ORIGINAL ARTICLE

EXPLORING FACULTY PERCEPTIONS REGARDING INTEGRATION OF ARTIFICIAL INTELLIGENCE IN MEDICAL AND DENTAL EDUCATION

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Background: Considering hype about artificial intelligence, limited research has been done regarding its integration in medical and dental education within Pakistani context. This study aims to explore faculty perceptions on integrating AI into medical and dental education. **Methods:** This is an exploratory qualitative study that has explored faculty perceptions on integrating Artificial Intelligence into medical and dental education. A purposive sample of 20 faculty members participated in the study. An interview guide with six semi-structured questions was utilized for data collection. After assuring anonymity and confidentiality, all interviews were audio recorded and transcribed verbatim. The transcripts were anonymized and shared with the co-authors for data analysis. Thematic analysis with a deductive approach was performed by utilizing the six-step process provided by Braun and Clarke. **Results:** Five main themes and fifteen subthemes emerged. The participants said that artificial intelligence has the power to completely transform medical and dental education by enhancing teaching, research and patient care. Some challenges need to be addressed that restrict wide implementation of artificial intelligence in the healthcare sector such as lack of expertise, resource constraints, and lack of understanding to use it for teaching and learning. Artificial intelligence has the potential to improve the learning environment by modifying learning experiences of students. According to the results, Institutions has a responsibility to provide comprehensive training programs for this purpose Artificial intelligence ethics must be kept in mind while integrating it into medical and dental education by creating explicit policies and offering faculty development initiatives. **Conclusion:** This study highlights the necessity of training programs that allow medical and dental faculty to effectively use artificial intelligence to enhance teaching and practice in healthcare. It is pertinent to keep ethics in mind while utilizing Artificial Intelligence into medical and dental education.

Keywords: Artificial intelligence, integration, medical education, dental education.

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INTRODUCTION

Technology has played a vital role in transformation of healthcare in recent years.[1] With the utilization of artificial intelligence (AI) in the healthcare industry there is a promising outcome in tackling a number of global healthcare issues, that may include management and administration, data analytics, critical thinking, and diagnosis.[2] There is a rapid advancement of AI in transforming various sectors, including healthcare and education. AI is starting to transform many industries, and its potential in the medical field is beginning to get a lot of attention.[3] With the advancement in the field of information technology, AI has expanded quickly. Developed nations have taken advantage to use of AI in education between 2016 and 2018.[2] A New Social Contract for Education, published in November 2021 by the United Nations Educational, Scientific, and Cultural Organization (UNESCO) laid out the global consensus framework for the close integration and mutual improvement of AI and education.[3] With the use of computers and other devices, AI has become a potent instrument that may replicate the human mind's capacity for problem-solving and decision making. Depending on its capabilities, design, and operating environment, it can display varying degrees of autonomy.[4] Teaching and learning methodologies are evolving in the field of education worldwide. When it comes to improving patient care and information distribution, artificial intelligence (AI) is already seeing considerable use in health and education systems in developed countries. Artificial intelligence (AI) has the potential to improve procedures for appraisal, particularly in the preclinical and clinical phases, by offering students with fast feedback, helping them acquire more knowledge and skills, creating secure learning environments, and accommodating different learning styles.[5] The integration of AI into medical and dental schools has changed the face of healthcare around the world, including in developing nations like Pakistan.

There is a lot of room for AI to change up the status quo in medical and dental Institutions in Pakistan, but the field is still in its early stages. Studies proof that AI can improve the accuracy of diagnoses, change treatment plans, and speed up administrative tasks.[6]

By providing students with interactive learning environments, replicating complex clinical scenarios, and offering immediate feedback, AI could help close the gap between instruction and clinical practice in dentistry and medicine. The instructors may equally benefit from AI-powered tools that assess their students' abilities and areas for improvement, paving the way for more targeted and fruitful learning experiences.[7] To better equip new graduates to deal with the ever-changing healthcare industry, It may be helpful to incorporate AI into the curriculum.[8] Therefore, better patient outcomes are possible as a result of having access to a larger pool of licensed healthcare providers.[9] Thus, it is crucial to integrate AI in medical and dental education to prepare well-equipped future healthcare professionals.[10]

This study aims to explore faculty perceptions on integrating AI into medical and dental education. In this way potential benefits and challenges of integrating AI into medical and dental education can be understood. Moreover, the role of institutions in AI integration and way forward can be understood in the light of faculty perceptions. This study highlights the necessity of training programs that allow medical and dental faculty to effectively use AI to enhance teaching and practice in healthcare.

MATERIAL AND METHODS

This qualitative exploratory study utilized Technology Acceptance Model (TAM). This model explores the variables that determine the manner in which technology becomes embraced and utilized. It aids in comprehending the attitudes, intents, and perceptions of learners and educators with regard to the use of AI in the educational setting. This study was conducted from March 2024-May 2024 after obtaining ethical approval from the Ethical Review Committee of HBS Medical and Dental College, Islamabad Pakistan (ERC No. App# EC02/3).

A purposive sampling[11] was done by selecting the senior teaching faculty (Assistant professor and above) from a private medical and dental college. An interview guide was developed having the open-ended interview questions along with informed consent form and interview protocols. Interview questions were developed by utilizing the seven-step process provided by the Association for Medical Education in Europe (AMEE) guide no 87.[12]

A thorough literature review was conducted on integrating AI in medical and dental education. A total of 10 draft items were made in the fourth step which were sent to medical education experts (five) for content/construct validation. Those experts were chosen who had a master's in health education with a minimum of three years of experience in the field. The items after expert validation were reduced to six. Cognitive interviews from four faculty members (two from medical and two from dental) were conducted to see interpretation. Only rephrasing of three items were done in this step. Lastly, pilot testing was done on the 10 faculty members (five medicals and five dental) to ensure clarity of the items. The finalized questions for the main interviews were six including the questions for rapport building and demographics. The questions were related to the faculty perceptions on integrating AI into the medical and dental education, benefits and challenges of integrating AI into medical and dental education, the role of institutions in AI integration and way forward.

The faculty members who were involved in the development of the questionnaire were excluded from the final individual interviews. The interview guide included the protocols regarding the setting of interviews and interview questions. All interviews were audio recorded utilizing the interview guide along with field notes. The faculty offices were utilized for interviews to avoid recall bias. Anonymity and confidentiality were ensured to the participants and the data were kept in a password protected laptop.

The data saturated at participant no 20. Later the recorded interviews were transcribed verbatim. The transcripts were anonymized and shared with the co-authors for data analysis.

Thematic analysis with deductive approach to theme identification was performed on qualitative data by utilizing the six-step process provided by Braun and Clarke (2006).[13] The steps followed were familiarizing with the data, initial code generation (in-vivo analytic codes), theme search, theme review, naming themes, and presenting findings.

In the first step all the authors read each line and sentence in the transcript carefully to familiarize them with the data. The next step was to get rich descriptions of the data set with generation of in-vivo codes. All the interviews were coded this way. Codes were discussed among all authors and modifications were made after the second cycle of coding. The data after completion of coding was arranged into subthemes which were again discussed among all authors. A slight modification to sub-themes produced a total of 15 subthemes under five main themes which were predetermined (deductive approach). The results in the form of theme, subtheme and participant's quotes are presented in Table-2.

RESULTS

Demographic Information

A total of 20 faculty members (Table-1) participated in the study with female predominance (55%). Both the medical faculty (60%) and dental faculty (40%) participated in the study.

Table-1 Demographics characteristics of the participants

Characteristics	Frequency (*n*)	Percentage (%)
Gender		
Male	09	45
Female	11	55
Age Range (years)		
30-39	06	30
40-49	07	35
50-59	07	35
Academic position		
Professor	05	25
Associate Professor	08	40
Assistant Professor	07	35
Teaching Experience (years)		
1-5	02	10
6-10	05	25
11-15	05	25
16-20	06	30
21-25	02	10
Medical Faculty	12	60
Dental Faculty	08	40

The faculty perceptions regarding AI integration in medical and dental education are summed up in Table-2 with representative quotations. However, the five main themes along with fifteen sub themes are described here in detail:

1. Perceptions of Faculty regarding AI integration in Medical and Dental Education

Regarding the use of AI in medical and dental education, participants had differing opinions. Some of the participants thought that AI has the power to transform medical and dental education completely. It has the potential to enhance teaching, research, and patient care greatly. Many Academicians are excited about utilizing AI in medical and dental education.

They think that AI can make learning more engaging and focused for the students. On the other hand, few participants didn't know how to utilize AI in medical education. There were worries about the lack of expertise and readiness for its application, even though many recognized AI's potential to enhance research, healthcare, and patient care. Others expressed concerns that AI would eventually take the place of human teachers and will undermine the necessity of collective efforts to include AI in medical education for the benefit of both teachers and students.

2. Challenges of AI Integration in Medical and Dental Education

While AI could revolutionize medical education in Pakistan, some study participants highlighted numerous barriers that prevent its widespread use. Some respondents brought up the fact that teachers don't always have the time, knowledge, or tools to effectively incorporate AI into the learning environment. Concerns over data privacy, ethical issues and the establishment of a transparent legal framework further impedes the integration process. Time constraints, a lack of infrastructure, and a lack of interest of some faculty members hinder the successful implementation of AI into medical and dental education in Pakistan.

3. Potential Benefits of AI Integration in Medical and Dental Education

Some of the respondents were of the view that AI has the potential to drastically change the environment of medical and dental institutions. AI has the ability to modify learning experiences to fit the needs of individual students, leading to improved academic outcomes. It can bridge the gap between the educational setting and real-world application by providing chances for practical application. Faculty members can have more time for research, student interaction, and instruction when AI automates routine work. According to the participants, AI can enhance the learning environment overall, aid tasks like making presentations, and provide timely feedback. Nevertheless, in order for AI to effectively improve medical and dental education, some concerns must be addressed. These concerns include the necessity for specific technical knowledge, the security of personal data, and the likelihood of biased AI algorithms.

4. The Institutions Role in Integrating AI into Medical and Dental Education

Although the prospect of AI in medical and dental education has been widely acknowledged, there are still many challenges that hinder its full implementation. According to a number of the participants, institutions recognize that they need to invest in resources and infrastructure if they want to support AI integration. However, faculty members need to undergo extensive training programs to gain the expertise needed to effectively utilize AI. Integrating AI into the curriculum also necessitates a clear objective. The successful use of artificial intelligence in medical and dental education requires adequate financing and compliance with regulations.

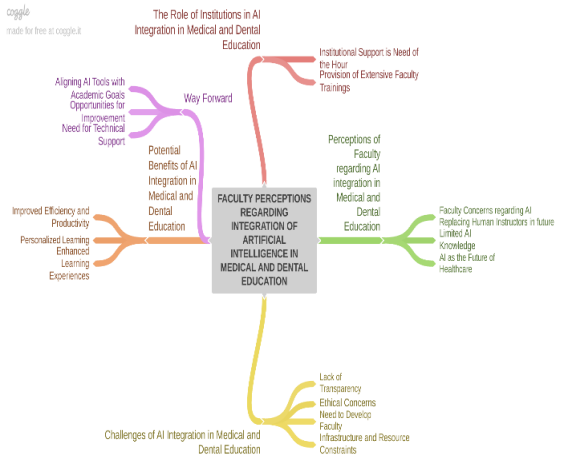
5. Way Forward

Despite AI's immense potential for enhancing medical and dental education, participants stressed the relevance of maintaining a balance between human interaction and innovation. The instructors need enough support and training to make good use of AI tools in educational settings. When incorporating AI in medical and dental education, ethical concerns must be addressed. To accomplish this goal there is a need to develop clear guidelines and provision of professional development opportunities for the educators.

Table-2: Faculty Perceptions regarding integration of AI in medical and dental education

Themes	Sub-themes	Participant Response
Perceptions of Faculty regarding AI integration in Medical and Dental Education	Limited AI Knowledge	"Many of us still have limited understanding of the usage of AI, even though it is the future of medical and dental education." (M, R#02)
	AI as the Future of Healthcare	"AI has the potential to significantly improve patient care, health care research, and teaching, which excites faculty members." (F, R#05)
	Faculty Concerns regarding AI Replacing Human Instructors in future	"Few of the faculty consider that AI could eventually take the place of human instructors and may replace them in the future" (M, R#07)
Challenges of AI Integration in Medical and Dental Education	Need to Develop Faculty	"Faculty have time concerns and need guidance for successfully incorporating AI into teaching and learning strategies." (F, R#06)
	Infrastructure and Resource Constraints	"The biggest challenge is our institutions lack infrastructure, skills and other resources to enable AI technologies." (M, R#10)
	Ethical Concerns	"There are ethical concerns such as data privacy and the possibility of AI reinforcing biases." (M, R#11)
	Lack of Transparency	"AI may generate a false information which is not based on facts." (M, R#12)
Potential Benefits of AI Integration in Medical and Dental Education	Personalized Learning	"AI can organize teaching to meet the needs, abilities, and shortcomings of each student." (F, R#14)
	Enhanced Learning Experiences	"Utilizing AI in medical and dental education can offer greater possibilities for hands-on training and enhancement of skills by bridging the knowledge gap between theory and practice both for students and the faculty." (M, R#18)
	Improved Efficiency and Productivity	"Making learning environments more effective, participatory, and engaging, allowing free time for the faculty for teaching, research work and interact with the students." (M, R#15)
The Role of Institutions in AI Integration in Medical and Dental Education	Institutional Support is Need of the Hour	"To utilize artificial intelligence (AI) efficiently in medical and dental education, those involved should allocate funds toward the required infrastructure and resources". (M, R#19)
	Provision of Extensive Faculty Trainings	"If we want to effectively use AI in educational settings, we need comprehensive training programs." (F, R#20)
Way Forward	Opportunities for Improvement	"Interaction between healthcare professionals and AI should be enhanced, not replaced." (M, R#03)
	Need for Technical Support	"It would be very beneficial for the faculty and other members to have trained and robust technical support to resolve AI-related matters." (M, R#17)
	Aligning AI Tools with Academic Goals	"Clear guidelines and protocols compatible with existing instructional methods and suitable for application in medical and dental education." (F, R#08)

**M=Male, F=Female, R= Respondent.*



Diagrammatic Presentation of Themes and sub-themes

DISCUSSION

This study was carried out to inquire faculty perceptions regarding integration of AI into medical and dental education.

The findings demonstrated that the faculty members had different opinions regarding AI knowledge and its utilization. Respondents in addition discussed potential benefits and pitfalls of integrating AI into medical and dental education. We have concluded five main themes and fifteen sub-themes from this study. The main themes offer multifaceted views on faculty members' knowledge, concerns, and expectations regarding AI's integration in medical and dental education.

There is a vast range of faculty opinions regarding AI and its integration in medical and dental

education. Most of the participants admitted they have little knowledge of how technology can be used in the classrooms. One of the participants said that "Many of us still have limited understanding of the usage of AI, even though it is the future of medical and dental education." Participants indicated that they need more fundamental information to completely comprehend AI's possibilities and limits. Previous study reveals that faculty knowledge gaps prevent AI adoption because they do not have the necessary training to successfully incorporate AI into pedagogy.[14] But they also acknowledged AI as a game-changing instrument that might completely change healthcare and education, indicating a widespread sense of optimism regarding its long-term effects.[14] In this study, faculty members expressed concerns that AI may eventually replace instructors. In another study, faculty was of same view regarding replacement of human instructors by AI reiterating findings from earlier research that educators worry about technology replacing them if it isn't balanced with the requirement for human judgement and empathy.[15]

The second theme explains the challenges of AI integration in medical and dental education. The call for use of AI comes with significant hurdles, including the requirement for faculty development, resource and infrastructure limitations, and ethical considerations. The need for focused faculty development programs was highlighted by several participants: "Faculty have time concerns and need guidance for successfully incorporating AI into teaching and learning strategies". Prior research concluded a similar stance that faculty members are unlikely to properly embrace and adapt AI techniques in the absence of proper professional development.[16]

The absence of technical resources and infrastructure within Pakistani institutions is another major barrier. One of the respondents emphasized the dearth of technical resources and infrastructure in Pakistani institutions, saying, "The biggest challenge is our institutions lack infrastructure, skills, and other resources to enable AI technologies". Globally, similar difficulties have been reported, [17] especially in areas with few financial or technological resources shown concerns about prejudice and data privacy in particular surfaced, which was in line with this research highlighted the necessity of strict ethical standards to reduce these dangers. There is also a possibility of lack of transparency as one of the participants pointed out “AI may generate false information which is not based on facts.” Few more studies[18,19] highlighted that AI tools may provide misleading data which might not be authentic. Now coming towards the benefits of AI integration in medical and dental education, various future benefits of AI in education were noted by the faculty, including increased productivity and efficiency, personalized learning, and improved learning experiences. AI's ability to adapt instruction to each student's needs was mentioned by one participant: "Organizing teaching to meet the needs, abilities, and shortcomings of each student". Since it allows for adaptable learning experiences that accommodate a range of learning styles and skills, personalized learning is often regarded as one of AI's greatest educational advantages.[20] One of the respondents expressed, "Utilizing AI in medical and dental education can offer greater possibilities for hands-on training and enhancement of skills." Another concern brought up by the participants was the potential for AI to bridge the gap between educational concepts and real-world application by providing numerous opportunities for practical training. This perspective is in agreement with worldwide studies which support AI's ability to simulate clinical scenarios to enhance applied skills.[21]

Institutional support was one of the most important criteria for the effective integration of AI in medical and dental education. The institute should allocate funds toward the required infrastructure and resources. According to study, institutional readiness has a significant impact on the effectiveness of implementing AI in healthcare education.[22] One participant said, we need comprehensive training programs to utilize AI in our teaching efficiently highlighting the strong interest in organizing training courses that would equip professionals with the knowledge to integrate AI into their educational setting. Studies that support structured training as a means of overcoming opposition and improving faculty proficiency with new technologies provide strong evidence for the significance of such programs.[23]

Finally, the faculty discussed areas that needed improvement, focusing on the necessity of technical guidance and utilizing AI tools that would be aligned with academic objectives. One participant said: "It would be very beneficial for the faculty and other members to have trained and robust technical support to resolve AI-related matters", this is consistent with a previous study[24], which found that trained supporting staff are essential for removing technical obstacles to AI adoption. In order to guarantee meaningful integration, faculty members also suggested that AI technologies may be in accordance with current educational frameworks. They suggested that "clear guidelines and protocols compatible with existing instructional methods" may be created. According to AMEE Guide no 158.[25] the use of ethical guidelines is in line with broader trends in the literature on AI education, which highlight the necessity of AI implementation strategies that

consider the particular pedagogical requirements of medical and dental education.

CONCLUSION

This study highlights both the benefits and constraints of incorporating AI into medical and dentistry education in Pakistan, offering insightful information about faculty perspectives. Faculty acknowledge that AI has the potential to revolutionize healthcare, education, and teaching, but their scant knowledge of its consequences and uses highlights the need for focused awareness and training initiatives.

Thus, integrating AI into Pakistani medical and dental education offers an array of ways but it also demands a thoughtful and equitable strategy. Infrastructure investments, faculty training, and creating an atmosphere where AI complements rather than replacing the fundamentally important human components of education are all priorities to be set by the educational institutions. These actions will open the door to a more creative and successful educational system, which will help medical and dental students and eventually healthcare professionals to serve a better role within the community.

LIMITATION OF STUDY

The results of this qualitative study are predicated on the varying subjective experiences and opinions of the faculty members. This offers deep and comprehensive insights, but it restricts the scope to broader groups and settings beyond Pakistan. As there was a small number of participants from a chosen institution, the study may not accurately reflect the variety of views by the faculty members of different medical and dental colleges across Pakistan. It's possible that variables like differences in faculty experience and institutional resources affected the results.

FUTURE RECOMMENDATIONS

Future research should adopt mixed method designs, use bigger and more varied samples, and incorporate the perspectives of administrators, students, and policymakers to provide an in-depth overview of institutional readiness for AI in medical and dental education to validate and elaborate on these findings.

AUTHORS' CONTRIBUTION

SA: Conception, acquisition, analysis, interpretation, drafting. AA: Designed methodology, analysis. HZ: Data collection, analysis, review. All authors are accountable for all aspects of the research work related to the accuracy of the findings.

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