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Artificial intelligence in dentistry: knowledge, attitudes, and educational readiness among dental students and dentists

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Abstract

Background Applications of artificial intelligence (AI) in medicine and dentistry have been increasing in recent years. Understanding the educational readiness, learning needs, and perceptions of AI among dental students and professionals is essential for curriculum development. This study aimed to evaluate the level of knowledge, sources of information, attitudes, and educational preparedness regarding AI among dental students' and dentists.

Methods A cross-sectional, anonymous online survey was conducted among 501 participants (332 females, 169 males), including undergraduate dental students, postgraduate/doctoral students, and practicing dentists. The 28-item questionnaire assessed demographics, AI knowledge, attitudes toward AI, and views on AI education. Descriptive statistics were used to summarize the data; Mann–Whitney U, Kruskal–Wallis, and chi-square tests were applied for group comparisons, while binary logistic regression and Spearman correlation analyses were used to examine predictors and associations related to AI learning and curriculum support.

Results More than half of the participants (53.7%) reported only superficial knowledge of AI, while 4.8% reported no knowledge. Formal university-based education was the primary source of AI information for only 3% of respondents, whereas social media constituted the main source for 64.7%. Despite limited structured educational exposure, attitudes toward AI were predominantly positive. Over 70% of participants agreed that AI should be included as an educational component supporting diagnostic reasoning and learning processes, while agreement with statements suggesting that AI would replace dentists within the next 30 years was low. Significant differences in AI perceptions were observed according to age and gender ($p \leq 0.001$), whereas professional experience showed limited influence on overall attitudes. Willingness to learn and apply AI-based systems was moderately correlated with perceived clinical benefit ($\rho = 0.524$, $p < 0.001$) and the perceived need to integrate AI into dental education ($\rho = 0.553$, $p < 0.001$).

Conclusions Despite limited formal education, dental professionals view AI as a supportive tool rather than a replacement. Given that social media was the primary source of AI information while formal university-based education was minimal, these findings highlight a clear need for structured curricular integration. These findings necessitate the integration of AI literacy into both university curricula and lifelong learning frameworks to ensure professional continuity.

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Keywords AI literacy, Attitudes, Awareness, Dentistry, Technology acceptance

Introduction

Artificial intelligence (AI) has been increasingly integrated into dentistry, offering innovative solutions to a wide range of clinical and educational challenges [1]. Advances in machine learning and deep learning have enabled AI-based systems to analyze large and complex datasets, thereby supporting diagnostic accuracy, treatment planning, and clinical decision-making in dental practice [2]. These developments have particularly influenced areas such as dental imaging interpretation, caries detection, radiographic analysis, pathology assessment, and electronic health record management [1, 3].

Beyond its clinical applications, AI is increasingly shaping dental education and practice by enhancing exposure to complex diagnostic scenarios, supporting evidence-based decision-making, strengthening interdisciplinary collaboration, and improving workflow efficiency through predictive analytics and partial automation [4–6]. Overall, these developments position AI as a complementary technology within modern dental practice and education [1, 7–9].

As AI becomes increasingly integrated into routine dental practice, preparing both current and future dental professionals to use these systems responsibly and effectively has become an important educational priority. Previous studies [7, 10, 11] have examined AI-related knowledge, attitudes, awareness, and readiness in dentistry; however, most have focused on single groups and provided mainly descriptive findings. As a result, comparative evidence across educational and professional levels remains limited, despite clear differences in clinical exposure, learning needs, and responsibilities between undergraduate students, postgraduate trainees, and practicing dentists. In addition, formal AI training is still limited in traditional dental curricula [12–14], and few studies have used multivariable models to examine which perceptions independently influence support for integrating AI into dental education. Therefore, this study aimed to compare undergraduate students, postgraduate trainees, and practicing dentists in terms of AI-related knowledge, information sources, attitudes, and perceived educational preparedness, and to identify factors associated with support for AI-related curriculum integration. Based on the existing literature, it was hypothesized that perceived clinical usefulness of AI and support for AI-related curricular integration would be positively associated with willingness to learn and apply AI-based systems, while demographic characteristics would contribute more limited independent effects.

Methods

This survey study was approved by the Local Ethical Board (Approval Number 2025/551 approval Date: 30.01.2025) and carried out in accordance with the guidelines of the Declaration of Helsinki. The study followed the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines for cross-sectional studies.

Sample size

A priori power analysis was conducted using G*Power software (version 3.1.9.7; Heinrich Heine University Düsseldorf, Düsseldorf, Germany) to determine the required sample size for group comparisons. Based on a one-way analysis of variance (ANOVA) with fixed effects and an omnibus design, a medium effect size was assumed ($f = 0.25$). The significance level was set at $\alpha = 0.05$, and the desired statistical power was 90% ($1 - \beta = 0.90$). Considering comparisons across three independent groups, the minimum required total sample size was calculated as 207 participants. The achieved power for this configuration was 0.90, indicating that the study was adequately powered to detect statistically meaningful differences between groups.

Ultimately, a total of 501 participants were included in the final analysis, exceeding the minimum required sample size.

Participants

Participation in this survey study was entirely voluntary. The study population consisted of undergraduate dental students, postgraduate/specialty or doctoral students, and practicing dentists. This heterogeneous sample was intentionally selected to capture perspectives on artificial intelligence (AI) across different stages of dental education and professional experience.

Undergraduate and postgraduate/doctoral students were recruited from four different dental faculties. These institutions were located in different regions of Türkiye, including Central Anatolia and Marmara, in order to enhance geographical diversity within the sample. Approximately 1,000 undergraduate and 500 postgraduate students were invited to participate in the study through institutional communication channels. The Google Forms survey link was distributed via official faculty mailing lists, student communication groups, and institutional social media platforms. Faculty representatives assisted in disseminating the survey within their respective institutions to maximize participation. Of these, 298 undergraduate students and 56 postgraduate/doctoral students completed the survey. Thus, the

student response proportion was approximately 23.6% based on the estimated number of invited students.

Among the 298 undergraduate participants, the distribution by academic year was as follows: 1st year ($n = 98$), 2nd year ($n = 60$), 3rd year ($n = 101$), 4th year ($n = 18$), and 5th year ($n = 21$).

The 56 postgraduate/doctoral students represented approximately 11.2% of the total invited student population.

Practicing dentists ($n = 147$) were identified through professional networks and contacted via social media platforms and messaging groups affiliated with regional dental chambers. The survey link was disseminated electronically, and participation was voluntary.

Undergraduate participants included dental students from all years of study, allowing the survey to capture AI-related knowledge and perceptions across different stages of undergraduate dental education. Postgraduate and doctoral students, as well as practicing dentists working in public, university, or private settings, were included to reflect professional perspectives shaped by clinical responsibility and experience.

The inclusion criteria were as follows: (i) being an undergraduate dental student, postgraduate/specialty or doctoral student, or a practicing dentist; (ii) voluntarily agreeing to participate in the study; and (iii) completing the questionnaire in full. Exclusion criteria included refusal to participate and submission of incomplete survey responses. Participants with missing responses in key outcome variables were excluded from inferential analyses.

All participants were informed about the purpose of the study prior to participation, and electronic informed consent was obtained through the survey platform. Anonymity and confidentiality of all collected data were strictly maintained throughout the data collection and analysis processes.

Study design and survey instrument

This study employed a cross-sectional, questionnaire-based design.

The survey instrument was developed using Google Forms and distributed online between January to June 2025. It consisted of a total of 28 questions addressing demographic characteristics, educational background, knowledge of AI, and perceptions of AI in dental education and clinical practice. The questionnaire included 10 multiple-choice questions, 12 five-point Likert-scale items, 3 multiple-response items, and 3 open-ended questions.

Demographic variables included gender, age, educational status (undergraduate level for students), postgraduate/specialty or doctoral training, current professional position (public, university, or private practice), and professional experience. For practicing dentists, professional experience was categorized into four groups: ≤5 years, 5–10 years, 10–20 years, and > 20 years.

The survey items explored participants' awareness of AI, levels of concern regarding AI developments, perceived clinical and educational applications of AI. The full English version of the questionnaire is provided as Supplementary File 1.

The questionnaire was intentionally designed to evaluate general awareness, perceptions, and educational preparedness regarding artificial intelligence in dentistry rather than focusing on specific AI natural language systems (e.g., AI chatbots). At the time of survey development, the aim was to assess broader conceptual readiness toward AI integration in education and clinical practice rather than usage patterns of individual platforms. Therefore, questions regarding the frequency or specific prior use of AI chatbot systems were not included.

Survey development, validity, and reliability

The questionnaire was developed de novo by combining and adapting items from previously published surveys investigating artificial intelligence in dentistry and dental education [3, 7, 11, 15]. Prior to the main survey administration, a pilot study was conducted with a small group of 20 dental students and practicing dentists to evaluate clarity, comprehensibility, and estimated completion time. Participants in the pilot phase were asked to provide feedback regarding wording, item relevance, and overall structure. Minor revisions were made to improve clarity and reduce ambiguity before final dissemination. Data from the pilot study were not included in the final analysis. To establish content validity, the questionnaire was evaluated using the Content Validity Index (CVI) process as described by Yusoff [16]. Two independent experts—both faculty members with academic experience in dentomaxillofacial radiology and prior research involvement in artificial intelligence applications in dental imaging—rated each item for relevance and clarity using a four-point scale. Item-level CVI (I-CVI) values were calculated by dividing the number of experts rating each item as either 3 or 4 by the total number of experts. All items demonstrated acceptable content validity, with I-CVI values exceeding the recommended threshold. The scale-level content validity index (S-CVI/Ave) was 0.94, indicating excellent overall content validity. Items requiring minor revision were refined accordingly prior to finalization.

The internal consistency of the questionnaire was assessed to evaluate its reliability. Reliability analysis was performed using Cronbach's alpha coefficient, which is widely accepted for Likert-scale survey instruments. The overall Cronbach's alpha value was 0.87, indicating a high level of internal consistency and demonstrating that the

questionnaire reliably measures perceptions and attitudes toward artificial intelligence in dentistry and dental education.

Statistical analysis

Statistical analysis was performed using the Statistical Package for the Social Sciences (SPSS Statistics version 22.0; IBM Corp., NY, USA). Descriptive statistics were used to summarize demographic variables and survey responses, which were reported as frequencies, percentages, means, and medians, as appropriate.

Comparisons between groups were conducted based on gender, age group, student status, and professional experience. The chi-square test was used for categorical variables, while the Mann–Whitney U test and Kruskal–Wallis test were applied for ordinal data derived from Likert-scale items. The Kruskal–Wallis test was specifically used to assess whether perceptions of AI differed according to professional experience.

For multivariable analysis, binary logistic regression was performed to identify independent predictors of (i) willingness to learn AI-based systems and (ii) support for the integration of AI into the dental curriculum. Five-point Likert responses were dichotomized prior to analysis (scores 1–2 = 0, indicating disagreement; scores 3–5 = 1, indicating neutral-to-positive endorsement). This transformation was applied to facilitate clinically and educationally interpretable odds ratios and to distinguish respondents with negative views from those showing at least a neutral or favorable orientation toward AI-related statements. Although dichotomization may reduce variability and result in some loss of information, it was considered appropriate in the present study because the primary objective of the regression analysis was to model overall endorsement versus disagreement in relation to educational readiness outcomes. Alternative approaches, such as ordinal logistic regression, were considered; however, they were not preferred because the study focused on parsimonious and readily interpretable models for applied educational questions, and because the outcome structure was analytically aligned with a binary distinction between disagreement and non-disagreement. This approach has also been used in the analysis of Likert-type survey data within regression frameworks [17, 18]. Odds ratios (ORs) with 95% confidence intervals (CIs) were reported.

Additionally, qualitative content analysis was performed on open-ended responses following the approach described by Elo et al. [19]. Responses were read repeatedly to achieve immersion, coded inductively, and grouped into categories based on thematic similarity. Coding was conducted independently by two researchers, and discrepancies were resolved through discussion to enhance trustworthiness. Frequently used terms were also identified and visualized using word clouds to illustrate general thematic trends.

To assess the adequacy of the logistic regression models, model assumptions were examined prior to analysis. Multicollinearity among independent variables was evaluated using variance inflation factors (VIF), and no evidence of problematic multicollinearity was observed. Model fit was assessed using the Hosmer–Lemeshow goodness-of-fit test, indicating acceptable agreement between observed and predicted outcomes.

Results

A total of 501 participants were included in the study, of whom 332 (66.3%) were female and 169 (33.7%) were male. Most participants were undergraduate dental students ($n = 298$, 59.5%), followed by practicing dentists ($n = 147$, 29.3%) and postgraduate/doctoral students ($n = 56$, 11.2%). Most participants were under 25 years of age, reflecting the high proportion of undergraduate students in the sample.

Regarding artificial intelligence awareness, more than half of the participants (53.7%) reported having only superficial knowledge, while 23.6% were familiar with AI but did not feel confident applying it in clinical practice. Only 18.0% reported active professional use of AI, and 4.8% indicated no knowledge of AI. Social media was the most frequently reported source of AI-related information (64.7%), followed by colleagues/peers (20.4%) and university courses (3.0%). General response distributions for AI-related perceptions and educational attitudes are presented in Table 1.

According to professional status, a statistically significant difference was observed only for concern regarding recent developments in AI (Kruskal–Wallis $H = 19.14$, $p < 0.001$; Table 2). No significant differences were found for perceived contribution of AI to diagnosis and treatment planning, reduction of clinical workload, or support for integration of AI-related content into dental education ($p > 0.05$ for all; Table 2).

According to gender, significant differences were found in perceived contribution of AI to diagnosis and treatment planning ($p = 0.016$) and reduction of clinical workload ($p = 0.001$), whereas no significant differences were observed for concern regarding AI developments or support for curricular integration (all $p > 0.05$; Table 3).

Across age groups, all evaluated AI-related perceptions differed significantly, including concern regarding AI developments, perceived contribution to diagnosis and treatment planning, perceived reduction of clinical workload, and support for integration of AI-related content into dental education (all $p \leq 0.001$; Table 4). These findings indicate that perceptions toward artificial intelligence vary substantially across different age groups.

Table 1 Participants' attitudes, perceptions, and concerns regarding artificial intelligence in dentistry (5-point Likert scale: 1 = strongly disagree, 5 = strongly agree)

Statement (1 = lowest, 5 = highest)	Mean ± SD	Median(IQR)
I consider myself technologically competent	3.32 ± 1.01	3(3–4)
I am concerned about recent developments in AI in dentistry	2.43 ± 1.19	2(2–3)
AI can positively contribute to diagnosis and treatment planning in dentistry	3.27 ± 1.17	3(3–4)
AI will replace dentists within the next 30 years	1.92 ± 1.16	2(1–3)
AI does not impose limitations on my professional practice	2.42 ± 1.21	2(2–3)
Recent AI developments in dentistry are exciting	3.04 ± 1.23	3(2–4)
AI-based systems pose ethical risks	3.33 ± 1.15	3(3–4)
AI-related education should be more extensively incorporated into the formal dental curriculum	3.55 ± 1.18	4(3–5)
I feel ready to learn and apply AI in my practice	2.98 ± 1.24	3(2–4)
AI-based systems can reduce dentists' workload	3.50 ± 1.15	4(3–4)
AI can reduce iatrogenic errors in dentistry	3.16 ± 1.18	3(3–4)
AI should be recognized as a core component of dental education	3.42 ± 1.14	3.5(3–5)

Table 2 Comparison of AI-related perceptions according to participant type

Variable	Kruskal–Wallis H	*p* value
AI-related concern level	19.14	**< 0.001**
AI contribution to diagnosis and treatment planning	1.06	0.589
AI reduces clinical workload	2.39	0.303
AI content should be integrated into dental education	3.81	0.149

Table 3 Comparison of AI-related perceptions according to gender

Variable	Mann–Whitney U	*p* value
AI-related concern level	30,584.0	0.084
AI contribution to diagnosis and treatment planning	24,493.0	**0.016**
AI reduces clinical workload	23,361.0	**0.001**
AI content should be integrated into dental education	25,740.0	0.119

Among practicing dentists, years of professional experience were not significantly associated with concern regarding recent developments in AI (Kruskal–Wallis H = 5.65, $p = 0.13$; Table 5). However, significant differences were identified for perceived contribution of AI to diagnosis and treatment planning, reduction of clinical workload, and support for integration of AI-related content into dental education (all $p < 0.001$; Table 5). Overall, more experienced dentists tended to report higher perceived benefits and stronger support for the integration of AI into clinical practice and education.

Table 4 Comparison of AI-related perceptions according to age groups

Variable	Kruskal–Wallis H	*p* value
AI-related concern level	30.92	< 0.001
AI contribution to diagnosis and treatment planning	18.66	0.001
AI reduces clinical workload	27.98	< 0.001
AI content should be integrated into dental education	27.91	< 0.001

Table 5 Comparison of AI-related perceptions according to professional experience (practicing dentists only)

Variable	Kruskal–Wallis H	*p* value
AI-related concern level	5.65	0.130
Perceived contribution of AI to diagnosis and treatment planning	25.43	< 0.001
Perceived potential of AI to reduce clinical workload	23.74	< 0.001
Perceived need to integrate AI-related content into dental education	24.78	< 0.001

Table 6 Comparison of AI-related perceptions between students and practicing dentists

Variable	Mann–Whitney U	*p* value
AI-related concern level	32,058.5	< 0.001
Perceived contribution of AI to diagnosis and treatment planning	27,435.0	0.320
Perceived potential of AI to reduce clinical workload	24,304.0	0.228
Perceived need to integrate AI-related content into dental education	24,444.0	0.270

When participants were grouped as students versus practicing dentists, only concern regarding recent developments in AI differed significantly between groups (Mann–Whitney U = 32,058.5, $p < 0.001$; Table 6). No significant differences were found for the other evaluated AI-related perceptions (all $p > 0.05$; Table 6).

Spearman correlation analysis showed that willingness to learn and apply AI-based systems was positively correlated with perceived contribution of AI to diagnosis and treatment planning ($\rho = 0.393$, $p < 0.001$), reduction of clinical workload ($\rho = 0.524$, $p < 0.001$), and support for integration of AI-related content into dental education

(ρ = 0.553, $p < 0.001$; Table 7). No significant correlation was found between concern regarding AI developments and willingness to learn AI (ρ = 0.030, $p = 0.509$).

In multivariable logistic regression analysis, support for integration of AI into the dental curriculum was the strongest independent predictor of willingness to learn and apply AI-based systems (Model A: OR = 5.89, 95% CI: 3.47–9.99; $p < 0.001$). In Model B, willingness to learn AI (OR = 5.87, 95% CI: 3.46–9.97; $p < 0.001$) and perceived clinical benefit of AI (OR = 4.86, 95% CI: 2.80–8.41; $p < 0.001$) were significant independent predictors of support for integrating AI into dental education. Sex, age group, and professional status were not significantly associated with either model (Table 8), and model fit was acceptable based on the Hosmer–Lemeshow test ($p > 0.05$).

Content analysis of open-ended responses identified recurring themes related to education, artificial intelligence, and deep learning. Frequently reported terms also reflected clinical utility, including diagnostic accuracy, decision support, efficiency, and workload reduction, as well as concerns related to ethics, data privacy, and human oversight (Fig. 1).

Table 7 Spearman correlations between willingness to learn AI and AI-related perceptions

Variable 1	Variable 2	Spearman's rho	*p* value
AI-related concern level	Willingness to learn and apply AI	0.030	0.509
Perceived contribution of AI to diagnosis and treatment planning	Willingness to learn and apply AI	0.393	< 0.001
Perceived potential of AI to reduce clinical workload	Willingness to learn and apply AI	0.524	< 0.001
Perceived need to integrate AI-related content into dental education	Willingness to learn and apply AI	0.553	< 0.001

Table 8 Binary logistic regression analyses of AI readiness outcomes

Predictor	Model A: AI Learning Willingness OR (95% CI)	*p*-value	Model B: Curriculum Integration OR (95% CI)	*p*-value
Perceived Clinical Benefit of AI	—	—	**4.86 (2.80–8.41)**	**< 0.001**
Support for AI Curriculum Integration	**5.89 (3.47–9.99)**	**< 0.001**	—	—
Willingness to Learn AI	—	—	**5.87 (3.46–9.97)**	**< 0.001**
Sex (Male vs. Female)	0.85 (0.49–1.46)	0.56	0.85 (0.48–1.48)	0.56
Status: Postgraduate vs. Dentist	1.06 (0.40–2.85)	0.90	1.06 (0.40–2.86)	0.90
Status: Undergraduate vs. Dentist	1.15 (0.38–3.52)	0.81	1.15 (0.38–3.53)	0.81
Age 25–35 vs. < 25	1.09 (0.36–3.28)	0.88	1.09 (0.36–3.29)	0.88
Age 35–45 vs. < 25	1.40 (0.26–7.57)	0.70	1.40 (0.26–7.58)	0.70
Age 45–55 vs. < 25	1.74 (0.27–11.07)	0.56	1.74 (0.27–11.08)	0.56
Age ≥ 55 vs. < 25	3.39 (0.25–45.31)	0.36	3.39 (0.25–45.32)	0.36

Discussion

This study evaluated AI-related knowledge, attitudes, and educational readiness among dental students and dentists and showed three main findings: formal education on AI was limited, attitudes toward AI were generally positive, and support for AI learning was more strongly associated with perceived usefulness than with demographic characteristics. These findings help clarify how AI is currently perceived across different stages of dental education and professional practice [20–22].

Consistent with previous survey-based studies, our findings demonstrate that formal education-based exposure to AI remains limited. In the present study, 53.7% of participants reported only superficial knowledge of AI, while 4.8% indicated no knowledge at all, highlighting a persistent "knowledge gap" despite growing interest in AI technologies. In our cohort of 501 participants, only 3% reported university-based courses as their primary source of AI knowledge, while the majority relied on informal sources such as social media (64.7%). This pattern closely mirrors findings from global studies, including those by Shrateh et al. [23] and Halat et al. [24], where strong general awareness coexisted with limited formal training opportunities. Similar educational gaps were reported by Roganović et al. [25], where only 7.9% of final-year dental students were familiar with AI applications. Taken together, these results indicate a structural mismatch between growing interest in AI and the limited availability of structured, curriculum-based education [8, 11].

The predominance of social media as an information source is also important. While such platforms may increase awareness, they may not provide balanced or sufficiently critical information about the clinical, ethical, and technical limitations of AI systems [26]. This may partly explain why favorable attitudes coexisted with limited self-reported knowledge in our sample. Accordingly, AI-related education in dentistry may need to extend beyond technical familiarity and include critical appraisal and ethical awareness [27].

In contrast to the skepticism observed by Roganović et al. [25]—where only 34% of respondents supported AI implementation—participants in our study reported



Fig. 1 Word cloud illustrating the most frequently reported themes related to the perceived advantages and disadvantages of artificial intelligence in dentistry, with emphasis on educational and clinical dimensions

broadly positive expectations regarding AI's role in dentistry. More than 70% agreed that AI could support diagnosis and treatment planning and help reduce clinical workload, while agreement with the statement that AI would replace dentists within the next 30 years remained low. This pattern reflects a predominantly complementary view of AI, consistent with the "collaborative intelligence" perspective described in the literature. This interpretation is consistent with previous studies in which AI was viewed more as an augmentative than a replacement technology [22, 28].

Importantly, our findings extend prior research by demonstrating that readiness toward AI is driven primarily by perceived clinical and educational utility. Willingness to learn and apply AI-based systems was moderately correlated with perceived contributions to diagnosis and treatment planning ($\rho = 0.393$), workload reduction ($\rho = 0.524$), and the perceived need for curriculum integration ($\rho = 0.553$; all $p < 0.001$). No association was observed between general AI-related concern and learning willingness ($\rho = 0.030$, $p = 0.509$), underscoring the central role of performance expectancy as a determinant of AI readiness [29].

These associations were also reflected in the logistic regression models. Participants reporting support for AI curriculum integration were more likely to express willingness to learn and apply AI-based systems (OR = 5.89, 95% CI: 3.47–9.99), while willingness to learn AI (OR = 5.87, 95% CI: 3.46–9.97) and perceived clinical benefit (OR = 4.86, 95% CI: 2.80–8.41) were associated with support for curricular integration. However, these findings should be interpreted cautiously. Because the study was cross-sectional, self-reported, and based on dichotomized Likert outcomes, the regression models identify statistical associations rather than directional or causal relationships. In addition, although major demographic variables were included, residual confounding from unmeasured factors such as prior digital literacy, institutional exposure to AI-related content, or personal technology interest cannot be excluded. Model assumptions, including independence of observations and absence of problematic multicollinearity, were considered during analysis; however, formal calibration and model fit indices were not comprehensively evaluated, which should be acknowledged when interpreting the magnitude of these associations. Therefore, the regression results are best understood as exploratory indicators of factors linked to AI readiness rather than definitive evidence for curriculum policy decisions [30, 31]. Nevertheless, the consistency of findings across correlation and regression analyses supports the internal robustness of the observed associations.

Demographic analyses revealed age-related differences in AI perceptions (all $p \leq 0.001$), suggesting a generational digital gradient. Interestingly, more experienced dentists reported stronger perceived benefits and greater curricular support. This aligns with Jeong et al. [28], who proposed that experienced clinicians may better recognize AI's potential to standardize procedures and reduce human error.

Gender-based differences were also observed in our study, with significant differences in perceived clinical

contribution (p = 0.016) and workload reduction (p = 0.001), though not in overall concern levels. These findings add nuance to existing literature, as prior studies have variably reported higher AI knowledge among male participants [32] or greater ethical concern among female dentists [25], suggesting that gender may influence perceived utility rather than generalized anxiety.

Compared with student-focused studies, such as that by Elchaghaby and Wahby [33], our inclusion of both learners and practicing dentists provides a broader view of AI perceptions across professional stages. Similar to previous reports, positive attitudes in our sample coexisted with limited practical exposure [3, 15], suggesting that favorable perception alone does not indicate educational preparedness.

In the Turkish dental education context, the gap between positive attitudes and limited formal exposure may also reflect the density of existing curricula and the uneven integration of emerging digital content across institutions. This may help explain why interest in AI appears to be ahead of formal training opportunities.

Taken together, the present findings indicate that contemporary dental professionals and students increasingly view AI as a beneficial and supportive component of both clinical practice and dental education, despite limited formal training. International position statements, including those by the FDI World Dental Federation [27], emphasize the importance of standardized AI literacy frameworks to ensure safe, ethical, and evidence-based implementation. Integrating AI concepts into undergraduate curricula and continuing professional development programs may therefore be critical for transforming positive attitudes into informed, ethical, and effective AI adoption. Early exposure, combined with clinically relevant applications and ethical guidance, has the potential to reduce misconceptions, align expectations with realistic capabilities, and ensure responsible integration of AI technologies into dentistry [22, 34]. Importantly, such integration should be conceptualized as a longitudinal educational process extending across undergraduate education, postgraduate training, and lifelong professional development, rather than as a single curricular intervention [21, 35].

Limitations

This study has several limitations. First, its cross-sectional design reflects perceptions at a single time point and does not allow assessment of changes in AI readiness over time. Second, although the sample was relatively large and included participants from different educational and professional levels, the voluntary online recruitment strategy may have introduced selection and accessibility bias, potentially favoring individuals with greater digital engagement. Consequently, despite recruitment from multiple institutions and professional networks, the sample cannot be considered fully representative of the entire dental population in Türkiye.

Third, the reliance on self-reported Likert-scale responses may be subject to social desirability and recall bias and may not fully capture nuanced or context-dependent perceptions of AI competence. The survey also did not include direct measures of operational AI capability; readiness was inferred indirectly through attitudinal items assessing willingness to learn and apply AI-based systems.

In addition, a substantial proportion of respondents were pre-clinical undergraduate students without direct patient care experience, which may have influenced responses to items addressing clinical utility. While content validity was established using the Content Validity Index (CVI) and a pilot study was conducted, construct validity was not examined through factor analysis, as the instrument was designed for exploratory assessment rather than multidimensional scale development. Finally, the findings reflect a single national context and may not be directly generalizable to other educational systems.

Conclusion

This study identified a clear gap between interest in AI and formal educational preparedness within the dental community. More than half of the participants (53.7%) reported only superficial knowledge of AI, and formal university-based education accounted for just 3% of AI exposure. Despite this limited educational background, participants generally viewed AI as a supportive educational and clinical tool, while concerns about professional replacement remained low. AI readiness was associated more strongly with perceived educational and professional benefit than with demographic characteristics. These findings indicate that perceived usefulness may play a central role in shaping support for AI learning across different stages of dental education and practice.

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12909-026-09264-x.

Supplementary Material 1.

Acknowledgements

This study was initially presented at the 3rd International Dental Education Congress in Bolu, Turkey, on February 20–22, 2025, based on a preliminary dataset (n = 380). The final analyses reported in this manuscript were conducted using the complete dataset (n = 501).

Authors' contributions

Study Design: AA. Data Collection: AA, SU, ÖA, KO. Statistical Analysis: ÖA, AA. Data Interpretation: AA, ÖA, SU, KO. Manuscript Preparation: AA, SU, ÖA, KO. Literature Search: AA, SU, ÖA, KO.

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Data availability
Data are available from the corresponding author upon reasonable request.

Declarations

Ethics approval and consent to participate
The study received ethical approval from the Research Ethics Committee of the Faculty of Dentistry at Necmettin Erbakan University, and the study was conducted in accordance with the Helsinki Declaration of Human Rights guidelines (Approval Date: 30.01.2025; Approval Number: 2025/551). Informed consents were obtained from all participants, and all data were processed anonymously.

Consent for publication
This study did not include any individual person's data in an identifiable form.

Competing interests
The authors declare no competing interests.

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References

1. Costin LI, Vasluianu RI, Baciu R-E, Agop-Forna D, Cătălin TS, Forna CN. The integration of artificial intelligence in dental practice. Rom J Oral Rehabil. 2023;2:272–9.
2. Wong S, Al-Hasani H, Alam Z, Alam, AJEr. Artificial intelligence in radiology: how will we be affected? Eur Radiol. 2019;29(1):141–3.
3. Eschert T, Schwendicke F, Krois J, Bohner L, Vinayahalingam S, Hanisch MJM. A survey on the use of artificial intelligence by clinicians in dentistry and oral and maxillofacial surgery. Medicina. 2022;58(8):1059.
4. Sadeep H. Assessment of knowledge and awareness of artificial intelligence and its uses in dentistry among dental students. J Pharm Negat Results. 2022;13:1304–309.
5. Chen Y-w, Stanley K, Att W. Artificial intelligence in dentistry: current applications and future perspectives. Quintessence Int. 2020;51(3):248–57.
6. Kılıc MC, Bayrakdar IS, Çelik Ö, Bilgir E, Orhan K, Aydın OB, Kaplan FA, Sağlam H, Odabaş A, Aslan AF. Artificial intelligence system for automatic deciduous tooth detection and numbering in panoramic radiographs. Dentomaxillofac Radiol. 2021;50(6):20200172.
7. Murali S, Bagewadi A, Kumar L, Fernandes A, Panwar A, Keluskar V. Knowledge, attitude, and perception of dentists regarding the role of artificial intelligence and its applications in oral medicine and radiology: a cross sectional study. J Oral Med Oral Surg. 2023;29(2):22.
8. El-Hakim M, Anthonappa R, Fawzy A. Artificial intelligence in dental education: a scoping review of applications, challenges, and gaps. Dent J. 2025;13(9):384.
9. Carrillo-Perez F, Pecho OE, Morales JC, Paravina RD, Della Bona A, Ghinea R, Pulgar R, Pérez MM, Herrera L. Applications of artificial intelligence in dentistry: A comprehensive review. J Esthet Restor Dent. 2022;34(1):259–80.
10. Krishnaprakash G, Jodalli P, Shenoy RP, Mohammed IP, Amanna S. Dentists' Knowledge, attitude, and perception regarding robotics and artificial intelligence in oral health and preventive dentistry: a cross-sectional study. J Clin Diagn Res. 2023;17(7):47–51.
11. Yüzbaşıoğlu E. Attitudes and perceptions of dental students towards artificial intelligence. J Dent Educ. 2021;85(1):60–8.
12. Alanya-Beltran J, Padilla-Caballero J, Shah S, Tomar PK, Mareeskannan V. Dentistry in the age of automation: the benefits and challenges of AI and robotics. In: 3rd International Conference on Advance Computing and Innovative Technologies in Engineering (ICACITE) *2023*: IEEE; Int Conf Adv Comput Innov Technol Eng. 2023;2682–87.
13. Abouzeid HL, Chaturvedi S, Abdelaziz KM, Alzahrani FA, AlQarni AAS, Alqahtani NM. Role of robotics and artificial intelligence in oral health and preventive dentistry–knowledge, perception and attitude of dentists. Oral Health Prev Dent. 2021;19:b1693873.
14. Saghiri MA, Vakhnovetsky J, Nadershahi N. Scoping review of artificial intelligence and immersive digital tools in dental education. J Dent Educ. 2022;86(6):736–50.
15. Hamd ZY, Elshami W, Al Kawas S, Aljuaid H, Abuzaid MMJH. A closer look at the current knowledge and prospects of artificial intelligence integration in dentistry practice: a cross-sectional study. Heliyon. 2023;9(6):e17089.
16. Yusoff MSB. ABC of content validation and content validity index calculation. Educ Med J. 2019;11(2):49–54.
17. Norman G. Likert scales, levels of measurement and the laws of statistics. Adv Health Sci Educ. 2010;15(5):625–32.
18. Sullivan GM, Artino Jr. Analyzing and interpreting data from Likert-type scales. J Grad Med Educ. 2013;5(4):541–2.
19. Elo S, Kääriäinen M, Kanste O, Pölkki T, Utriainen K, Kyngäs H. Qualitative content analysis: A focus on trustworthiness. Sage Open. 2014;4(1):2158244014522633.
20. Schwendicke F, Chaurasia A, Wiegand T, Uribe SE, Fontana M, Akota I, Tryfonos O, Krois J. Artificial intelligence for oral and dental healthcare: core education curriculum. J Dent. 2023;128:104363.
21. Car J, Ong QC, Fox TE, Leightley D, Kemp SJ, Švab I, Tsoi KK, Sam AH, Kent FM, Hertelendy A. The digital health competencies in medical education framework: an international consensus statement based on a Delphi study. JAMA Netw Open. 2025;8(1):e2453131–2453131.
22. Pauwels R, Del Rey YC. Attitude of Brazilian dentists and dental students regarding the future role of artificial intelligence in oral radiology: a multicenter survey. Dentomaxillofac Radiol. 2021;50(5):20200461.
23. Shrateh ON, Al-Batat S, Al-Qudimat AR, Ghannam LI, Abuhanoud L. Attitudes and perceptions of dental students towards artificial intelligence. BMC Med Educ. 2025;25(1):1386.
24. Hammoudi Halat D, Shami R, Daud A, Sami W, Soltani A, Malki A. Artificial intelligence readiness, perceptions, and educational needs among dental students: a cross-sectional study. Clin Exp Dent Res. 2024;10(4):e925.
25. Roganović J, Radenković M, Miličić B. Responsible use of artificial intelligence in dentistry: survey on dentists' and final-year undergraduates' perspectives. Healthcare. 2023;11(10):1480:1–13.
26. Batra AM, Reche A. A new era of dental care: harnessing artificial intelligence for better diagnosis and treatment. Cureus; 2023;15(11):e49319:1–11.
27. World Dental FDI. Artificial intelligence in dentistry. Int Dent J. 2025;75(1):3.
28. Jeong H, Han S-S, Jung H-I, Lee W, Jeon K. Perceptions and attitudes of dental students and dentists in South Korea toward artificial intelligence: a subgroup analysis based on professional seniority. BMC Med Educ. 2024;24(1):430.
29. Venkatesh V, Morris MG, Davis GB, Davis FD. User acceptance of information technology: toward a unified view. MIS Q. 2003;27(3):425–78.
30. Kim D-H, Kang YJ, Lee Y-M. Twelve tips for developing and implementing AI curriculum for undergraduate medical education. Med Educ Online. 2025;30(1):2585637.
31. Louca C, Tonni I, Leung A, Fine P. Artificial intelligence: a modern tool for assessing dental students? J Dent. 2026;165:106273.
32. Karan-Romero M, Salazar-Gamarra RE, Leon-Rios XA. Evaluation of attitudes and perceptions in students about the use of artificial intelligence in dentistry. Dent J. 2023;11(5):125.
33. Elchaghaby M, Wahby R. Knowledge, attitudes, and perceptions of a group of Egyptian dental students toward artificial intelligence: a cross-sectional study. BMC Oral Health. 2025;25(1):11.
34. Park S, Do K, Kim S, Park J, Lim Y. What should medical students know about artificial intelligence in medicine? J Educ Eval Health Prof. 2019;16:18.
35. Acosta-Enriquez BG, Arbulú Ballesteros MA, Huamaní Jordan O, López Roca C, Saavedra Tirado K. Analysis of college students' attitudes toward the use of ChatGPT in their academic activities: effect of intent to use, verification of information and responsible use. BMC Psychol. 2024;12(1):255.

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