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Article

Evaluation of attitudes, uses and perceptions of Artificial Intelligence tools among students of the Faculty of Medicine and Pharmacy of Rabat using the MAIRS-MS scale

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Abstract: Artificial Intelligence (AI) is becoming a transformative change in the medical and health care disciplines, in improving learning, decision-making, and clinical training. The study examines AI perceptions, attitudes, and uses and readiness with the aid of the MAIRS-MS scale among medical and pharmacy students. This was cross-sectional quantitative research carried out among a sample size of 245 medical and pharmacy students in faculty of medicine and pharmacy, Rabat, Morocco, which employed stratified sampling. The data was gathered using online questionnaires that were structured and included the validated MAIRS-MS scale which had been translated to and culturally adapted into Classical Arabic. The tool evaluated the sociodemographic, AI use, attitudes, and preparedness. Validity and reliability were ensured with the help of expert review and pilot testing. Data analysis was done using SPSS statistical test followed by descriptive statistics. Informed consent and ethical approval were novel. Out of 245 students, females (53.5%) were a little more than males (46.5%), with 59.2% of pre-clinical and a mean age of 20.89 / 2.16 years being displayed. The usage of the AI was high and was 83.5% attributed to 1 or more hours per week and 41.7% to daily usage. The cognitive scores were 26.40 + 3.55 and positive understanding was found. Satisfaction was high (8.1 ± 1.3). The results confirm the importance of incorporating organized AI education into medical courses with the goal of developing competencies, which are responsible and efficient in further healthcare practice.
Keywords: Artificial intelligence; AI; medical education; medical students; MAIRS-MS scale.

1. Introduction

Artificial intelligence (AI) is a concept that has gained central role in higher education that fundamentally alters the way teaching, learning, and academic support of various disciplines [1, 2]. Individualization of learning experience, adaptation of instructional content to the individual needs, and real-time feedback with the help of AI technologies contribute to better engagement of the students [3] [39]. The AI in education market is expected to surpass USD 20 billion in the global market by 2027 as adoption rates and institutional investment in AI are rising [4]. The AI-based intelligent teaching systems and adaptive platforms may modify speed and complexity of learning resources, medical learning progressions based on mastery in undergraduate and graduate courses [5]. Also, AI simplifies administrative processes of medical education and helps with various research activities like literature reviews and allows an educator to devote more attention to innovative teaching instead of administrative duties [6]. In medical and health sciences education, the role of AI is also highly vast with a fast-growing and developing sphere [7] [40]. Virtual patient simulation, automating assessment, predicting learner outcomes are done by machine learning, natural language processing, to create personalized educational experiences to support both foundational and clinical learning

[8]. Collectively, these tendencies demonstrate the transformative nature of AI in medical education and highlight the need to equip students to learn how to interact with AI tools.

The attitude and perceptions of students on artificial intelligence (AI), is vital to its effective incorporation in the medical education process [9]. The perceived usefulness, perceived simplicity, and exposure to digital technologies are the main factors that drive the acceptance and adoption of AI by medical students, which has been defined by the Technology Acceptance Model [10]. Research shows that among students with a positive attitude to the adoption of AI, the recognition of its potential to improve diagnostic accuracy, clinical decision-making, or personalized learning exists [11][38]. Nevertheless, ethical, professional and social issues such as data privacy, bias in algorithms, academic integrity, and the influence AI have on the doctor patient relationship are also of critical concern [12]. AI preparedness in medical education is the cognitive knowledge, technical skill, and moral consciousness of medical training students about the application of AI in healthcare [13]. An introduction to the concepts of AI in the undergraduate medical education is a factor that can significantly enhance the readiness and confidence of students in applying AI-powered technologies to clinical practice [14]. Validated scales are also necessary to determine readiness, as is measuring it using validated instruments like the Medical Artificial Intelligence Readiness Scale among Medical Students (MAIRS-MS) [15]. An assessment can assure future healthcare professionals that they able to implement AI ethically and safely, and that patient care improved according to the dynamic nature of digital medicine.

Medical Artificial Intelligence Readiness Scale of Medical Students (MAIRS-MS) consists of a validated tool created to measure medical students to their understanding of the integration of (AI) in healthcare and medical education [15]. The scale offers a broad outline of AI preparedness based on four fundamental parameters namely cognitive, ability, visionary, and ethical preparedness [7]. The cognitive domain checks how knowledge and understanding of AI concepts and applications in medicine among students are presented, and the capability one determines their competence and confidence in working with AI-based technologies [16]. The visionary dimension considers the way students viewed AI in the future of the healthcare system and medical practice, whereas the ethical dimension reviews the knowledge of ethical, legal, and professional aspects of using AI [17]. The MAIRS-MS scale has been proven to have a high level of psychometric, reliability and construct validity of the scale and therefore, it can be effectively utilized in educational and clinical studies [18]. Research relevant as it allows measuring the readiness of students to work with AI-driven innovations in a systematic manner and sees any gaps in AI-related competencies and informs the curriculum development [19]. MAIRS-MS lends itself to evidence-driven AI implementation in medical education and is consistent with the worldwide trends of increasing digital literacy and technological capabilities of receiving medical practitioners [15].

Although the application of artificial intelligence in the medical educational field has become more integrated, a number of gaps and constraints are still clear in research conducted. The available empirical data cover AI preparedness among medical students of developing nations, specifically in North Africa but it does not provide a broad context [20]. Most research uses technological performance as the central criterion, but does not consider the attitude of the students, their perceptions, and their ethical implication of adopting AI [41]. Regional studies also have the disadvantage of not having standardized and validated assessment tools, which reduces the comparability and reliability of the findings in different educational contexts [21]. Also, the majority of the studies use cross sectional designs, and thus are limited in their ability to cause and effect, as the designs lack shifts in AI readiness and pattern of usage with time. Lastly, access and exposure to AI technologies and curriculum differences can affect the readiness of students and hence poor results in different institutions [22]. These shortcomings demonstrate the necessity of detailed context-specific research that would help to improve comprehension of AI integration in medical education. This study fills these gaps by using a proven scale in a Moroccan setting, which will yield quality, region-specific data on the subject of AI preparedness.

The study is an innovative contribution on medical education, as it represents one of the first attempts to apply MAIRS-MS instrument to evaluate attitudes, readiness, and use of (AI) in medical and pharmacy students in Morocco. In contrast to earlier works that mainly consider technological acceptance or specific elements of AI adoption, in this study the multi-dimensional methodology is used that considers cognitive, capability, visionary, and ethical preparedness at the same time. The study is especially innovative that its cultural and linguistic translation of the MAIRS-MS scale in Classical Arabic and a methodological soundness in the Moroccan academic environment. Moreover, the study can provide substantial references of how AI can be practically integrated into medical education. The study evaluates the patterns of AI use, along with attitudes and perceived usefulness among medical and pharmacy students through the validated MAIRS-MS scale. The study assesses the preparedness of students and the educational requirements of incorporating AI in the field of medicine and training programs.

2. Methodology

Study Design

The research design is cross-sectional observational research designed with a quantitative descriptive and analytical research design to assess the attitude, use, and perceptions of artificial intelligence (AI) tools by students. The cross-sectional research design allowed gathering data at one moment and thus gives a full picture regarding the extent to which students utilize the AI technologies in medical school education. This was a suitable design that was used to establish trends, relationships, and changes in AI preparedness and utilization without controlling variables. The use of the proven MAIRS-MS scale made the study reliable in measuring the readiness of students to integrate AI into their work, which could be of great value when it comes to updating the role of AI in medical training and education.

Study Setting

It was carried out at the faculty of medicine and pharmacy, one of the topmost establishments of higher learning in Rabat, Morocco, before professionals of medicine and pharmacy were assigned this important work. This educational institution has all-inclusive programs on pre-clinical and clinical stages. The information was collected in the course of the academic year among students successfully attending these programs. The heterogeneous population of students in the institution and the organized course of study offered suitable climate to evaluate the concepts of attitude, and use of AI tools in medical education.

Study population and framework

This study was carried out in the Faculty of Medicine and Pharmacy in Rabat, Morocco. The sample population involved all the students who attended the medical and pharmacy courses on a regular basis during the period of the data collection, both in the pre-clinical and the clinical stages. This system was very effective in terms of having representatives of students in various levels of academic training. Students who declined participation or completed invalid or incomplete questionnaires were left out of the final analysis to ensure the accuracy and reliability of study results.

Inclusion and Exclusion Criteria

Table 1: Inclusion and Exclusion Criteria

Inclusion Criteria	Exclusion Criteria
Medical or pharmacy students enrolled at the Faculty of Medicine and Pharmacy in Rabat	Students who refused to provide informed consent
Aged 18 years or older at the time of data collection	Students younger than 18 years
Enrolled in either the pre-clinical or clinical phase of study	Students not enrolled in the Faculty of Medicine and Pharmacy in Rabat during the study period
Provided written or electronic informed consent to participate	Submission of incomplete questionnaires
Able to understand and respond to the questionnaire in Classical Arabic	Submission of invalid, inconsistent, or duplicate responses
Regularly attending academic courses during the data collection period	Students on academic leave, exchange programs, or internship outside the institution during data collection
Willing to voluntarily participate without coercion or incentives	Withdrawal from the study after initial consent

Access to electronic devices and internet connection required to complete the online questionnaire	Technical issues preventing completion of the questionnaire
Participation limited tone response per student to ensure data integrity	Multiple submissions from the same participant

Sample Size and Sampling Technique

A sample size of 384 people was obtained by computing the minimum sample size with a 95% level of confidence, a margin of error of 5% and an estimated proportion of 50%. A sample size of 343 was calculated after finite population correction to an estimated student population of about 5,400 students. The stratified proportional sampling method has been used where both medical and pharmacy students have been sufficiently represented. Stratified proportional sampling was pragmatically applied by distributing participants based on subgroup figures and the final sample was roughly representative of medical and pharmacy students. The method maintained sub-group comparability as well as balanced inclusion although the sample size was reduced. The sample was sorted into two groups where the percentages of 199 medical students and 46 pharmacy students were divided. Feasibility factors such as limited access to potential participants and lack of time led to the selection of 245 participants in the final sample. The minimal size needed was 384, though time and access to participants led to the final sample size of 245 respondents. Such reduction could have influenced statistical power and slightly reduced representativeness but proportional stratified sampling was used to maintain subgroup balance. Precisely, the participants were sampled based on their relative fractions in the population, both medical and pharmacy students were represented. Ratios These proportions were highly represented in the final sample, which allowed subgroup comparisons. The 100% response rate also minimized the non-response bias, which partly offset the effects of the smaller sample on the study validity.

Instrument Translation and Cultural Adaptation

In the study, a stringent instrument translation and cultural adaptation of Medical Artificial Intelligence Readiness Scale (MAIRS-MS) to suit the Moroccan environment was done. Classical Arabic version of the scale was a translation of the original English language version of the scale using internationally established standards of cross-cultural adaptability of measurement tools. This involved the use of forward translation through bilingual specialists, expert panel review and back-translation on the purpose of establishing linguistic/semantic equivalency. The adapted version was accessed in terms of understandability and comprehensibility as well as suitability in the local educational context. This was done methodically to make sure that the translated instrument had retained the validity and reliability of the original scale and had a good representation of the linguistic of a Moroccan medical student.

Validity and Reliability of the Instrument

Methodological rigor was addressed by ensuring the reliability and validity of the translated questionnaire was well evaluated. Medical Education and Research Methodology Judges validated the content of the instrument with experts in medical education and research methodology reviewing the relevance, coherence, and relevance of the instrument. Classical Arabic version was also analyzed by scientists of both languages to assure linguistic sanity and semantic perfection. An initial pilot sample of 30 students was selected to test their comprehension, suitability of items and cultural fit of the items to Moroccan context. The pre-test feedback was taken into consideration to fine-tune the instrument and then administer.

Data Collection Tool

A structured self-administered electronic questionnaire was created to evaluate how, whether, and especially how ready students were with AI applications in medical school studies. Accessibility and participation of the questionnaire were made possible by distributing the questionnaire online. The obtained responses were exported and analyzed by the use of SPSS software. The questionnaire was divided into four major parts to make sure that all the relevant variables were properly assessed.

The initial section captured the sociodemographic data, such as age, gender and level of education (pre-clinical or clinical). The second part covered trends in AI, including frequency of usage, amount of time one spends walking around with the AI tools, and intention to spend on advanced AI capabilities. The third part tested attitudes and perceived AI use via the items assessing them on a Likert scale to a five-point size with the strongest disagreement or agreement measures. They were concerned with academic, professional, linguistic and informational uses, ethical and social issues of AI.

The fourth part evaluated the AI preparedness of students involving carefully assessed MAIRS-MS scale. This tool evaluates four aspects: cognitive, capability, visionary and ethical aspects. Answers were logged on a five-point Likert scale on the basis of the instructions in the original instruments. Data were gathered within a set period of time and the subjects were made aware of the purpose of the study, confidentiality and voluntary involvement before the completion of the research.

Statistical Analysis

All the data collected were uniformly coded and analyzed using the Statistical Package for the Social Sciences (SPSS) software so that the data could be subjected to absolute and accurate statistical processing. Characteristics of participants and the variables of the study were summarized using descriptive statistics. Central tendency and dispersion took the form of means and standard deviations for quantitative variable and frequencies and percentages taken the form of a table and a graph respectively. Any p-value lower than $p < 0.05$ was taken to be statistically significant in all comparisons.

Ethical Considerations

The research was done with full adherence to acceptable ethical guidelines on conducting research with human subjects. Informed consent had been acquired among all the respondents before data was collected, by giving clear information about the objectives of the study, procedures and voluntary nature thereof. Participation was purely optional and the students were made aware of their right to withdraw at any point without any repercussions. All the responses were anonymous and no personal information that could be used to identify the respondent was asked. Data were held in secure areas and could only be accessed in the course of research. The relevant authorities of the Faculty of Medicine and Pharmacy of Rabat granted its ethical approval in the framework of the approved protocol.

3. Results

Sociodemographic Analysis

Sociodemographic analysis involved 245 people enrolled at the Faculty of Medicine and Pharmacy at the University of Rabat as an important sample to analyze descriptively. Females were 131 students (53.5%), whereas males consisted of 114 students (46.5%), which means that the female participation was slightly higher. In terms of the academic level, 145 students (59.2%) comprised the pre-clinical level, whereas 100 (40.8) students were in the clinical level. The result of this distribution is that the proportion of early-stage students more represented. The relatively equal gender balance and the presence of both training stages increase the sample representativeness to assess AI-related attitudes among the faculty (see Table 2).

Table 2. Sociodemographic characteristics of participants (n = 245)

Variable	Category	n (%) / Mean ± ET
Sex	Women	131 (53.5%)
	Man	114 (46.5%)
Training stage	Pre-clinical	145 (59.2%)
	Clinical	100 (40.8%)
Age (years)	—	20.89 ± 2.16

Age distribution of participating students

The average age of the participants was 20.89 years old with the standard deviation of 2.16 indicating a highly young academic population. The histogram indicates that there is a normal age distribution with majority of students aging between 19 and 23 years with an age center being of 21 years. The participants were mostly a young academic group of participants, and in this case the majority of the participants were concentrated in the shallow age group that is characteristic of a medical early training. The distribution was found to be around the normal distribution meaning that it was consistent amongst the sample. The age distribution is in line with anticipated enrolment trends in pre-clinical and early stages of medical and pharmacy education (Figure 1).

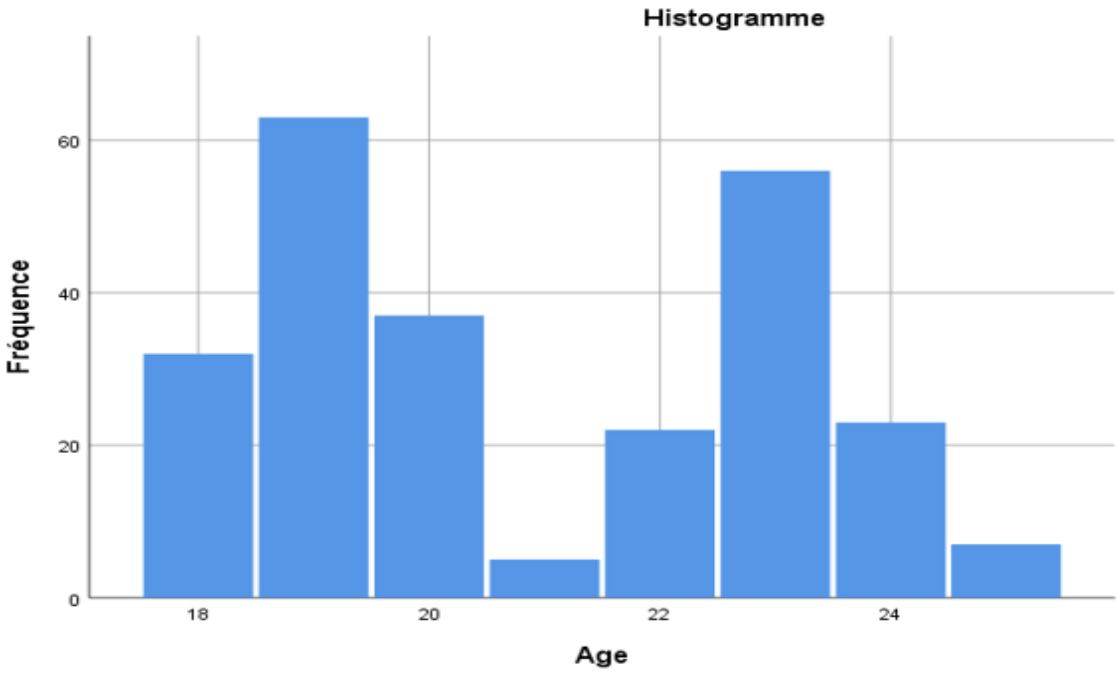

Figure 1. Histogram of the age distribution of participating students

Patterns of AI use among medical students

The pattern analysis of AI use of the 245 students shows that a significant percentage of students are using artificial intelligence tools. In terms of the time spent using AI per week, 74 students (32.2%) spent 1-3 hours, 66 (28.7%) spent 4-6 hours, and 52 (22.6%) more than 6 hours to use AI per week (Table 3). A small percentage of students (38 out of 530) identified themselves with less than 1 hour of use only (16.5%), suggesting that the vast majority of the students spend a considerable amount of time on AI tools (Table 3). The analysis shows the high consumption of artificial intelligence devices by the students, with the majority spending several hours in a week using them. Frequent use can be observed as numerous students mention that they use it regularly in their everyday or weekly lives. Minimal or no usage is only exhibited by a small proportion. Moreover, most participants indicate they would invest in sophisticated AI tools, which portends high levels of perceived significance and implication in the academic process.

Table 3. Patterns of AI use among medical students (n = 245)

Variable	Category	n (%)
Weekly usage (hours)	< 1 h	38 (16.5%)
	1–3 h	74 (32.2%)
	4–6 h	66 (28.7%)
	> 6 a.m.	52 (22.6%)
Frequency of use	Daily	96 (41.7%)
	Every 2–3 days	62 (27.0%)
	Weekly	48 (20.9%)
	Monthly / Never	24 (10.4%)

Willingness to pay for the advanced version	Yes	142 (61.7%)
	No	88 (38.3%)

Distribution and central trends of the Cognition score related to medical AI

The histogram shows how the Cognitive scores (Items 1-8) were distributed among the 245 respondents. The Cognitive score mean was 26.40 and having a standard deviation of 3.55 which depicts moderate variation at both ends of the average. There is an indication of a normal distribution as most of the scores fall within the 23 and 30 points with the mode in the range of 25 as shown in the score distribution. The range of scores is rather low, which also illustrates the overall cultural sensitivity of students to the field of artificial intelligence. The overall cluster of mean, points to the generally positive cognitive perceptions and understanding of concepts related to AI, as the surveyed medical and pharmacy students are concerned (see Figure 2).

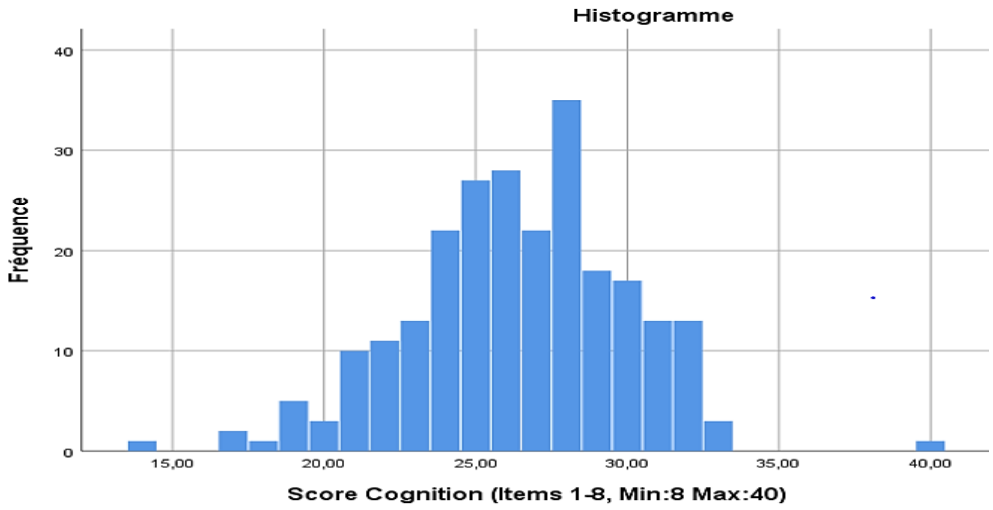

Figure 2. Histogram of the distribution of the Cognition score (Items 1–8; N = 245; Mean = 26.40; Standard deviation = 3.55)

The Q-Q plot used to verify the normality of the Cognition scores demonstrates that the vast majority of the observed values lie very close to the reference diagonal signifying the approximate adherence towards the normal distribution. The Q-Q plot has shown that cognition scores mostly follow a normal distribution at least near the reference line as most of the values fit within the line. There are some deviations in extreme ends which are minor and do not significantly impact the general trend. The normality assumption can be fulfilled, and parametric statistical tests will be appropriate to further investigations. The distribution meets the condition of normality; that is why there is no doubt about the use of parametric tests in the upcoming analysis (Figure 3).

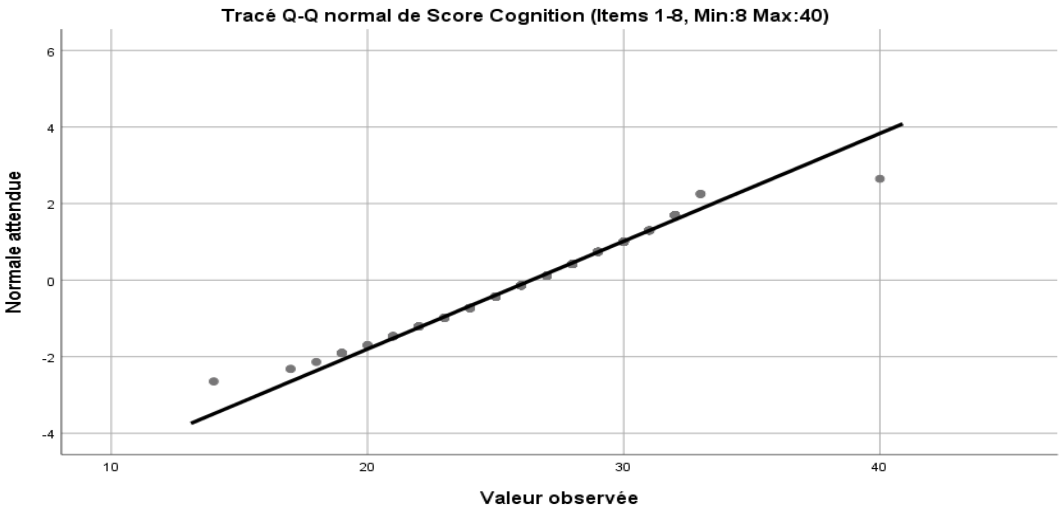

Figure 3. QQ plot assessing the conformity of the Cognition score to a normal distribution

Students' evaluation of AI performance

The assessment of the performance of AI (scale 1 10, n = 245) tends to provide rather high levels of satisfaction among the students. The overall satisfaction (8.1 ± 1.3) had the highest mean score which indicated that AI tools are strongly approved in academic use. Accuracy By also highly rated (7.8 ± 1.4), people expressed a sense of trust in correct AI generated responses. The ratings in the depth of the information and breadth were slightly lower and still favorable (7.5 ± 1.6) and testified to the fact that students considered AI as comprehensive and informative. The standard deviations are relatively low, which confirms homogenous perceptions among the participants (Table 4).

Table 4. AI performance evaluation (scale 1–10, n = 245)

Dimension	Mean ± Standard deviation
Precision	7.8 ± 1.4
Depth and breadth	7.5 ± 1.6
Overall satisfaction	8.1 ± 1.3

Pedagogical and practical uses of AI

In response to the question of pedagogical and practical applications, 182 students (79.1%) agreed or strongly agreed that AI can assist in academic problem solving making it the most supported application. Besides, 176 students (76.5%) noted AI usage to master new skills, whereas (73.9%) reported the use of AI as a means to learn something related to disciplinary knowledge. The most common uses of AI were also in the occurrence of trend and news searching (168; 73.0) and linguistic translation (164; 71.3). Broad academic integration was observed with 158 students reporting that learning foreign languages took place positively (68.7%) (see Table 5).

Table 5. Pedagogical and practical uses of AI (Likert scale, n = 245)

Item	Agree / Strongly agree n (%)
Search for news and trends	168 (73.0)
Learning new skills	176 (76.5)
Academic problem solving	182 (79.1)
Linguistic translation	164 (71.3)
Acquisition of disciplinary knowledge	170 (73.9)

Foreign language learning	158 (68.7)

Concerns and Perceptions related to AI

The results show that students confirm having positive interactions with AI. The highest point observed included the threat of plagiarism, 148 students had indicated that (64.3%), the next was the issue of data protection and confidentiality, which were indicated by 132 respondents (57.4%). Ninety six students (41.7 percent) expressed that they feared being replaced at work and 102 students (44.3 percent) expressed worries that they would no longer have prolonged social interactions. Conversely, few students (25.2%) only (58) found AI unreliable implying that trust in AI performance is not low despite the ethical and professional reservations (see Table 6).

Table 6. Concerns and negative perceptions related to AI (n = 245)

Concern	Agree / Strongly agree n (%)
Data protection and confidentiality	132 (57.4)
Risk of plagiarism	148 (64.3)
Fear of professional replacement	96 (41.7)
Decreased interpersonal interactions	102 (44.3)
Perception of unreliability	58 (25.2)

Attitudes and forward-looking views regarding AI

The overall views towards AI proved to be mostly positive. Most of them (196; 85.2%) said that AI is engaging and fun to use and the majority (188; 81.7) said it initiates change in various fields. Moreover, 174 (75.7)-students were of the view that AI is the future and 162 (70.4%)-students felt that AI is encouraging society members to develop. Nonetheless, fewer respondents (92; 40.0%) accepted that AI can be used to reduce loneliness, which means that AI has the most important perceived advantages on an academic and professional level, not on the social one (see Table 7).

Table 7. General attitudes and forward-looking views regarding AI (n = 245)

Affirmation	Agree / Strongly agree n (%)
AI represents the future	174 (75.7)
AI is a driver of transformation in sectors	188 (81.7)
AI is interesting and enjoyable to use.	196 (85.2)
AI helps alleviate loneliness	92 (40.0)
AI promotes personal development	162 (70.4)

Distribution of the overall Medical AI Readiness score

The histogram shows how the total score of the Medical AI Readiness fell out among the 245 respondents and the lowest and the highest values are observed to be 22 and 110 respectively. Distribution is more or less normal with most of the scores falling between 70 and 90. The maximum frequency rate is seen within the range of 80-85, which shows that a majority of the students show moderate to high levels of preparedness to artificial intelligence in medical education. The range of scores was very small, with only few participants having a score below 60 or higher than 100. Comprehensively, the distribution of scores to be found at the upper-middle range indicate relatively positive readiness to implement AI in medical training (Figure 4).

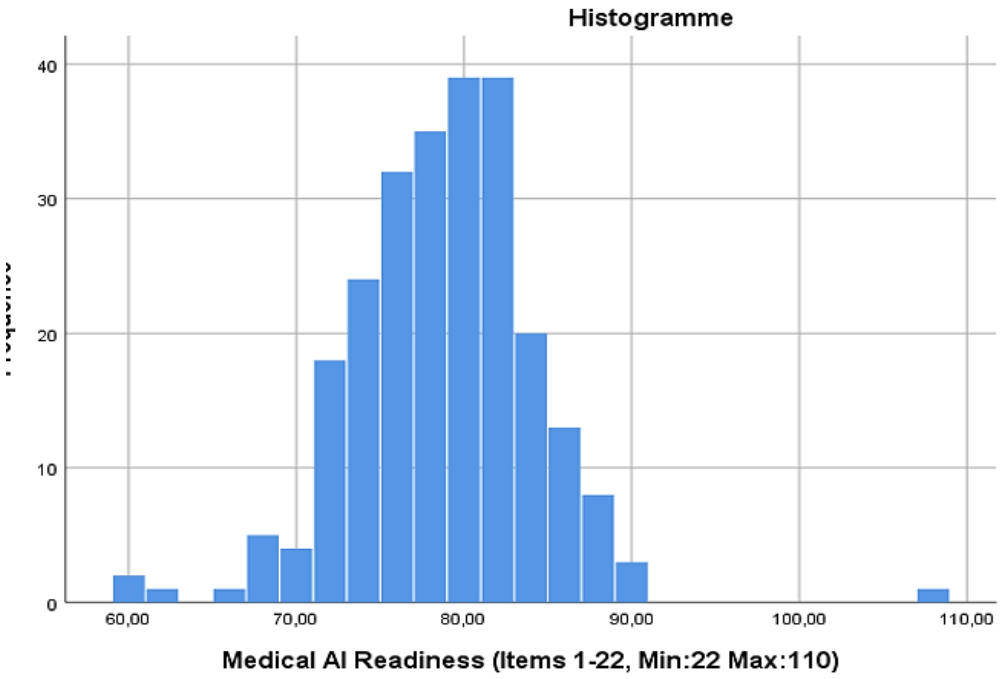

Figure 4. Histogram of the distribution of the overall Medical AI Readiness score

4. Discussion

The discussion examines the attitudes, uses, and perceptions of AI tools among students of the Faculty of Medicine and Pharmacy of Rabat based on the validated MAIRS-MS scale. The sociodemographic results indicated a marginally higher number of female participants over males, as well as the participation of both pre-clinical and clinical phases. This normal distribution justifies the consistency of the identified patterns in attitudes and perceptions related to AI in the sample. Similarly, Morris et al. (2021) results correlate with the world trends of medical education, where the participation of females in the educational process has steadily risen to be a significant percentage of medical students [23]. Although the results indicate a representationally representative sample, the pre-clinical students constituted a larger number, thus, restricting the extrapolation of the findings to more experienced cohorts, who would respond differently to AI tools. It has been established that a gender-balanced sample is absolutely needed when it comes to evaluating the digital readiness because both male and female students are similar in terms of the level of technology acceptance in the educational environment. Moreover, reported gender balance might not be entirely accurate since technology acceptance might be uneven in terms of gender differences. This increased proportion of pre-clinical students is in line with AlZaabi & Masters (2025) studies that have identified that medical students in their first year of study are more likely to use digital and AI-based tools to support their conceptual knowledge [24]. According to Sami et al. (2025) research, younger medical students have more openness and a positive attitude to the introduction of AI in education [25]. The large prevalence of early-stage students indicates that AI-related attitudes could be formed in the initial stages of medical education, potentially through the utilization of digital tools to assist with theoretical studies. The age homogeneity might also limit variability in point of view by overrepresenting digitally minded attitudes and underrepresenting apprehension or critical attitudes toward the inclusion of AI. Together, the demographic composition substantiates the applicability of studying the AI preparedness in this academic group and fits the global trends in the medical education setting.

The results indicate a high level of interaction with the use of AI devices by medical and pharmacy students, with the majority of the participants claiming to use it every week and daily suggests a high level of perceived academic efficacy. Distribution of cognitive readiness scores also reveals a generally positive cognition and knowledge of AI concepts, with the scores being concentrated around the central range and with little variance and dispersion. While, Fawzi (2023) emphasized that the use of AI-based tools like ChatGPT and clinical decision-support systems in academic activities and exam study by medical students is growing in popularity [26]. Moreover, Pillai et al. (2024) illustrated that regular experience with AI has been associated with increased perceived usefulness and intention to use these technologies in a workplace activity [27]. Furthermore, as shown in a study by Flavián et al. (2022), cognitive

readiness and decreased resistance to technological incorporation of AI concepts into healthcare facilities are possible due to early exposure to the basics of AI use [28]. It is shown that the cognitive scores are concentrated around the mean which is consistent with the evidence that structured exposure to AI in medical curriculum supports balanced and informed seeing as opposed to polarized views [29]. Moreover, such intention to invest into sophisticated AI devices promotes the Technology Acceptance Model, as the perceptions of usefulness and ease of use are important forces conditioning adoption habits [30]. Therefore, the patterns of usage and cognitive preparedness reveal that modern medical students are gradually adopting AI in their educational experience and are acquiring the core skills that enable them to work with AI by the time they become clinicians.

The results suggest that cognition scores associated with medical AI preparation are distributed more or less normally, which provides the appropriateness of parametric tests and implies a homogeneous cognitive knowledge between individuals. The consistent distribution of scores around the middle range is the indicator of the balanced and overall positive cognitive preparedness. Knobloch et al. (2024) study findings demonstrate that there is not only high acceptance of AI tools but also that there are similar and consistent perceptions of medical and pharmacy students [31]. The same trends are reflected in the Li et al. (2022) studies where medical students were found to have positive cognitive attitudes to AI when showing artificial online settings [11]. Students expressed a high level of satisfaction with the performance of AI with overall satisfaction being rated the highest, before perceived accuracy and depth of informational breadth and depth with a reasonably low variation in responses. While, Preiksaitis & Rose (2023) findings assessing the use of generative AI in medical education have expressed a high level of satisfaction and perceived usefulness, especially in the activities related to academic support and information retrieval [21]. However, Yang et al. (2021) discussed that perceived usefulness and system performance were the important factors, which caused user satisfaction and intention to adopt the technology behaviorally [32]. Moreover, Shin (2021) identified that students who think that AI is accurate and informative tend to trust its products more and incorporate it into their learning plans [33]. The comparatively small spread of the performance rating is consistent with the fact that being constantly exposed to AI tools can help eliminate uncertainty and increase trust towards digital systems. Comprehensively, the cognitive readiness distribution and high performance ratings in this research are correlated with the global data that reflects the increasing confidence levels in the usage of AI in the field of medical education.

The results show significantly more positive beliefs about artificial intelligence in the domains of medical and pharmacy students, with the majority of them agreeing that AI is not only engaging and transformative, but also future-oriented and facilitates personal development, whereas fewer students rated social benefits such as decreasing feelings of loneliness. Jackson et al. (2024) study findings revealed the increase in the ability of medical students to regard AI as a vital part of healthcare systems in the future [34]. Also, the general scores on Medical AI Readiness were grouped in a moderate-high point with majority of the students falling in the upper-middle categorization which implies that there is generally a good preparedness to use AI in medical training. The great enthusiasm and usefulness predict the Technology acceptance model that perceived usefulness as well as enjoyment is a predictive of adoption. In similar research, Tuomi (2022) stated that students tend to ascribe AI to the categories of innovation and professional growth whereas their beliefs regarding the social or emotional role are very low [35]. The moderate-high levels of readiness can be compared to research hypotheses that the concepts of AI explored at an early age during undergraduate training grow confidence and readiness to practice enhanced with technologies. Wani et al. (2026) mentioned that manifestation of levels of worry that AI is more of an academic and occupational resource than an alternative to human communication that are evident in the literature regarding digital health [36]. Although, the results reflect overall positive perception and moderate to high readiness, it might as well be an act of optimism bias due to a low limit of critical exposure to AI setbacks. Moreover, self-reported preparedness can be an overstatement of real competence in the application of AI in clinical settings. However, Helms & Donovan (2026) study focus on studying early-stage students further restricts the information that could be known about the change in attitudes depending on clinical experience, making longitudinal and competency-based assessments necessary [37]. Such less appreciation of social implications implies a utilitarian orientation of AI as perceived by the students. These results promote the increased inclusion of AI in the medical curricula as well as requirements to develop systematic educational models that can facilitate its responsible use.

Limitations

There are a few limitations in this study which need to be put into consideration when determining the results. Cross-sectional design does not allow forming causal relationships between the attitude of students, patterns of AI use, and their readiness levels. Data were only gathered at one time hence any changes in perceptions or behaviors across time could not be evaluated. The research was carried out in one institution: the Faculty of Medicine and Pharmacy in Rabat, which might not reflect the relevance of the study in other medical institutions in Morocco or

other countries, especially those that are less technologically exposed and exposed to AI. Despite the stratified proportional sampling, the end up sample size (n = 245) was less than the minimum calculated sample (n = 343), which was mainly because of feasibility issues. This reduction could have an impact on the statistical power and comparisons across subgroups. The data were self-reported via an online questionnaire also accessible to introduction of bias in responses such as social desirability bias, overestimation of AI usage or readiness, which may potentially impact the quality of the reported perceptions and behaviors.

Recommendations

The study findings using the MAIRS-MS scale allow deriving several practical suggestions to improve the efficient and responsible use of the AI tools by students of the Faculty of Medicine and Pharmacy of Rabat. The curriculum also needs to include structured training programs that will enhance the technical competence and critical interpretation of AI tools in students so that they can properly apply it both in academia and in clinical practice. The faculty development programs are vital to ensure that the educators would be in a position to support students in learning ethical and evidence-based AI use so as to establish an environment of support. Institutional rules and policies on acceptable AI use should be enumerated clearly, especially to resolve issues surrounding academic dishonesty, data privacy and misinformation. Incorporating assignments, as well as problem-solving tasks based on AI, into coursework, can promote the active use of these instruments that are supervised and lead to improved learning. Misconceptions should be managed through awareness campaigns and workshops to develop positive and realistic perceptions of AI in the sphere of medical education and practice with its benefits and limitations being discussed. Lastly, feedback and periodic assessment programs must be introduced to check the attitude and pattern of use of the students with time so that the teaching methods and policies can be adjusted accordingly. Altogether, these suggestions should contribute to a balanced, ethical, and informed use of AI technologies among med students.

5. Conclusion

The present study offers descriptive insights concerning the increased use and awareness of artificial intelligence (AI) among medical and pharmacy students at the Faculty of Medicine and Pharmacy of Rabat. The results indicate that the attitudes are generally positive, the reported use is high and moderate or high, as indicated by MAIRS-MS. Students were highly mindful about the possibilities of AI in the academic and professional environment, especially with regards to assisting students in learning, solving problems, and developing their skills. There were certain ethical and professional issues to consider but they did not significantly decrease the general trust towards the AI applications. It can also be suggested that pre-clinical students can be more open and be ready as a result of the previous exposure to digital devices. These findings should be taken with caution due to the cross sectional and specific nature of the study which restricts causal inferences and generalizability outside of this institution. Besides, self-reported measures can bring on response bias. Although the study has demonstrated the applicability of incorporating AI in medical training, additional studies in different environments are required to confirm such trends and serve as an evidence-based curriculum design guideline.

Declaration and statemen

Funding: Not applicable.

Ethical Approval: The study was approved ethically at the Faculty of Medicine and Pharmacy of Rabat before initiating the study.

Ethics and Consent to Participate declarations: All participants had been informed consent, so their participation was voluntary, and their confidentiality and the right to withdraw without penalties were maintained.

Conflict of interest: The Authors do not have any conflict of interest.

Data availability statement: Data is available and will be provided at the editor's request.

Author Contributions: The authors have contributed to writing, designing, compiling, and editing the final manuscript.

مقياس استعداد طلاب الطب لاستعمال الذكاء الاصطناعي سلم (MAIRS-MS)

1- أعارض بشدة **2-** أعارض **3-** محايد **4-** أوافق **5-** أوافق بشدة

	1	2	3	4	5
1. يمكنني تعريف المفاهيم الأساسية لعلم البيانات.					
2. يمكنني تعريف المفاهيم الأساسية لعلم الإحصاء.					
3. يمكنني شرح كيفية تدريب أنظمة الذكاء الاصطناعي.					
4. يمكنني تعريف المفاهيم والمصطلحات الأساسية للذكاء الاصطناعي.					
5. يمكنني تحليل البيانات التي يتم الحصول عليها من الذكاء الاصطناعي في مجال الرعاية الصحية بشكل صحيح.					
6. يمكنني التمييز بين وظائف وميزات الأدوات والتطبيقات المتعلقة بالذكاء الاصطناعي.					
7. يمكنني تنظيم سير العمل بما يتماشى مع منطق الذكاء الاصطناعي.					
8. يمكنني التعبير عن أهمية جمع البيانات وتحليلها وتقييمها وأمانها لتطوير الذكاء الاصطناعي في مجال الرعاية الصحية.					
9. يمكنني استخدام المعلومات المستندة إلى الذكاء الاصطناعي مع دمجها مع معرفتي المهنية.					
10. يمكنني استخدام تقنيات الذكاء الاصطناعي بفعالية وكفاءة في تقديم الرعاية الصحية.					
11. يمكنني استخدام تطبيقات الذكاء الاصطناعي وفقًا لغرضها المحدد.					
12. يمكنني الوصول إلى المعلومات وتقييمها واستخدامها ومشاركتها وإنشاء معرفة جديدة باستخدام تقنيات المعلومات والاتصال.					
13. يمكنني شرح المشكلات التي تقدم تطبيقات الذكاء الاصطناعي في الرعاية الصحية حلولًا لها.					
14. أجد أنه من القيّم استخدام الذكاء الاصطناعي لأغراض التعليم والخدمة والبحث.					
15. يمكنني شرح تطبيقات الذكاء الاصطناعي المستخدمة في خدمات الرعاية الصحية للمريض.					
16. يمكنني اختيار التطبيق المناسب للذكاء الاصطناعي وفقًا للمشكلة التي تواجه الرعاية الصحية.					
17. يمكنني شرح حدود تقنية الذكاء الاصطناعي.					
18. يمكنني شرح نقاط القوة والضعف في تقنية الذكاء الاصطناعي.					
19. يمكنني التنبؤ بالفرص والتهديدات التي يمكن أن تخلقها تقنية الذكاء الاصطناعي.					
20. يمكنني استخدام البيانات الصحية وفقًا للمعايير القانونية والأخلاقية.					
21. يمكنني التصرف وفقًا للمبادئ الأخلاقية أثناء استخدام تقنيات الذكاء الاصطناعي.					
22. يمكنني متابعة اللوائح القانونية المتعلقة باستخدام تقنيات الذكاء الاصطناعي في الرعاية الصحية					

To: The Administration of the Faculty of Medicine and Pharmacy of Rabat

Subject: Authorization to Conduct Research

Dear Sir/Madam

On behalf of the research team for the study entitled "Medical Students' Attitudes Towards ChatGPT: A Multi-Center Study", we hereby confirm our authorization for this project to be conducted at the Faculty of Medicine and Pharmacy of Rabat. We acknowledge the collaboration of your esteemed faculty as a participating center and confirm that EL BAHRI ABDELHAK will serve as the institutional contact and coordinator for the study at your site. This research has been reviewed and approved by the lead institution's research committee [IR.SBMU.RETECH.REC.1403.843], and we will ensure full compliance with all local ethical and administrative regulations.

We sincerely appreciate your support and collaboration in facilitating this important international project. Please do not hesitate to contact us for any further information or documentation.

Sincerely,

Dr. Somaye Sohrabi

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09/04/2025

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