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ORIGINAL ARTICLE

Artificial Intelligence Use, Perceptions, and Curricular Readiness among Medical Students at the University of Anbar, Iraq

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ABSTRACT

Background: Artificial intelligence (AI) technologies have transformed medical education. Although the use of AI tools is widespread among medical students globally, the formal incorporation of AI into medical curricula remains in its early stages, particularly in resource-constrained settings. This study aimed to assess current utilization patterns, perceptions, and readiness among medical students at the University of Anbar regarding the integration of AI technologies into the medical curriculum and to identify the principal facilitators and barriers to such integration.

Methods: A cross-sectional survey was conducted among medical students at the University of Anbar, Iraq, between April and September 2025. A validated, structured questionnaire comprising 23 items was used to evaluate utilization patterns, educational applications, perceptions, and barriers to integrating AI technologies into the medical curriculum.

Results: Of 346 medical students surveyed, 316 (91.3%) reported using AI technologies, with ChatGPT employed by 86.4% of users. The most frequent applications were studying and concept review (88.3%) and research activities (63.6%). Overall, 65.0% of respondents endorsed the integration of AI into the medical curriculum, and 72.8% affirmed its educational value. The principal barriers identified were technical (47.7%), economic (35.8%), and academic (34.1%). Only 28.3% of students reported faculty encouragement to use AI in medical education.

Conclusion: AI adoption among medical students at the University of Anbar is high and predominantly accompanied by favorable attitudes toward curricular integration. Nevertheless, substantial technical, economic, and institutional barriers persist, indicating that a multilevel implementation strategy is required for sustainable integration.

Key words: Artificial intelligence; Medical education; Curriculum integration; Student perceptions; Digital learning.



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INTRODUCTION

Artificial intelligence (AI) is increasingly reshaping medical education and influencing the preparation of future healthcare professionals [1]. With the growing integration of AI-powered diagnostic and clinical decision-support systems into healthcare practice, medical curricula must evolve to equip graduates with the competencies required for digitally driven clinical environments [2]. The coronavirus disease 2019 (COVID-19) pandemic further accelerated the shift toward digital education, creating new opportunities as well as challenges for the adoption of AI-supported learning technologies [3].

Globally, medical students are increasingly relying on AI platforms such as ChatGPT and Claude for educational activities, including information retrieval, comprehension of complex concepts, and assignment preparation [4, 5]. Nevertheless, uncontrolled or unsupervised use of these technologies may negatively influence learning quality and introduce ethical concerns [6].

In the Middle East and North Africa, modernization of medical education is hindered by financial constraints, unequal technological infrastructure, and continued dependence on conventional teaching approaches [7]. In Iraq, years of conflict and economic instability have further limited technological advancement in higher education institutions [8], despite increasing efforts to shift from traditional education to digital learning in Iraqi higher education [9].

The effective incorporation of AI into medical education depends on multiple factors, including stable internet access, economic resources, institutional culture, and ethical considerations related to academic integrity and clinical application [10–12].

Recent reviews and evidence-based frameworks support phased approaches to AI integration that begin with evaluation of student readiness, institutional preparedness, educational objectives, ethical governance, and implementation challenges [13]. Although competency frameworks combining AI literacy with traditional medical competencies have been developed internationally [14], they require adaptation for resource-limited settings [15].

The College of Medicine, University of Anbar, is located in Ramadi, the capital of Anbar Governorate in western Iraq. It received its first medical students in the 1990–1991 academic year and, in 2025, celebrated the graduation of its thirtieth cohort. During and after the COVID-19 pandemic, the college actively used digital technologies for distance learning, meetings, seminars, workshops, and courses. The college also provided online clinical services to patients in the governorate through clinics delivered by its academic medical staff. Since the emergence of generative AI tools, including ChatGPT, in early 2023, many faculty members and students have used

these technologies, but this use has remained unsystematic. Therefore, the college formed a research team, comprising the authors of this study, to conduct surveys among students, faculty, and other stakeholders regarding the potential use of AI tools in the undergraduate curriculum. Medical students should understand and engage with AI tools, including their advantages, limitations, and major concerns, such as ethical considerations [10–12].

Within this context, the University of Anbar represents an important setting for evaluating AI integration in medical education. Therefore, this study aimed to assess AI utilization, perceptions, facilitators, and barriers related to AI integration among medical students at the university.

MATERIALS AND METHODS

A cross-sectional descriptive study was conducted among medical students at the University of Anbar, Ramadi, between April and September 2025. Ethical approval was obtained from the Ethical Approval Committee of the University of Anbar (Reference number 48; 3 March 2025), and informed consent was obtained electronically before participation.

The study population included medical students enrolled during the 2024–2025 academic year. The sample size was calculated using the single-proportion formula with a 95% confidence level, 5% margin of error, and expected prevalence of 50%, yielding a minimum sample of 384 participants. After adjustment for a projected 50% response rate, 768 students were targeted, and 346 valid responses were obtained. Eligible participants were students who had completed at least one semester and provided consent. Visiting students, students on academic leave, and questionnaires with less than 80% completion were excluded.

A structured questionnaire was developed through literature review and expert consultation [16]. The instrument contained 23 items covering demographics, AI usage, educational applications, perceptions, and barriers. Content validity was confirmed by expert review (content validity index = 0.92), and pilot testing among 20 students demonstrated clarity and feasibility. The survey was distributed electronically via Google Forms through official university communication channels.

Data were analyzed using the IBM SPSS Statistics software package (Statistical Package for the Social Sciences), version 28.0 (IBM Corp., Armonk, NY, USA). Continuous variables were expressed as means \pm standard deviations, while categorical variables were presented as frequencies and percentages. Pearson's chi-square test or Fisher's exact test was used where appropriate, with $P < 0.05$ considered statistically significant. Binary logistic regression was applied to evaluate factors associated with support for curricular AI integration, adjusting for age, sex, and academic stage.

RESULTS

Demographic characteristics

Of the 1,200 enrolled medical students, 346 participated in the study, giving a response rate of 28.8%. Participants were aged 18–28 years, with a mean age of 22.3 ± 2.1 years. There was a slight male predominance, with 176 male students (50.9%) and 170 female students (49.1%). Nearly half of the respondents were sixth-year students (49.7%), whereas only four students (1.2%) were in the third year. Most participants were from Al-Anbar Governorate (79.5%) (Table 1).

Table 1. Demographic characteristics of the participating medical students ($n = 346$).

Characteristic	Value
Age (years)	
Mean \pm SD	22.3 \pm 2.1
Range	18–28
Sex	
Male	176 (50.9)
Female	170 (49.1)
Academic year	
First	25 (7.2)
Second	63 (18.2)
Third	4 (1.2)
Fourth	49 (14.2)
Fifth	33 (9.5)
Sixth	172 (49.7)
Governorate	
Al-Anbar	275 (79.5)
Baghdad	27 (7.8)
Other governorates	44 (12.7)

Data are presented as number (%) unless otherwise indicated.

Patterns of artificial intelligence tool use

Among the 346 respondents, 316 students (91.3%) reported active use of AI tools. ChatGPT was the most frequently used platform, reported by 273 students (86.4% of AI users). Most AI users relied on free versions only (93.0%), and the most common frequency of use was fewer than five times per week (40.5%). Regarding session duration, 61.1% of AI users reported using AI tools for less than 30 minutes per session. The main location of use was home only (50.3%), followed by both home and university (38.0%) (Table 2).

Educational applications and perceived benefits

The most frequently reported educational application of AI tools was studying or reviewing concepts, reported by 279 students (88.3% of AI users), followed by general knowledge and research activities (201 students; 63.6%), assignment

Table 2. Patterns of artificial intelligence (AI) tool use among AI users ($n = 316$).

Usage pattern	n (%)
AI tools used	
ChatGPT	273 (86.4)
Multiple tools	37 (11.7)
DeepSeek	14 (4.4)
Other tools	14 (4.4)
Usage frequency	
< 5 times per week	128 (40.5)
5–10 times per week	88 (27.8)
> 10 times per week	100 (31.6)
Duration per session	
< 30 minutes	193 (61.1)
30–60 minutes	94 (29.7)
> 60 minutes	29 (9.2)
Experience duration	
< 1 year	110 (34.8)
1–2 years	138 (43.7)
> 2 years	68 (21.5)
Access type	
Free versions only	294 (93.0)
Paid subscriptions	22 (7.0)
Usage location	
Home only	159 (50.3)
University only	37 (11.7)
Both home and university	120 (38.0)

Percentages are calculated among students who reported using AI tools.

completion (107 students; 33.9%), essay writing or editing (101 students; 32.0%), discussion of clinical cases (77 students; 24.4%), and examination preparation (68 students; 21.5%). Students generally expressed favorable perceptions toward AI in medical education. Overall, 225 students (65.0%) strongly agreed or agreed that AI should be included in the medical curriculum, and 252 students (72.8%) strongly agreed or agreed that AI tools enhance learning. In addition, 248 students (71.7%) considered AI complementary to traditional teaching methods, and 259 students (74.9%) expressed willingness to learn how to use AI effectively (Table 3).

Comparison with traditional learning methods

When students were asked to compare AI-assisted learning with traditional learning methods, 92 students (26.6%) considered AI-assisted learning more beneficial than traditional methods. However, the largest proportion, 161 students (46.5%), preferred a combined approach that integrates AI with traditional learning. In contrast, 42 students (12.1%) preferred traditional methods alone, and 51 students (14.7%) were undecided.

Table 3. Students' perceptions of AI in medical education ($n = 346$).

Statement	Strongly agree n (%)	Agree n (%)	Neutral n (%)	Disagree n (%)	Strongly disagree n (%)
AI should be included in the curriculum	120 (34.7)	105 (30.3)	80 (23.1)	29 (8.4)	12 (3.5)
AI tools enhance learning	161 (46.5)	91 (26.3)	63 (18.2)	22 (6.4)	9 (2.6)
AI complements traditional teaching methods	130 (37.6)	118 (34.1)	69 (19.9)	20 (5.8)	9 (2.6)
Students are willing to learn how to use AI effectively	183 (52.9)	76 (22.0)	63 (18.2)	15 (4.3)	9 (2.6)

AI, artificial intelligence. Percentages are calculated using the total study sample as the denominator.

Table 4. Barriers to artificial intelligence implementation in medical education as reported by students ($n = 346$).

Barrier category	n (%)	Specific concerns
Technical obstacles	165 (47.7)	Internet connectivity, device access, and platform limitations
Economic obstacles	124 (35.8)	Subscription costs, data charges, and device affordability
Academic obstacles	118 (34.1)	Lack of guidance, unclear curriculum integration, and assessment concerns
Organizational/administrative obstacles	101 (29.2)	Policy uncertainty, limited institutional support, and infrastructure limitations
Cultural/social obstacles	89 (25.7)	Acceptance, preference for traditional methods, and peer attitudes
Ethical/legal obstacles	63 (18.2)	Plagiarism concerns, data privacy, and professional standards
Logistical obstacles	54 (15.6)	Time constraints, training needs, and resource allocation

Percentages are calculated using the total study sample as the denominator.

Barriers to AI implementation

The most frequently reported barrier to implementing AI in medical education was technical difficulty, reported by 165 students (47.7%). Economic barriers were reported by 124 students (35.8%), followed by academic barriers in 118 students (34.1%), organizational or administrative barriers in 101 students (29.2%), cultural or social barriers in 89 students (25.7%), ethical or legal barriers in 63 students (18.2%), and logistical barriers in 54 students (15.6%) (Table 4).

Concerns regarding the use of AI in medical education

The most frequently reported concern was the accuracy of AI-generated information, reported by 232 students (67.1%). Other major concerns included the potential displacement of critical thinking by AI (212 students; 61.3%), ethical issues including plagiarism (156 students; 45.1%), reduced interaction with teachers (134 students; 38.7%), and substitution of clinical judgment by AI (79 students; 22.8%).

Faculty support and readiness

Only 98 students (28.3%) reported receiving positive encouragement from faculty members to use AI tools in medical education. In contrast, 185 students (53.5%) reported receiving no encouragement, and 63 students (18.2%) reported mixed messages. Faculty encouragement was significantly associated with student attitudes toward curricular AI integration ($\chi^2 = 17.52$, $df = 4$, $P = 0.002$). Students who reported positive faculty encouragement had the highest level of support for

curricular AI integration (81.6%) (Table 5).

Future perspectives

Regarding the future role of AI in medical education, 157 students (45.4%) supported full curricular integration, 161 students (46.5%) favored AI as a supplementary educational tool, and 28 students (8.1%) opposed integration. When asked whether AI could replace traditional teaching methods, 38 students (11.0%) considered full replacement plausible, 243 students (70.2%) supported replacement only for selected functions, and 65 students (18.8%) opposed any replacement of human roles.

Academic phase and sex differences

Patterns of AI use and attitudes differed across student groups. Support for curricular AI integration was significantly higher among preclinical students than among clinical students (72/92 [78.3%] vs. 153/254 [60.2%]; $\chi^2 = 8.87$, $df = 1$, $P = 0.003$). AI usage frequency also differed significantly by sex ($P = 0.027$) and academic phase ($P = 0.001$), whereas overall AI use and perceived educational benefit did not differ significantly by either sex or academic phase (Table 6).

Table 5. Association between faculty encouragement of artificial intelligence (AI) use and student attitudes toward curricular integration ($n = 346$).

Faculty encouragement	Support AI integration n (%)	Neutral n (%)	Oppose AI integration n (%)
Positive encouragement ($n = 98$)	80 (81.6)	13 (13.3)	5 (5.1)
No encouragement ($n = 185$)	110 (59.5)	50 (27.0)	25 (13.5)
Mixed messages ($n = 63$)	35 (55.6)	17 (27.0)	11 (17.5)
Total	225 (65.0)	80 (23.1)	41 (11.9)

Note: Pearson's chi-square test assessed the overall association. Logistic regression showed that students reporting positive faculty encouragement were more likely to support curricular AI integration than those reporting no/mixed encouragement (crude OR = 3.16, 95% CI: 1.78–5.58; $P = 0.0001$). After adjustment for sex, academic phase, and age, the association remained significant (adjusted OR = 2.83, 95% CI: 1.62–4.94; $P < 0.001$).

Table 6. AI usage patterns stratified by sex and academic phase.

Variable	Group 1	Group 2	P-value
A. Stratification by sex			
	Male ($n = 176$)	Female ($n = 170$)	
AI usage			0.292
Yes	164 (93.2)	152 (89.4)	
No	12 (6.8)	18 (10.6)	
Usage frequency among AI users	Male users ($n = 164$)	Female users ($n = 152$)	0.027
< 5 times/week	60 (36.6)	68 (44.7)	
5–10 times/week	41 (25.0)	47 (30.9)	
> 10 times/week	63 (38.4)	37 (24.3)	
Perceived educational benefit among AI users	Male users ($n = 164$)	Female users ($n = 152$)	0.706
Strongly agree/agree	127 (77.4)	114 (75.0)	
Support for curricular AI integration	Male ($n = 176$)	Female ($n = 170$)	0.512
Strongly agree/agree	117 (66.5)	108 (63.5)	
B. Stratification by academic phase			
	Preclinical ($n = 92$)	Clinical ($n = 254$)	
AI usage			0.837
Yes	85 (92.4)	231 (90.9)	
No	7 (7.6)	23 (9.1)	
Usage frequency among AI users	Preclinical users ($n = 85$)	Clinical users ($n = 231$)	0.001
< 5 times/week	52 (61.2)	76 (32.9)	
5–10 times/week	18 (21.2)	70 (30.3)	
> 10 times/week	15 (17.6)	85 (36.8)	
Perceived educational benefit among AI users	Preclinical users ($n = 85$)	Clinical users ($n = 231$)	0.768
Strongly agree/agree	66 (77.6)	175 (75.8)	
Support for curricular AI integration	Preclinical ($n = 92$)	Clinical ($n = 254$)	0.003
Strongly agree/agree	72 (78.3)	153 (60.2)	

AI, artificial intelligence. Preclinical = years 1–3; Clinical = years 4–6. Percentages for usage frequency and perceived educational benefit were calculated among AI users within each stratum; percentages for AI usage and support for curricular integration were calculated among all students within each stratum. Pearson's chi-square test was used, except for AI usage by sex and academic phase, for which Fisher's exact test was used.

DISCUSSION

This cross-sectional survey provides insight into the utilization and perceptions of AI among medical students at a single Iraqi institution operating in a challenging context. The high self-reported AI usage rate (91.3%) appears higher than figures reported in several comparable studies among healthcare and medical students, including regional and resource-constrained settings [17], suggesting that students are relatively resourceful in accessing AI tools despite infrastructural constraints. Because the design was cross-sectional and based on self-report, the findings describe current patterns

of use and opinion rather than causal effects on clinical skills, diagnostic performance, or learning outcomes.

The predominance of ChatGPT (86.4% of users) is consistent with international reports and reflects the platform's accessibility and general-purpose utility [18]. However, this reliance on a single tool may indicate limited exposure to the broader medical-AI landscape, which is a relevant consideration for AI literacy [19]. The low uptake of specialized medical AI tools may reflect a combination of restricted awareness and constrained infrastructural access.

The findings also indicate pragmatic engagement with AI

tools: most students (93.0%) used free versions, primarily from home (50.3%) or from both home and the university (38.0%), highlighting institutional infrastructure gaps that students appear to circumvent independently. Short session durations (< 30 minutes for 61.1% of users) suggest task-focused rather than sustained use.

The distribution of educational applications, predominantly studying concepts (88.3%) and research (63.6%), indicates a learning-oriented use pattern. Notably, the relatively low use of AI for discussion of clinical cases (24.4%) suggests an underutilized opportunity to develop clinical reasoning, an area in which AI-supported case discussions have shown promise in other settings [20].

Student attitudes toward AI adoption were largely favorable, with 65.0% supporting curricular integration and 72.8% endorsing its educational value. This level of support is comparable to, and in some categories higher than, ranges reported in European studies (approximately 50%–60%), although direct comparison must be cautious given differences in study design and context [12]. The willingness to develop AI skills (74.9%) is also noteworthy. The barriers identified are multifactorial: while technical barriers (47.7%) predominate, the salience of economic (35.8%) and academic (34.1%) barriers indicates that infrastructural investment alone is unlikely to be sufficient for successful integration [21]. The low rate of faculty encouragement (28.3%) is of particular concern, given the potential role of faculty engagement and institutional support in the adoption of educational technologies [22]. Ethical concerns expressed by students (18.2%), although modest in frequency, warrant attention and can be addressed through institutional policies and AI-specific academic-integrity frameworks [12].

The higher proportion of preclinical students (78.3%) supporting integration compared with clinical students (60.2%) merits further investigation. Differences in pedagogical needs between preclinical and clinical training may partly explain this pattern, although the limited number of students in some preclinical years warrants cautious interpretation [23].

Several limitations should be acknowledged. First, the response rate of 28.8% raises the possibility of selection bias if respondents differed systematically from non-respondents. Second, the cross-sectional design precludes causal inference regarding the impact of AI use on learning outcomes. Third, the single-institution setting limits generalizability. Fourth, reliance on self-report introduces recall and social-desirability bias. Fifth, the quantitative design does not capture the deeper contextual and motivational factors that qualitative inquiry could elucidate.

The findings support a phased approach to AI integration that incorporates faculty development, enhancement of infrastructure (internet connectivity and computing facilities), AI-literacy training, development of usage guidelines, and

pilot courses. Although student adoption is high, mitigation of the identified barriers will be essential for sustainable and equitable integration.

These findings may be of interest to other universities operating in resource-constrained settings. Despite infrastructural limitations, student adoption of AI is high, and the preference of 46.5% of respondents for AI as a complementary rather than a replacement tool is congruent with prevailing international guidance on the role of AI in augmenting, rather than substituting, human instruction [24].

This study may guide further research on AI integration in medical education, including comparative effectiveness studies of AI-assisted versus traditional instruction, the development of AI competency frameworks, optimal models for curricular integration, faculty perspectives, and the cost-effectiveness of alternative implementation approaches.

CONCLUSION

Medical students at the University of Anbar demonstrated a high rate of AI adoption (91.3%) and substantial support for curricular integration (65.0%). Notwithstanding this favorable orientation, substantial technical (47.7%) and economic (35.8%) barriers persist, together with limited faculty encouragement (28.3%). Students' preference for AI as a complementary tool, rather than a replacement for traditional instruction, indicates a nuanced appreciation of its role in learning. These findings may inform planning for AI integration in similar resource-constrained institutions, while recognizing that context-specific evaluation remains essential.

ETHICAL DECLARATIONS

• Ethics Approval and Consent to Participate

Ethical approval was obtained from the Ethical Approval Committee of the University of Anbar (Reference number 48; 3 March 2025). Electronic informed consent was obtained from all participants before participation.

• Consent for Publication

Not applicable.

• Availability of Data and Material

The datasets generated and analyzed during the current study are available from the corresponding author upon reasonable request, in accordance with applicable institutional and ethical regulations.

• Competing Interests

The authors declare that they have no competing interests, financial or otherwise, that could be perceived as influencing the work reported in this manuscript.

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• Use of Generative Artificial Intelligence

Generative AI tools were not used to draft the scientific content, conduct the analyses, or generate the data of this study. AI assistance was limited to language editing of selected sentences for grammar and readability; all content was reviewed and verified by the authors, who assume full responsibility for the integrity of the manuscript.

• Authors' Contributions

R.M.A. conceived and designed the study and drafted the manuscript. M.A.K. and A.K.A. contributed to questionnaire development, data collection, and data interpretation. W.N.J. performed the statistical analyses and contributed to results interpretation. T.A.K. supervised the project, critically revised the manuscript, and approved the final version. All authors read and approved the final manuscript.

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