

A digital tutor; artificial intelligence as an aid among undergraduate medical students

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ABSTRACT

Objective

To evaluate student's perceived effectiveness in the use of AI as digital tutors in supporting them for studies.

Material and methods

This cross-sectional analytical study was done at Al-Tibri Medical College, Isra University, Karachi, Pakistan. Using purposive sampling, 315 students consented to participate in the study. After ethical approval, a questionnaire was designed and pilot tested before being distributed to the students. There were total of six sections of the questionnaire. The quantitative data was tested using SPSS v23.0. Students responded to Likert scale which was subjected to ordinal and interval data analysis both for better presentation of results. Open ended questions which were subjected to thematic analysis using Braun and Clarke six-steps for thematic analysis.

Results and Discussion

The study found that undergraduate medical students widely use and positively perceive AI tools, particularly for understanding complex topics, exam preparation, and solving MCQs. ChatGPT was the most frequently used platform. Students appreciated AI for its efficiency and academic support, though some noted concerns about misinformation and over-dependence. Significant differences in perceptions were observed across years, with senior students reporting greater benefits. Overall, AI was seen as a valuable supplement to medical education.

Conclusion

Artificial Intelligence tools, were widely used and positively perceived by undergraduate medical students as effective aids in learning, though concerns about over-reliance and misinformation highlighted the need for guided integration into medical education.

Keywords

Artificial Intelligence; Digital Tutor; Medical Education

INTRODUCTION

In the current era of Artificial Intelligence (AI), technology has sporadically evolved. At present, it has gained attention via artificial neural networks and deep learning.¹ AI was first introduced back in the 1950s by John McCarthy.² He defined AI as an intelligent machine with various behaviors like learning, reasoning, communicating, perceiving and with abilities for performing humanely tasks. It is described as having three main paradigms viz. statistical (probability based methods and machine learning), symbolic (based on logic and knowledge) and sub-symbolic (embodied in intelligence and searching).³

Currently, AI is vigorously used in the field of economics and finance, automotive and is now increasingly being used in medical education as well.⁴ AI's role in medical education is a hot topic of debate among researchers, showing keen interest in evaluating its benefits and limitations/challenges.⁵ The importance of AI in the field of radiology has already been highlighted by various studies. In addition, managing chronic medical disorders and cancers has become easier with the advent of AI, even in teaching medical ethics to undergraduate medical students.⁶

In the last two decades, substantial advancements have been observed by AI in medical education. The advances like "teacher bots" have been a game changer, being able to deliver content on time and at free will, provide swift feedback and

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even supervise the progress.⁷ Their use in education is increasing day by day, proving to have the potential in helping students attain specialized and individualized help. They can also be used in teaching sex education to students.⁸ Additionally, it helps in identifying their gaps in knowledge, also freeing teachers from giving attention to all and also in improving adaptive and personalized teaching or story telling to the students.⁹

Among lifelong learning fields, medical education is at the top. It can range right from undergraduate level to postgraduate, specialized trainings and beyond, which is termed as “continuing medical education”.¹⁰ It encompasses all the fields of medical education including doctors, nurses, paramedics and other allied health care workers. Expanding medical knowledge exponentially required faculty members not only recall knowledge but also keep themselves with the up-to-date knowledge in their respective fields.¹¹ With the help of AI, reduced efforts are needed for faculties for interpreting digital information and improving their own abilities to teach better. However, humanistic aspect of medicine will remain emphasized since it is difficulty to replace it with technology.¹²

Furthermore, in the era of digitalization, the learning styles of current generations significantly vary from the older ones. In the present era, digital learners are super inter-connected via Internet.¹³ They even prefer rapid feedback on their achievements, expressing need for individualized psychosocial support.¹⁴ Similarly, educationists ought to respond to changing teaching and learning environments through use of more collaborative, team-based and / or game-based learning methods rather than the traditional teaching methodologies. In order to uphold students’ attention and keep them engaged, it is vital to identify and use suitable teaching and learning strategies.¹⁵

Several researchers have demonstrated a focus on integration of core competencies such as interdisciplinary teams, patient-centered care, and improvement of quality, informatics and evidence-based practices and integrating them into medical education.¹⁶ The Carnegie Foundation in 2010 presented challenges along with recommendations on achievement of excellence in the field of medical education.¹⁷ It addressed the work of Flexner and his four theme viz. habit of inquiry, standardization and individualization, identity formation and integration. Nevertheless, the directions and goals for futuristic

medical education were presented abstractly.¹⁸ It’s a rarity to see studies conducting evidence based investigations as to the implementation, conceiving and achievement of medical educators globally. This needs to be carried out for preparing them for future of newer technology and expanding of knowledge. Moreover, handful of researchers have superficially demonstrated as to how the next generation should be educated in order to fit their characteristics.¹⁹ In accordance with the perspective of open-systems on theory of social system, environment plays a crucial role in the education system of any educational school. It is hypothesized that the instructional strategies of the changing world influences medical schools’ usage of resources such as teachers and students.²⁰

In order to study the dynamics, usage and importance of using AI as a digital tutor, this research was carried out to evaluate student’s perceived effectiveness in the use of digital AI-based tutors such as ChatGPT, Bing AI, Google Bard / Gemini, etc. in supporting them for studies.

MATERIAL AND METHODS

This cross-sectional analytical research was carried out on the undergraduate medical students of Al-Tibri Medical College, Isra University, and Karachi, Pakistan after ethical approval [Approval number- ATMC/IERC/15th (02-2024)/35]. The duration of study was 3 months (January 2025 to March 2025). Non-purposive sampling technique was used where all MBBS students currently studying at the said college were invited to participate in the study. After ethical approval from the Ethical Review Committee of the college [ERC/], all 450 medical students were invited. Since all students were supposed to be included in the study therefore sample size calculation was not required. Any student unwilling to participate in the study was excluded without any negative consequences. A total of 315 students consented to participate in the study.

Pilot Testing of Questionnaire

After ethical approval, a questionnaire was designed after going through published literature on the use of AI by medical students. The designed proforma was pilot tested before employing on the students. The purpose of pilot testing was to collect information whether the questionnaire is feasible, acceptable and appropriate for the students. The reliability came out to be 0.77, which deemed the questionnaire fit for using on the students. For pilot testing, 5 % of the total sample viz. 25 students

out of the 450 registered at Al-Tibri Medical College were included. Their data was not part of the main study sample. Some questions were ambiguous and needed rephrasing for the general population of students. The revised questionnaire was used in the final research. Both initial and revised questionnaires were designed on Google forms.

From the revised and final questionnaire, section 1 included demographics of the students such as age, gender, year of MBBS. Section 2 included the pattern of using AI tools along with their frequency and subjects used for. In section 3, the perceived effectiveness of AI was asked on a Likert scale (1 being strongly disagree to 5 being strongly agree) while section 4 asked about usability and satisfaction with the use of AI. In section 5, limitations with the use of AI were asked on Likert Scale. Section 6 had open ended questions which were subjected to thematic analysis using Braun and Clarke six-steps for thematic analysis (21).

Data Collection Procedure

On a designated day, the researchers announced to all students in class (physically) regarding the topic and purpose of research. Same announcement was made on the official Whatsapp group of the students (for those absent in the physical class of the day of announcement in class). After taking informed consent, the QR code for Google form was shared to the students Whatsapp group. Participation in the study was voluntarily and students were ensured that their identity and data will be kept strictly confidential and anonymous. If any student did not want to participate in the study, they were allowed to refrain from participating. In order to encourage the students' participation, it was advised that the results of this study might give an indication to the higher authorities for implementing and making the use of AI compulsory as a student-centered modern teaching methodology in the curriculum. The Google form QR code was active throughout the data collection provide to provide the students ample time (and those absent) to fill the form. The total time for filling the questionnaire was around 15 to 20 minutes.

Data Analysis

SPSS version 23.0 was used for analyzing the data. Demographical data included in the study was age, gender, year of study, pattern of using AI tools. Students responding to Likert scale were subject to ordinal and interval data analysis both for better presentation of

results. Normality of data was tested using Shapiro-Wilk test which came out to be $p=0.12$, therefore the data did not significantly differ from normal distribution. Therefore, the data was assumed to be normally distributed. For ordinal data, frequency and percentages were reported, while for interval data mean and standard deviation was reported. For comparison of the presented data, after adjustment of confounders such as year of MBBS, One-way ANOVA (Eta squared for measuring effect size) was applied keeping $p<0.05$ as statistically significant.

RESULTS

The demographic characteristics of the 315 undergraduate medical students who participated in the study are shown in Table I. The gender distribution included 144 (45.7%) males and 171 (54.3%) females. Regarding the year of study, 36 (11.43%) students were from the 1st year, 63 (20%) from the 2nd year, 81 (25.71%) from both the 3rd and 5th years, and 54 (17.14%) were in their 4th year. ChatGPT emerged as the most frequently used AI tool among students, reported by 216 (68.6%), followed by DeepSeek (17.1%), Meta (5.7%), Google Gemini (5.7%), and Google Bard (2.9%). In terms of usage frequency, 135 (42.9%) students reported daily use, 81 (25.7%) used AI tools 2–3 times per week, 63 (20%) used them occasionally, 27 (8.6%) once a week, and 9 (2.9%) rarely.

The students' responses to various statements about AI using a 5-point Likert scale are illustrated in Table II.

Year-wise comparison of students' ratings on AI-related statements, using mean $\pm$ SD, with associated p-values and Eta squared (η^2) values are presented in Table III.

Table I: Demographics of participants included in the study ($n=315$)

Variables		Frequency (%)
Gender	Male	144 (45.7 %)
	Female	171 (54.3 %)
Year of MBBS	1	36 (11.43 %)
	2	63 (20 %)
	3	81 (25.71 %)
	4	54 (17.14 %)
	5	81 (25.71 %)

Variables		Frequency (%)
Most common AI tool used	ChatGPT	216 (68.6 %)
	DeepSeek	54 (17.1 %)
	Meta	18 (5.7 %)
	Google Gemini	18 (5.7 %)
	Google Bard	09 (2.9 %)
Frequency of usage	Daily	135 (42.9 %)
	2-3 times per week	81 (25.7 %)
	Occasionally	63 (20 %)
	Once a week	27 (8.6 %)
	Rarely	09 (2.9 %)

Table II: Students' Response to Questionnaire about AI (n=315)

Question	Strongly Disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly Agree (5)
AI tools help me better understand complex medical concepts	9 (2.9 %)	18 (5.7 %)	72 (22.9 %)	72 (22.9 %)	144 (45.7 %)
I feel more confident in my exam preparation after using AI tools	9 (2.9 %)	27 (8.6 %)	108 (34.3 %)	72 (22.9 %)	99 (31.4 %)
AI-based explanations are more interactive and engaging than traditional resources	-	54 (17.1 %)	108 (34.3 %)	63 (20 %)	90 (28.6 %)
AI tools provide accurate and up-to-date information	-	36 (11.4 %)	135 (42.9 %)	63 (20 %)	81 (25.7 %)
Using AI has improved my academic performance in tests/quizzes	9 (2.9 %)	36 (11.4 %)	90 (28.6 %)	63 (20 %)	117 (37.1 %)

Question	Strongly Disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly Agree (5)
AI tools are helpful in answering (MCQs)	-	18 (5.7 %)	45 (14.3 %)	117 (37.1 %)	135 (42.9 %)
I rely on AI for quick revision before exams	45 (14.3 %)	45 (14.3 %)	54 (17.1 %)	72 (22.9 %)	99 (31.4 %)
Satisfaction Level in using Artificial Intelligence	9 (2.9 %)	18 (5.7 %)	72 (22.9 %)	108 (34.3 %)	108 (34.3 %)
Do you find the AI interface User-friendly?	225 (71.4 %)	90 (28.6 %)	-	-	-
How strongly do you agree or disagree to verifying information provided by AI	-	27 (8.6 %)	45 (14.3 %)	54 (17.1 %)	189 (60 %)
AI sometimes gives incorrect or misleading information.	45 (14.3 %)	18 (5.7 %)	99 (31.4 %)	108 (34.3 %)	45 (14.3 %)
I am concerned about becoming over-dependent on AI tools.	27 (8.6 %)	63 (20 %)	72 (22.9 %)	54 (17.1 %)	99 (31.4 %)

Table III: Comparison of Year-Wise Rating of Questions by Students (n=315)

Questions	Year of MBBS					p-value	Eta squared
	1st	2nd	3rd	4th	5th		
AI tools help me better understand complex medical concepts	3.75 ± 1.10	3.57 ± 1.51	4.44 ± 0.69	3.83 ± 0.91	4.22 ± 0.92	<0.001*	0.1
I feel more confident in my exam preparation after using AI tools	3.75 ± 1.66	3.43 ± 0.91	3.44 ± 0.84	4 ± 1.12	4 ± 0.95	0.001*	0.06

Questions	Year of MBBS					p-value	Eta squared
	1st	2nd	3rd	4th	5th		
AI-based explanations are more interactive and engaging than traditional resources	2.75 ± 0.44	3.71 ± 1.29	3.33 ± 0.95	4.33 ± 1.12	3.67 ± 0.82	<0.001*	0.17
AI tools provide accurate and up-to-date information	3.25 ± 0.84	4.14 ± 0.84	3.22 ± 1.04	3.83 ± 0.91	3.56 ± 0.96	<0.001*	0.12
Using AI has improved my academic performance in tests/quizzes	3.25 ± 1.11	3.57 ± 1.5	3.44 ± 0.84	4.33 ± 1.12	4.11 ± 0.88	<0.001*	0.11
AI tools are helpful in answering (MCQs)	4.25 ± 0.84	4 ± 1.21	3.67 ± 0.67	4.67 ± 0.48	4.44 ± 0.69	<0.001*	0.17
I rely on AI for quick revision before exams	3.25 ± 1.11	3.71 ± 1.5	3 ± 1.42	4 ± 1.17	3.33 ± 1.5	0.001*	0.06
Satisfaction Level in using Artificial Intelligence	3.75 ± 1.11	4 ± 1.43	3.67 ± 0.48	4.33 ± 1.12	3.89 ± 0.88	0.004*	0.05
Do you find the AI interface User-friendly?	1.5 ± 0.51	1.29 ± 0.46	1.44 ± 0.5	1.17 ± 0.38	1.11 ± 0.32	<0.001	0.11
How strongly do you agree or disagree to verifying information provided by AI	2.25 ± 1.1	2.57 ± 0.73	2.56 ± 0.96	2.17 ± 0.38	2.33 ± 0.95	0.03*	0.03

Questions	Year of MBBS					p-value	Eta squared
	1st	2nd	3rd	4th	5th		
AI sometimes gives incorrect or misleading information.	3.5 ± 0.51	3.86 ± 1.26	3.44 ± 1.07	2.67 ± 0.95	3 ± 1.42	<0.001*	0.11
I am concerned about becoming over-dependent on AI tools.	3.25 ± 1.1	3.86 ± 1.56	3.67 ± 1.16	2.17 ± 0.69	3.78 ± 1.24	<0.001*	0.20

*One-way ANOVA test applied (p<0.05- significant)

The qualitative analysis of the study reported the following according to Braun and Clarke's six steps for thematic analysis.

Step 1: Familiarization with the Data

We reviewed all responses to three questions:

1. Biggest advantages of using AI for exam preparation
2. Limitations or challenges faced while using AI tools
3. Suggestions for improving AI in medical education

Step 2: Initial Codes

Responses were coded inductively. Examples:

Advantages

- "Quick responses", "Time-saving" → **Efficiency**
- "Made difficult concepts easy" → **Concept clarity**
- "Point-to-point information" → **Conciseness**
- "Revision" → **Reinforcement of learning**

Limitations

- "Paid version is better" → **Access barrier**
- "Two or three questions couldn't upload" → **Technical limitations**
- "None"/"No any" → **Perceived absence of limitations**

Improvements:

- "AI should be free" → **Affordability**
- "No improvement needed" → **Satisfaction with current tools**
- "They can be good" → **Potential enhancement recognition**

Step 3: Themes

Grouped codes into broader themes:

- **For Advantages:**
 - *Cognitive Support:* Concept simplification, point wise learning
 - *Efficiency & Convenience:* Fast access, quick answers, time-saving
 - *Academic Utility:* Revision, targeted preparation
- **For Limitations:**
 - *Technical Constraints:* Uploading issues, limitations of free versions
 - *Content Gaps:* Missing or insufficient information
 - *No Significant Issues:* Some students report no challenges
- **For Improvements:**
 - *Access & Affordability:* Suggesting free versions
 - *Content Quality:* Better integration with curriculum
 - *No Changes Needed:* Positive feedback on current utility

Step 4: Reviewing Themes

Themes were reviewed to ensure alignment with the data. Some responses were brief or vague (e.g., “They can be good”), but still contributed to identifying broader patterns.

Step 5: Defining and Naming Themes

Final Themes:

- AI as a Cognitive Amplifier
- Efficiency and Time-Saving
- Technical and Access Barriers
- Minimal User Frustration
- Demand for Free and Reliable Access
- User Satisfaction and Minimal Need for Change

Step 6: Producing the Report

Overall, students reported AI to be helpful for simplifying complex topics and accelerating revision. Some students had reservations in terms of constraints

in free access whilst other minor issues. Suggestions mainly focused on freely availability of AI tools and enhance integration with education. Most students were satisfied with the currently available functions of AI, there demonstrating a strong acceptance and perceived academic value as digital tutor.

DISCUSSION

This researched observed medical students to be highly engaged with the use of AI tools. Most students reported using AI tools frequently, especially for understanding complex concepts, exam preparation, and solving MCQs. Overall, perceptions were largely positive, with a majority agreeing AI improved their academic performance, being user-friendly, and providing accurate information. However, a notable proportion also expressed concerns about potential misinformation and over-dependence on AI. Statistically significant year-wise differences were observed in students’ responses, with senior students generally reporting greater benefits and reliance on AI tools. These findings indicate a growing integration of AI into medical education, accompanied by both enthusiasm and critical awareness.²¹

As stated in his work by John McCarthy who is regarded to be the first to use the term AI back in 1955.²² Within education sector, application of AI is ever-increasing. Its impact on the learning experience of students has been evaluated for assessing need for artificial intelligence in education.²³ Chassignol et al suggested that it is evident that AI is applied in education, more commonly within the administrative section and now into teaching and has now also influenced or impacted learning of students.²⁴ In the analysis of scholarly articles included in a research, it is reported that the application of AI in medical education has been used in different ways. For instance in instruction, in development of content or in the learning process of students, AI is being used increasingly.^{25, 26}

Studies have reported that the efficiency of students have significantly improved in their academic performances.²⁷ Similarly in our study as well, students across all years reported a highly positive perception of AI tools, especially in areas like understanding complex concepts (68.6%), exam preparation (54.3%), and solving MCQs (80%). A significant number (57.1%) believed that AI improved their academic performance.

With regards the advantages, limitations and

improvements suggest by students with the use of AI, students appreciated AI for its efficiency, speed, and ability to simplify difficult concepts and aid in quick revisions. Many noted it was particularly useful for targeted, point wise information. In terms of the limitations of AI, even though some students reported no significant challenges, others noted technical issues (like difficulty uploading questions) and restrictions in free versions compared to paid ones. In addition, regarding improvement to AI, suggestions centered around making AI tools freely accessible, improving reliability, and better alignment with the medical curriculum. However, many students felt that no changes were needed, indicating overall satisfaction.

Overall, the results demonstrate a strong acceptance and perceived benefit of AI tools among medical students, particularly for academic support and self-directed learning. While students recognize limitations and caution against over-dependence, their overall experience with AI is positive; potentially underscoring the potential for responsible integration of AI in undergraduate medical education.

This study has several limitations that should be acknowledged. First, the data were collected from a single group of undergraduate medical students, which may limit the generalizability of the findings to other institutions or geographic regions. The self-reported nature of the responses, particularly in the Likert-scale and open-ended questions, may introduce response bias, including social desirability bias. Additionally, while the study provides a snapshot of student perceptions and experiences, it does not measure actual academic performance or objectively assess the impact of AI tools on learning outcomes. The qualitative responses were brief and, in some cases, vague or incomplete, limiting the depth of thematic analysis. Lastly, the study did not account for confounding factors such as prior digital literacy, study habits, or access to technology, which may influence both the use and perception of AI tools in education.

Based on the findings of this study, several recommendations can be made. First, medical educators and curriculum planners should consider the structured integration of AI tools into undergraduate medical education to support learning, particularly for complex subjects and exam preparation. Institutions should also provide access to reliable and cost-effective AI platforms, ensuring equitable use among all students. To address concerns about misinformation and over-reliance, it is recommended to incorporate training sessions on critical appraisal and ethical use of AI in medical education. Furthermore, regular feedback from students should be gathered to monitor the effectiveness and limitations of AI-based learning aids. Finally, future research should explore the objective impact of AI on academic performance through controlled studies and expand to multi-institutional settings for broader applicability.

CONCLUSION

Artificial Intelligence tools, were widely used and positively perceived by undergraduate medical students as effective aids in learning, though concerns about over-reliance and misinformation highlighted the need for guided integration into medical education.

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