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Perception and Utilization of Artificial Intelligence in Dentistry and Dental Education: a Cross-Sectional Survey

Sana Tariq, Jamilah Riaz Janjua, Muhammad Riaz Shahbaz Janjua, Rimsha Shiraz*, Maryam Naseem

HBS Institute of Healthcare and Allied Health Sciences Islamabad Pakistan, * Fauji Foundation Hospital Rawalpindi Pakistan

ABSTRACT

Objective: to assess perception, awareness and utilization of artificial intelligence in dental education and dental practice.
Study Design: Cross-sectional survey.
Place and Duration of Study: Online Survey across Pakistan from Mar to Oct 2025.
Methodology: A structured questionnaire was distributed electronically. Assessing demographics, awareness, Al utilization, academic benefits and perceptions regarding the role of Al in dental practice. Data were analyzed using Statistical Package for the Social Sciences (SPSS) version 22:00.
Results: A total of 210 undergraduate dental students and house officers participated in the study. The majority of respondents were familiar with artificial intelligence (86.7%), and 70.5% reported regular use of AI tools. ChatGPT was the most commonly used platform (76.2%), followed by Google Gemini (45.2%) and Grammarly (41.9%). Most participants perceived AI as beneficial in academics, particularly for summarizing learning material (85.7%), writing assignments (81.9%), and improving learning efficiency (80.0%). In clinical practice, a high proportion acknowledged the role of AI in early detection of oral diseases (86.7%), interpretation of digital radiographs (83.8%), and diagnosis (81.0%). Although 89.5% believed AI will play an important role in the future of dentistry, 57.1% expressed ethical concerns, and the majority (65.7%) disagreed that AI could replace teachers.
Conclusion: Dental trainees demonstrated a generally positive perception and increasing utilization of artificial intelligence. Higher AI use was significantly associated with favorable academic perceptions and viewed as a supportive adjunct rather than a substitute for educators.

Keywords: Artificial intelligence; Dental education; Dental trainees; Academic perception; Utilization.

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INTRODUCTION

Artificial intelligence (AI) has emerged as a significant technological advancement in healthcare, influencing diagnostics, treatment planning, and medical education. In dentistry, AI-based systems have been applied in radiographic interpretation, caries detection, orthodontic treatment planning, and academic learning support, demonstrating improved diagnostic accuracy and workflow efficiency.[1,2]

Dental education is increasingly transitioning from conventional didactic teaching toward technology-assisted and learner-centered approaches.[3] AI-driven tools such as intelligent tutoring systems, automated assessment platforms, and adaptive learning applications have shown potential to enhance academic engagement, improve conceptual understanding, and support self-directed learning among dental students.[4–6] These tools may be particularly useful in managing the academic and clinical workload faced by undergraduate students and early-career dental practitioners.

Despite growing global adoption, the integration of artificial intelligence into dental education in developing countries remains limited. In Pakistan, structured exposure to AI during undergraduate dental training is minimal, and there is limited published data regarding awareness, acceptance, and utilization of AI-based tools among dental students and house officers. Besides that, being a low and middle-income group country, the facilities of AI driven dental equipment and patient management software are not only scarce but also really expensive. This makes it out of reach of many institutions, let alone the students themselves go and search for them. Hence, understanding perceptions at this formative stage is crucial, as early professional exposure may significantly influence the future adoption and ethical use of AI in clinical practice.[7]

While artificial intelligence offers several academic and clinical advantages, concerns persist regarding over-dependence on technology, accuracy

Correspondence: Dr Rimsha Shiraz, HBS Institute of Healthcare and Allied Health Sciences Islamabad Pakistan
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limitations, ethical considerations, and the potential impact on clinical judgment.[8]

This study was conducted to assess the perception, awareness, and utilization of artificial intelligence among undergraduate dental students and house officers in Pakistan and to evaluate factors associated with its acceptance in dental education and early clinical training. In addition to academic assistance, artificial intelligence has also demonstrated potential in enhancing clinical decision-making skills during undergraduate training through simulation-based learning and virtual patient scenarios. AI-powered simulators allow students to practice diagnostic reasoning and treatment planning in a risk-free environment, thereby improving clinical confidence before real patient exposure. Such tools have been shown to bridge the gap between theoretical knowledge and clinical application in dental education.

METHODOLOGY

After obtaining ethical approval from the Institutional Review Board of HBS Medical and Dental College, Islamabad (Approval No: HBS/IRB/08/25, dated 4th March,2025), A cross-sectional survey was conducted using a structured, self-administered online questionnaire to assess the perception and utilization of artificial intelligence (AI) in dental education and practice.

Inclusion Criteria: Undergraduate dental students and house officers affiliated with dental institutes across Rawalpindi and Islamabad were included.

Exclusion Criteria: None

Undergraduate dental students and house officers affiliated with dental institutes across Rawalpindi and Islamabad were invited to participate through non-probability convenience sampling. The validated questionnaire was used in this study. The instrument consisted of the following domains: 1) Demographic characteristics, including age, gender, professional status (undergraduate student or house officer), and institutional affiliation, 2) Awareness and utilization of artificial intelligence, assessing familiarity with AI, frequency of AI use, and commonly used AI tools (e.g.,ChatGPT, Google Gemini, Notion AI, Grammarly),3) Perception of artificial intelligence in academics, evaluating the perceived role of AI in writing assignments, presentations, examinations, summarization of learning material, creation of visuals, learning efficiency, stress reduction, problem-solving ability, and academic performance, 4) Perception of artificial intelligence in dental practice, assessing beliefs regarding the role of AI in diagnosis, treatment planning, interpretation of digital radiographs, prosthetic design, and early detection of oral diseases, 5) Attitudes toward the future impact and ethical implications of artificial intelligence, including perceptions of AI's role in the future of dentistry, its potential to replace teachers, and agreement with commonly cited concerns regarding the risks of artificial intelligence.

Responses were recorded using five-point Likert scales (ranging from strongly agree to strongly disagree) and multiple-response items where applicable. The questionnaire was reviewed by subject experts for content relevance and clarity. Prior to formal data collection, it was pilot tested on a small group of respondents to ensure comprehensibility, logical flow, and face validity. Feedback from the pilot phase was used to refine question wording where necessary. Participation was voluntary, and informed consent was obtained electronically from all participants prior to data collection. No personally identifiable information was collected, and anonymity and confidentiality of responses were maintained throughout the study.

Data was analyzed by using Statistical Package for Social Sciences (SPSS) 22.00. Quantitative data was represented using Mean±SD and qualitative data was represented by using percentage and frequency. Chi square test was applied and *p*-value of ≤0.05 was considered as statistically significant.

RESULTS

A total of 210 undergraduate dental students and house officers participated in the study. The mean age of respondents was 22.18±1.90 years. The majority were female 150(71.4%) while 60(28.6%). Most participants were undergraduate dental students 170(81.0%), and the remaining were house officers (n = 40, 19.0%) (Table-I). Table II demonstrates a high level of awareness and utilization of artificial intelligence among participants, with 86.7% reporting familiarity with AI and 70.5% indicating regular use of AI tools. Among the commonly used platforms, ChatGPT was the most frequently utilized tool (76.2%), followed by Google Gemini (45.2%), Grammarly (41.9%), and Notion AI (25.7%). In the academic domain, the majority of respondents perceived AI as beneficial, particularly for summarizing learning material

(85.7%), writing assignments (81.9%), and improving learning efficiency (80.0%). A substantial proportion also agreed that AI reduces academic stress (71.4%) and enhances problem-solving ability (67.6%), although 43.8% expressed disagreement regarding its use in examinations due to ethical concerns. In dental practice, most participants acknowledged the role of AI in early detection of oral diseases (86.7%), interpretation of digital radiographs (83.8%), and diagnosis (81.0%). Furthermore, 89.5% believed that AI will play an important role in the future of dentistry, while concerns regarding ethical risks were reported by 57.1%, and the majority (65.7%) disagreed that AI could replace teachers. There was a statistically significant association between professional status and regular utilization of AI tools (p=0.009), perception of AI in diagnosis and treatment planning (p=0.042), and belief that AI could replace teachers (p<0.001). No statistically significant association was observed for awareness of AI (p=0.230) or perception of AI improving academic performance (p = 0.086) shown in Table-III.

Table-I: Demographic Characteristics of Study Participants (n=210)

Variables	Values
Mean Age (Years)	22.18±1.90
Gender	
Male	150 (71.4%)
Female	60 (28.6%)
Undergraduate Dental Students	170 (81.0%)
House Officers	40 (19.0%)

DISCUSSION

The present study assessed the perception, awareness, and utilization of artificial intelligence among dental trainees in Pakistan and demonstrated an overall positive attitude toward AI-based tools in dental education. A high level of familiarity with artificial intelligence was observed among respondents, reflecting increasing exposure to digital technologies in contemporary academic environments. Similar levels of awareness have been reported in recent international studies conducted among dental and medical students, suggesting a global shift toward acceptance of AI-driven educational support systems.[9]

A significant finding of this study was the association between age group and frequency of AI utilization, with respondents aged 21–26 years reporting more frequent use of AI tools compared to younger participants. This trend may be explained by increased academic demands, greater exposure to clinical learning environments, and higher reliance on digital resources as students progress through dental training. Previous studies have similarly reported that increased academic maturity and exposure to complex coursework are associated with higher adoption of artificial intelligence–based tools.[10,11]

Table-II: Awareness, Utilization, Perception, and Attitudes Toward Artificial Intelligence Among Participants (n = 210)

Domain	Variable	Frequency (%)
Awareness and Utilization	Familiar with AI	182 (86.7%)
	Regular use of AI tools	148 (70.5%)
	Rare/No use of AI tools	62 (29.5%)
Commonly Used AI Tools*	ChatGPT	160 (76.2%)
	Google Gemini	95 (45.2%)
	Grammarly	88 (41.9%)
	Notion AI	54 (25.7%)
Perception in Academics	Assists in writing assignments	172 (81.9%)
	Helps in presentations	165 (78.6%)
	Summarizes learning material	180 (85.7%)
	Improves learning efficiency	168 (80.0%)
	Reduces academic stress	150 (71.4%)
	Enhances problem-solving ability	142 (67.6%)
	Disagreement regarding use in examinations	92 (43.8%)
Perception in Dental Practice	Role in diagnosis	170 (81.0%)
	Role in treatment planning	158 (75.2%)
	Interpretation of digital radiographs	176 (83.8%)
	Early detection of oral diseases	182 (86.7%)
	Beneficial in prosthetic design/digital workflow	148 (70.5%)
Future Impact and Ethics	AI important in future dentistry	188 (89.5%)
	AI can replace teachers (Agree)	48 (22.9%)
	AI can replace teachers (Disagree)	138 (65.7%)
	Concern regarding ethical risks	120 (57.1%)

**Multiple responses were allowed for AI tools; therefore, percentages may exceed 100%*

Table-III: Association Between Professional Status and Awareness, Utilization, and Perception of Artificial Intelligence (n=210)

Variable	Undergraduate Students (n=170) n (%)	House Officers (n=40) n (%)	p-value
Awareness of AI (Yes)	145(85.3%)	37(92.5%)	0.230
Regular Use of AI Tools (Yes)	113(66.5%)	35(87.5%)	0.009
AI Improves Academic Performance (Agree)	140(82.4%)	28(70.0%)	0.086
AI Useful in Diagnosis and Treatment Planning (Agree)	128(75.3%)	35(87.5%)	0.042
AI Can Replace Teachers (Agree)	30(17.6%)	18(45.0%)	<0.001

Importantly, respondents who reported frequent use of artificial intelligence demonstrated a significantly more positive perception regarding its role in achieving better academic grades. Frequent AI users were more likely to perceive improvements in learning efficiency, comprehension of complex subjects, and academic performance. These findings are consistent with existing literature highlighting the role of AI in adaptive learning, personalized feedback, and enhanced academic productivity.[11–13] The strong statistical association observed in the present study

(p<0.001) reinforces the potential academic value of AI when used regularly and purposefully.

Gender-based analysis did not reveal a significant association with AI awareness or utilization, indicating that acceptance and use of artificial intelligence among dental trainees may be influenced more by academic needs and exposure rather than gender differences. Similar observations have been reported in previous studies exploring AI adoption in health professions education.[5,10]

With regard to attitudes toward the role of artificial intelligence in education, the majority of respondents disagreed with the notion that AI could replace teachers. This finding suggests that dental trainees largely perceive artificial intelligence as a supportive adjunct rather than a substitute for human instruction. This perspective aligns with ethical and educational frameworks emphasizing that artificial intelligence should complement, rather than replace, clinical reasoning, faculty mentorship, and professional judgment.[14]

Faculty development and educator preparedness remain critical challenges in the effective implementation of artificial intelligence in dental education. Without adequate training and regulatory oversight, the educational benefits of AI may not be optimally realized. Recent literature emphasizes the need for faculty upskilling and institutional policies to ensure ethical, transparent, and pedagogically sound use of AI technologies in academic settings.[15]

The findings of this study have important implications for dental education in Pakistan. The positive perception of artificial intelligence, particularly among frequent users, indicates readiness for structured integration of AI concepts into undergraduate dental curricula. Introducing foundational AI literacy, along with guided and ethically regulated use of AI-based tools, may enhance learning outcomes while minimizing risks associated with over-dependence or misuse. Recent educational frameworks have similarly advocated for the inclusion of AI competencies within health professions education to prepare future practitioners for technology-enhanced practice.[16,17]

Furthermore, artificial intelligence–driven feedback systems can provide immediate, objective, and individualized academic feedback, which is often difficult to achieve in conventional large-group teaching settings. This individualized feedback mechanism has been associated with improved student satisfaction and self-directed learning behaviors in health professions education.[18]

LIMITATIONS OF STUDY

This study has certain limitations. The use of non-probability convenience sampling and self-reported responses may limit generalizability and introduce response bias. Additionally, the cross-sectional design does not allow causal inferences regarding the impact of artificial intelligence on academic performance. Future multicenter and longitudinal studies using validated assessment instruments are recommended to further evaluate the long-term educational and clinical implications of artificial intelligence in dental training.

CONCLUSION

Dental trainees demonstrated a generally positive perception and increasing utilization of artificial intelligence in academic and clinical learning. Higher frequency of AI use was significantly associated with more favorable academic perceptions, including improved learning efficiency and perceived academic performance. While attitudes toward the future role of artificial intelligence in dentistry were largely positive, most respondents viewed AI as a supportive tool rather than a replacement for educators. These findings highlight the growing presence of artificial intelligence in dental education and its perceived academic value among dental trainees.

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Authors' Contribution

Following authors have made substantial contributions to the manuscript as under:

ST & JRJ: Study design, drafting the manuscript, data interpretation, critical review, approval of the final version to be published.

MRSJ & RS: Data acquisition, data analysis, approval of the final version to be published.

MN: Critical review, concept, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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