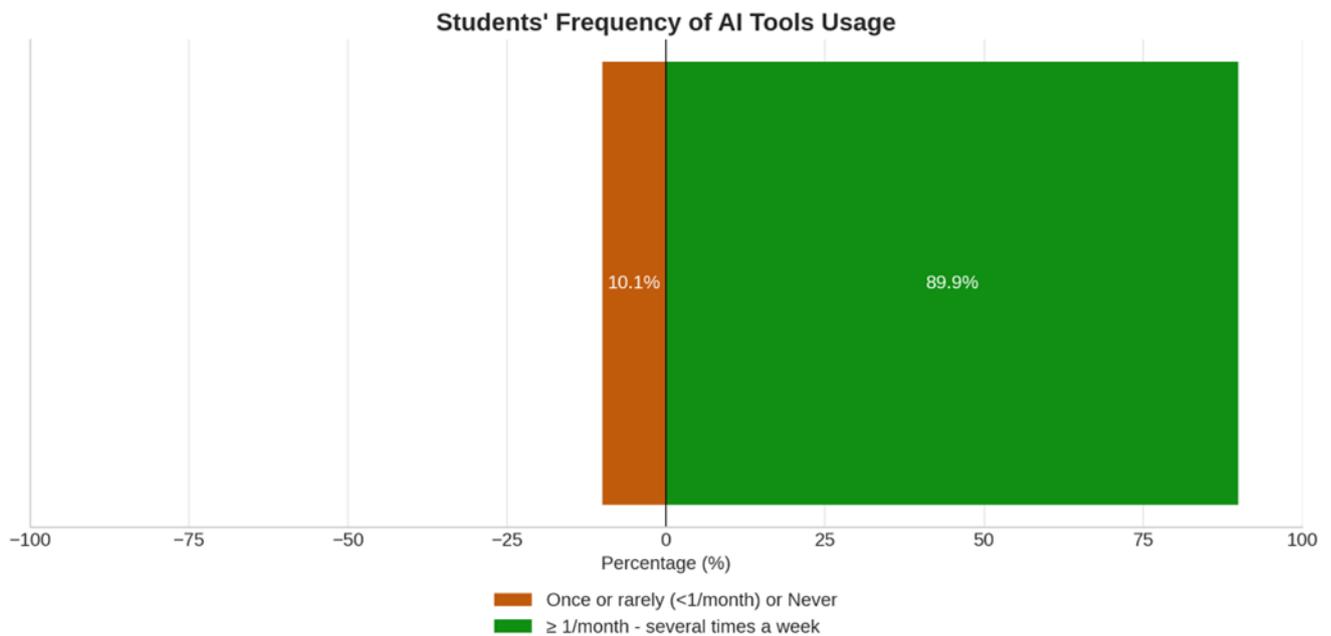**Figure (1) students' knowledge on artificial intelligence (AI) technology**

Figure 2 frequency of AI tool usage

Students' Evaluation of AI Weaknesses

Category	Likert Scale Mean
Data bias	4.1
Complexity of medicine is not reflected	3.7
Liability unclear	3.6
Data security	3.4
Loss of empathy	3.2
Reduction of professional skills	3.0
Reduced patient safety	3.0
Medical staff could become redundant	1.9

Figure 3 the perceived weaknesses of AI.

Students' Evaluation of AI Strengths

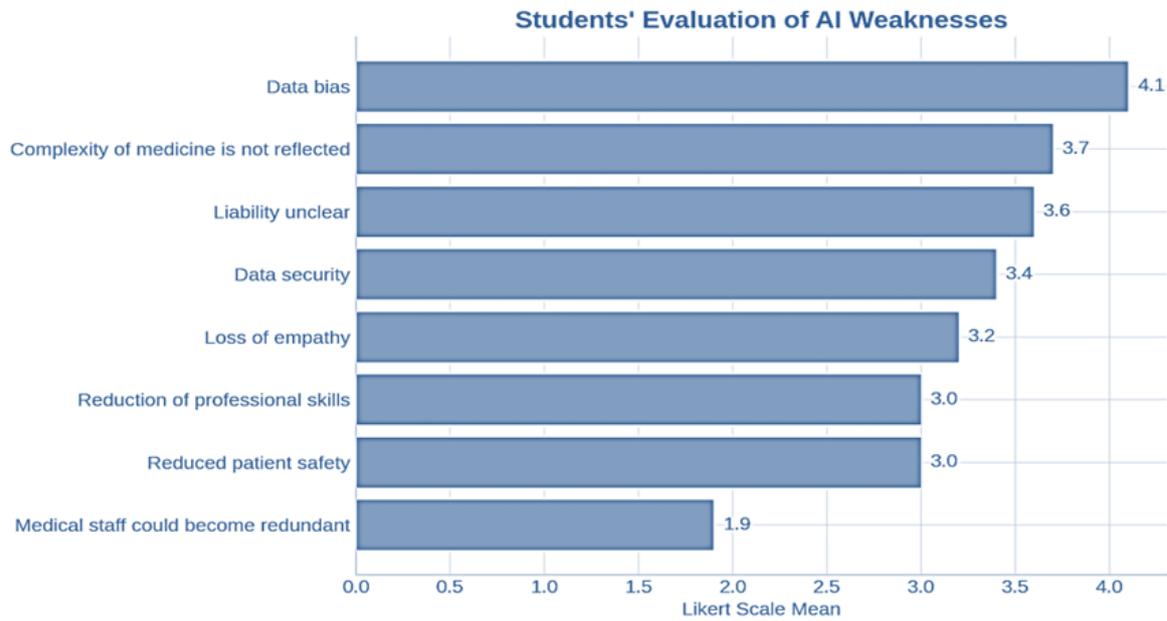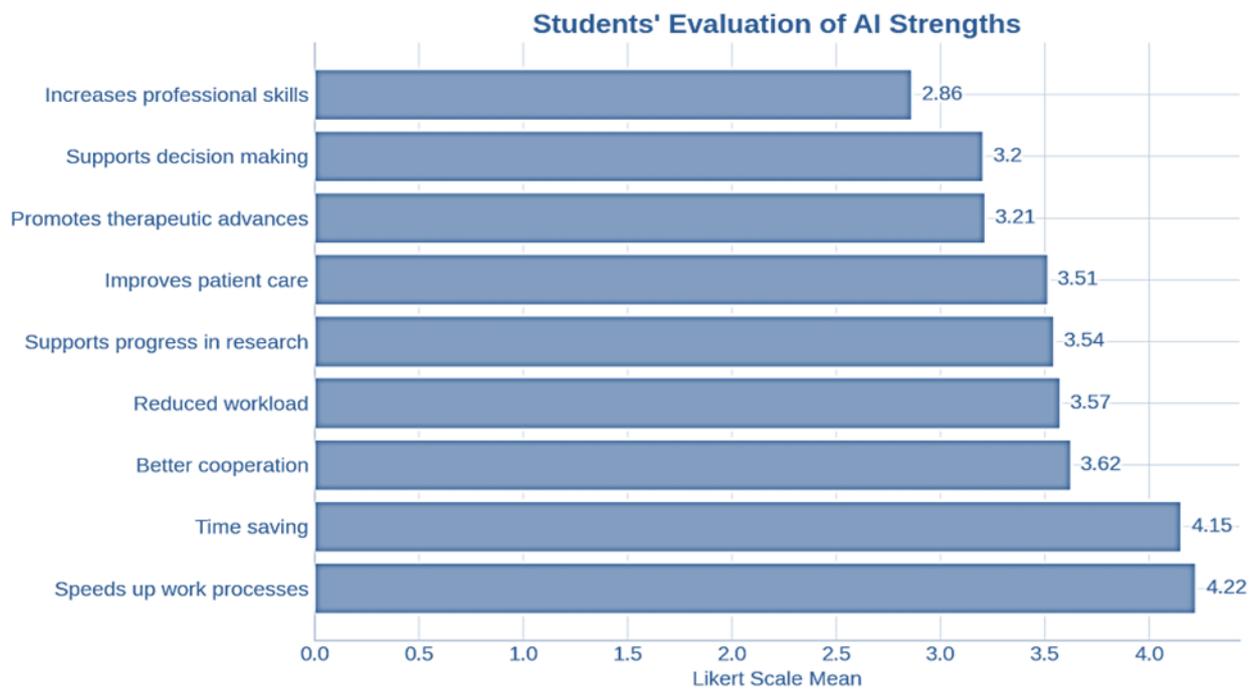| Category	Likert Scale Mean
Increases professional skills	2.86
Supports decision making	3.2
Promotes therapeutic advances	3.21
Improves patient care	3.51
Supports progress in research	3.54
Reduced workload	3.57
Better cooperation	3.62
Time saving	4.15
Speeds up work processes	4.22

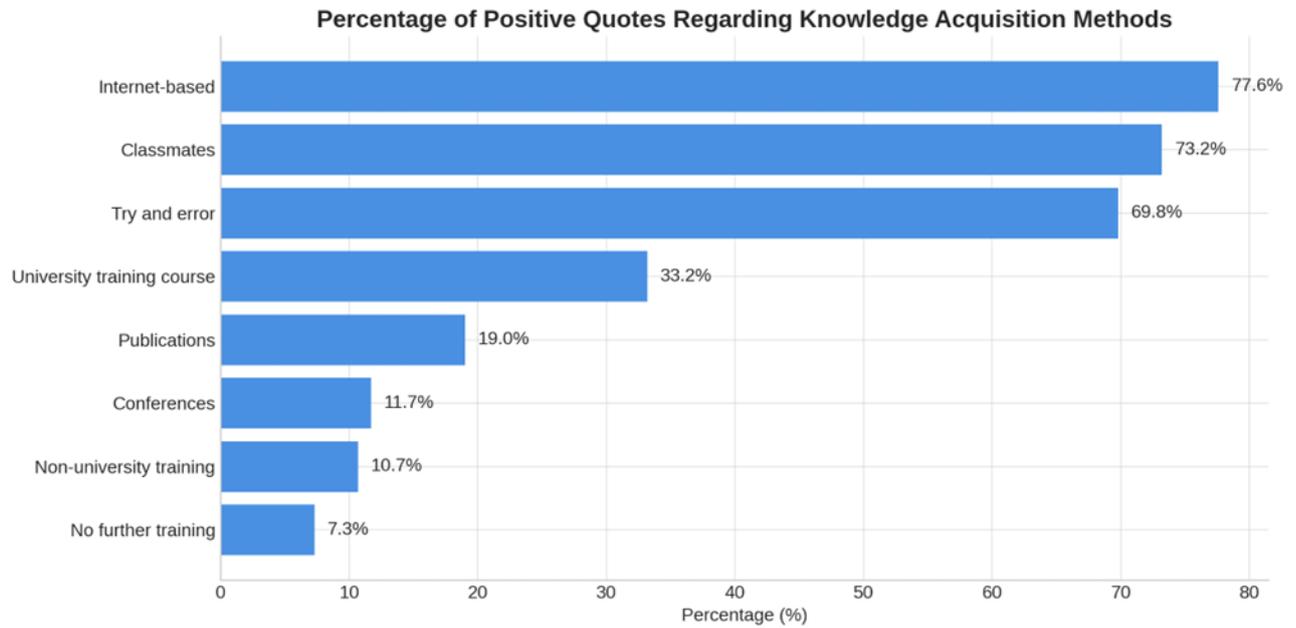**Figure 4 the strengths marked by students.**

Figure 5 percentage of positive quotes regarding knowledge acquisition methods
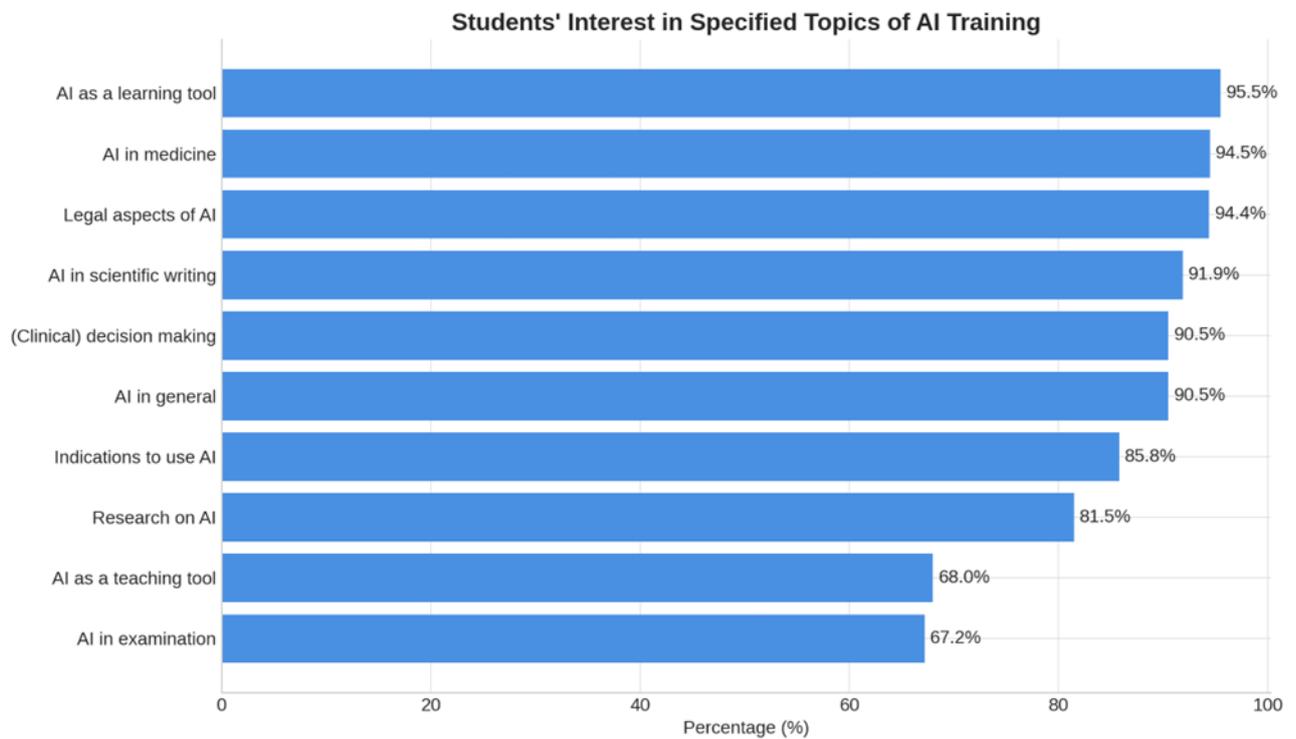

Figure 6 students' interest in specific topics associated with artificial intelligence (AI)

On the other hand, 12.1% only had "heard of it," and as low as 1.0% had "no idea about AI" in the first place. The results reveal that although the general student population knows AI technology, the in-depth know-how is still limited to many students. Hence, it is vital to apply AI-related content in all areas of the medical curriculum as a holistic strategy to prepare medical graduates for theoretical knowledge and practical abilities to become active clinicians using AI technology in healthcare settings.

Figure (2) illustrates the frequency of AI tool usage among medical students. The findings reveal that a vast majority of students (89.9%) reported using AI tools at least once per month, ranging from monthly to several times a week. In contrast, only 10.1% of respondents reported never using such tools or using them less than once a month. This distribution indicates a high level of engagement with AI technologies in academic contexts, reflecting the growing integration of digital tools into students' study routines. The data further suggest that AI is not merely a theoretical concept for these learners but an actively utilized resource in their medical education. These results underscore the importance of institutional support and structured training to optimize students' use of AI and enhance their digital competence in preparation for future clinical practice.

The figures (3-5) illustrate medical students' evaluations of the perceived weaknesses (figure 3) and strengths (figure 4) of artificial intelligence (AI) in the context of healthcare and medical education based on mean values obtained from a 5-point Likert scale. In Figure 3, which illustrates the perceived weaknesses of AI, the biggest issue was data bias, with an average score of 4.1, which indicated that most students were very concerned about the fairness and reliability of AI-generated outputs. The following concerns were the misalignment of AI with the complexity of medicine (3.7) and the fact that the law is unclear about who is liable (3.6), showing that students are critically aware of the ethical and legal issues related to AI application. Another important point was raised about data security (3.4) and loss of empathy (3.2), which present threats to the confidentiality of patients and the humane element of care that may be perceived. Surprisingly, job redundancy among medical staff was the lowest rated at 1.9, implying that students do not consider AI a direct threat to the medical internship job market. Construing the opposite, Figure 4 shows the strengths marked by students' positive assessment of AI, with the main ones given

to fast-track work procedures (4.22) and time-saving (4.15), making clear the high esteem for AI's potential to promote efficiency. The other strong points noted were enhanced teamwork (3.62), less workload (3.57), and the side of supporting research and patient care (3.54 and 3.51, respectively). These findings mainly convey that AI will improve the health process. However, the lowest score was "increased professional skills" (2.86), which may hint that the students are unsure if using AI will cost them their profession without training. The overall perspective of the two sides is that the students know how AI can change the game in the medical field and, simultaneously, the possible hazards in the process. The logic of their evaluations, which are penetrable and splendid, point to the necessity for the training of medical students through the balanced use of AI machines in teaching—this means that instead of just standing out as a great technical solution, AI also has ethical, legal, and human-centered implications which should be tackled.

Figure (6) shows the areas of interest of medical students concerning the topics associated with artificial intelligence (AI) training. Generally, the statistics indicate an unusually high level of interest in various AI-related topics. This means a massive need to formally add AI content to medical education. The most substantial support topic was "AI as a learning tool" (95.5%), which

is the opinion of 95.5% of students. The following two topics were "AI in medicine" (94.5%) and "Legal aspects of AI" (94.4%).

This indicates that students are not only interested in the functional applications of AI but also aware of its regulatory and ethical aspects. Besides, considerable attention was given to "AI in scientific writing" (91.9%), "Clinical decision making" (90.5%), and "AI in general" (90.5%), which proves that the students were cognizant of the AI's growing impact in both academic and clinical settings. Though minor topics such as "Indications to use AI" (85.8%) and "Research on AI" (81.5%) received lower support since they still got quite a huge one. The least picked items, "AI as a teaching tool" (68.0%) and "AI in examination" (67.2%), were also mentioned. Although they were not as popular, they still indicate the importance of the educational value of these two tools for students to learn AI. This outcome is a significant opportunity for the medical curriculum to alter and meet the new generation's expectations. They are also prompted about the need for these AI tools' practical application, ethical understanding, research involvement, and communication.

Discussion

The study presented is a complete presentation of the perceptions, practices, and educational

needs of medicine students on artificial intelligence (AI) in medical education. The findings document the existing state of AI knowledge in future physicians and the barriers to integrating AI technologies into undergraduate curricula. Self-evaluation of artificial intelligence knowledge revealed that even if a general awareness is abundant, a profound comprehension stays limited. Although a slight majority of 45.2% of the students claimed that they "get" AI and a third of them (31.7%) can "explain it roughly," merely 10.1% of them have reported that they could give a detailed explanation. This idea is backed by earlier studies, for example, pointing to the problem of disconnected concepts and practice, that learners understand the value of AI. Still, they have never received it in their formal training or don't feel secure using it in practice or research (16, 17).

The self-assessment of the usage of AI tools has further backed this up. Nearly nine out of ten (89.9%) respondents mentioned using AI tools one or more times a month as they are engaging actively with these technologies. However, practical exposure to this privilege is not the proper competence since informal use (search engines, translation, and chat GPT, e.g.) may not necessarily lead to understanding the AI algorithms or clinical implications (18). Hence, this calls for a more structured and regulated approach to AI literacy in medical training (19).

The evaluation of the students concerning the AI's perceived weaknesses in copying was the root of the problems deeply embedded in clinical ethics and practice. Data bias, lack of transparency in medical complexity representation, and unclear legal liability were rated as the primary concerns, showing students'

awareness of AI's ethical, legal, and humanistic aspects in healthcare (20). Interestingly, the least concerning thing mentioned was "medical staff could become redundant," implying that students see AI not as a substitute device but as a collaborator. This redefined stance seems contrary to what is usually said in public, saying that AI is the reason for the death of medical jobs. However, it presents a mature perspective on the role of AI in assisting (21).

On the other hand, students also had a contented perspective concerning the operational strengths of AI. The most frequently stated advantages were speeding up work processes and time spent, followed by support of cooperation, research, and clinical decision-making. These outcomes suggest a techno-optimistic, which means AI is primarily seen as improving efficiency and cutting back on administrative burdens. Nevertheless, the relatively low score for "increasing professional skills" (2.86) might reflect the recognition of the fact that the development of professional skills cannot be achieved automatically through AI utilization unless managed teaching and feedback mechanisms are invented and executed (17, 22).

Moreover, the study also investigated the digital competence preferences of the students, which included internet-based resources (77.6%), peer collaboration (73.2%), and trial-and-error learning (69.8%) as their preferred forms of knowledge. This experience signifies the growing tendency of informal, self-directed learning to inform students' digital competencies (23). Rtiger Penn (2019) revealed that the low importance given to structured institutional sources like course units (33.2%) and academic cone (11.7%) in digital competence sources addresses a disconnect

between institutional offerings and learners (a concern widely spread in these medical training circles). The modern technological evolution paradigm (24). The impressive high interest shown by students in the wide range of AI topics that extend from "AI as a learning tool" (95.5%), "legal aspects of AI" (94.4%), and "clinical decision-making" (90.5%) marks the cry for a revamped initiative in the curricula. The rejuvenation of the curacy is raised not only by students being aware of AI's part in their future use of technology, intuition, and ethics but by their willing generation of such knowledge in sidereal, clinical, and ethical fields. The most surprising of all is the fact that even the ones with the lesser support, such as "AI in examination" (67.2%), surprisingly enough, all got a lot of backing that suggested (16, 25). Overall, the evidence strongly supports the swift performance of an integrated and systematic approach to AI teaching in medical schools. The curriculum expansion should accommodate the model perception of AI not just in the technical but also in the ethical, legal, and human spheres, hence equipping students to use such tools critically and responsibly. Faculty development, acquisition of resources for AI infrastructure, and partnerships with computer science and bioethics departments are significant steps to confront the current knowledge and practice deficits (26, 27).

Conclusion:

This investigation reveals a significant shift in medical education, as students transition from minimal AI use to active engagement with AI technologies. Despite their strong interest, there is a lack of organized knowledge and formal training.

The demand for comprehensive AI curricula is crucial, addressing not only technical skills but also ethical considerations and critical thinking. Institutions need to enhance interdisciplinary training and faculty readiness to prepare medical students for a future where AI is integral to healthcare.

Recommendation:

- Structured AI Training: Include interdisciplinary AI training that covers concepts, applications, and ethics in the curriculum.
- Faculty Development: Enhance faculty expertise in AI through professional development and collaborations with relevant departments.
- Early Exposure to AI Tools: Integrate AI tools from the beginning, using practical software applications and simulations.
- Focus on Ethics: Teach ethical issues like algorithmic bias and patient data privacy within the curriculum.
- Support Student Initiatives: Fund and encourage student-led AI projects to promote innovation and collaboration.
- Equitable Access: Ensure all students have access to digital resources and AI platforms.
- Regular Evaluation: Continuously assess and improve AI education initiatives with stakeholder feedback.
- Proactive Approach: Foster an ethically grounded strategy to prepare future physicians for digital transformation in he.

Conflict of Interest: Non

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