Evaluation of Anxiety Levels and Ethical Opinions on Artificial Intelligence among Dental Students and Academicians : A Pilot Study

Diş Hekimliği Fakültesi Öğrencilerinin ve Akademisyenlerin Yapay Zeka Uygulamalarına İlişkin Kaygı Düzeyinin ve Yapay Zeka Etiği Hakkındaki Görüşlerinin Değerlendirilmesi: Bir Pilot Çalışma

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Citation: Kalaoğlu E E, Yeğin E. Evaluation of Anxiety Levels and Ethical Opinions on Artificial Intelligence among Dental Students and Academicians : A Pilot Study.*Int Arc Dent Sci.* 2025;46(1):51-58.

ABSTRACT

INTRODUCTION: To evaluate the concerns regarding artificial intelligence(AI) applications and the opinions on AI ethics among students of Istanbul Gelişim and Istanbul Medeniyet University Faculty of Dentistry, as well as among academics in dentistry faculties across Turkey.

METHODS: Google Forms-an online survey was created and shared with participants. The survey consists of three sections including participants' demographics, concerns about the use of AI in dentistry, and thoughts on ethics. Mann-Whitney U Test and Spearman Rho Correlation Analyses were employed to examine the relationship between professional experience/class and levels of concern.

RESULTS: A total of 315 individuals participated in the survey, with 85% being dentistry students. AI concern scores of dentistry students (7.49±4.51) were found to be similar to those of academics (8.47±4.34). As the students' class levels increased, their levels of concern increased (p=0.05, r=0.11). Conversely, as academics' professional experience increased, their levels of concern decreased significantly (p=0.02, r=-0.37). The general consensus regarding the ethical acceptability of AI applications was 55%, suggesting acceptance with education and oversight. However, the majority (61%) believed that the use of AI applications in dentistry education should be important but limited.

CONCLUSION: Both dental students and academicians were concerned about AI applications. They emphasize the importance of education and supervision for ethical usage.

Keywords: *Artificial intelligence, ethics, dental students, academicians*

ÖZ

GİRİŞ ve AMAÇ: İstanbul Gelişim Üniversitesi ve İstanbul Medeniyet Üniversitesi Diş Hekimliği Fakültesi öğrencileri ile Türkiye'deki diş hekimliği fakültelerindeki akademisyenlerin yapay zeka uygulamalarına ilişkin kaygılarını, yapay zeka etiği konusundaki görüşlerini değerlendirmektir.

YÖNTEM ve GEREÇLER: Google forms üzerinde online bir anket oluşturularak katılımcılar ile paylaşılmıştır. Anket; katılımcıların demografik bilgileri, yapay zekanın diş hekimliği uygulamalarında kullanılmasına ilişkin endişelerini ve yapay zeka etiği ile ilgili düşüncelerini içeren üç bölümden oluşmaktadır. Mesleki deneyim/sınıf ve kaygı düzeyleri arasındaki ilişkiyi incelemek için Mann-Whitney U Testi ve Spearman Rho Korelasyon Analizleri kullanılmıştır.

BULGULAR: Ankete toplam 315 kişi (180 kadın, %57; 135 erkek, %43; ortalama yaş=22,45±2,97) katılmış olup katılımcıların %85'i diş hekimliği öğrencileridir. Diş hekimliği öğrencilerinin yapay zeka kaygısı puanı (7.49±4.51) akademisyenler (8.47±4.34) ile benzer bulunmuştur. Öğrencilerin sınıf seviyeleri arttıkça kaygı düzeyleri de artmıştır (p= 0.05, r=0.11). Akademisyenlerin ise mesleki deneyimleri arttıkça kaygı düzeyleri azalmıştır (p= 0.02, r=-0.37). Yapay zeka uygulamalarının etik olarak kabul edilebilir kullanımıyla ilgili genel görüş (%55), eğitim ve denetim ile kabul edilebilir olduğu yönündedir. Ancak, yapay zeka uygulamalarının diş hekimliği eğitiminde kullanımına ilişkin çoğunluk (%61), önemli ancak sınırlı olmalıdır görüşündedir.

SONUÇ: Hem diş hekimliği öğrencileri hem de akademisyenler yapay zeka uygulamalarıyla ilgili kaygılıdır. Etik kullanımı için eğitim ve denetim önemlidir görüşündedir.

Anahtar Kelimeler: *Yapay zeka, etik, diş hekimliği öğrencileri, akademisyenler*

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Received Date: 03.03.2024
Accepted Date: 20.09.2024

INTRODUCTION

Artificial intelligence (AI) is the simulation, imitation, or replication of human intelligence, created by the fields of engineering and science, and expressed through technological devices. It involves the ability to think, learn, solve problems, and make decisions.[1] The use of AI in healthcare has led to significant advancements by enabling the rapid analysis of collected data, utilizing databases, considering patient-specific factors, facilitating workflows, and enhancing the productivity of healthcare professionals.[2] In dentistry, AI aims to assist practitioners in providing better patient care, reducing treatment duration and costs, and minimizing decision-making errors.[3] AI supports dentists in a range of tasks, from fundamental duties such as recording a patient's medical history to more complex processes, including analyzing acquired information for accurate diagnosis, identifying potential treatment options, and predicting prognoses. It is also used in conjunction with diagnostic tools such as radiographs to enhance the accuracy and speed of diagnoses.[4] Although the adoption of AI in various subfields of dentistry has been somewhat delayed, its increasing accessibility causes a significant interest in recent years. Notable progress has been made in different areas of dentistry, including disease diagnosis, localization, classification, prognosis prediction, and risk assessment.[5] Similar to other fields, dentistry is transitioning toward a new era of data-driven medicine, supported by robotics. Robotic dental assistance has the potential to be applied in various specialties, including prosthodontics, implantology and orthodontics.[5] Clinicians can leverage augmented reality to help patients visualize expected treatment outcomes before undergoing procedures. Additionally, augmented and virtual reality technologies can enhance dental education by improving students' learning experiences during preclinical training.[6]

As AI transforms or eliminates existing professions while creating new ones, automation and computerization will inevitably reshape the nature of work. McKinsey Global Institute (2017) suggested that, depending on the pace of AI adoption, between 75 million and 375 million workers may need to change occupations and/or upgrade their skills by 2030.[7] Studies on AI-related anxiety in the literature trace back to the first generation of computers, when researchers identified widespread concerns about computers threatening the essence of what it means to be "human." However, traditional measures of computer anxiety, internet anxiety, and robot anxiety are considered insufficient when applied to AI technologies and products. AI-related anxiety may stem from misconceptions about technological advancements, confusion regarding autonomy, and socio-technical blindness.[8]

Currently, AI is being increasingly utilized in dentistry for applications such as image and radiographic analysis, contributing to a more predictive approach to oral healthcare. However, this also raises critical ethical concerns and societal challenges. The advancement of technology necessitates a focus on AI ethics in dentistry.[9] While many dentists anticipate the integration of AI systems into diagnostics, prognosis assessment, and treatment planning, the expanding adoption of AI in dentistry has heightened concerns regarding the legal and ethical dilemmas associated with its use.[10] AI technology has already begun impacting the education sector, as demonstrated during the COVID-19 pandemic, where it facilitated personalized learning through interactive experiences.[11] However, many educational institutions encounter difficulties in effectively integrating AI into teaching procedure due to several factors such as lack of AI training for educators, the high cost of AI software, and ethical concerns.[6] The recent introduction of the powerful AI-driven language model ChatGPT-4 has immediately demonstrated its potential to help students grasp even complex scientific concepts, while simultaneously raising numerous legal and ethical concerns.[12]

A review of the existing literature revealed no studies examining AI-related anxiety among dental students and academicians. Our study is the first to explore AI ethics in this context and to gather the perspectives of both dental students and faculty members. Considering that adaptation to technology and ethical considerations may be influenced by age, our study also evaluates and compares the views and concerns of academicians and students.

MATERIALS AND METHODS

This study was conducted using a cross-sectional research design to evaluate and compare the concerns, perspectives on artificial intelligence (AI) ethics, and awareness levels of students and academicians from the Faculty of Dentistry at Istanbul Gelişim University and Istanbul Medeniyet University. Ethical approval for the study was obtained from the Ethics Committee of the Faculty of Dentistry at Istanbul Gelişim University (Date: October 24, 2023, No: 28). Informed consent was obtained from participants who agreed to take part in the study, and the study was conducted in accordance with the principles of the Declaration of Helsinki.

Sample and Power Analysis

The study included students from two dental faculties in Istanbul (one private and one public) and academic staff from eight different universities across Turkey. While the selection of two universities provided an initial basis for examining students' concerns and ethical perspectives on AI applications, the inclusion of

academicians from multiple institutions ensured a broader perspective.

As this study was designed as a pilot study to determine the concerns and ethical viewpoints of students from two newly established dental faculties and academicians across Turkey regarding AI applications, no power analysis was conducted. Therefore, the study did not aim to establish a sample representative of the entire Turkish population. Despite the limited sample size (267 students and 48 academicians), this pilot study serves as a foundation for larger and more comprehensive research. Future studies are recommended to include a larger sample size and a greater number of universities.

Participants

The participants of this study consisted of students enrolled in the Faculty of Dentistry at Istanbul GelişimUniversity and Medeniyet University, as well as academicians working at various dental faculties across Turkey. Participation was voluntary, and an online survey link was distributed via email to invite potential participants to take part in the study.

Survey Development Process:

The survey used in this study was generated with the assistance of artificial intelligence (ChatGPT-3). During the survey development process, specific keywords and explanatory information were provided to the AI system. The AI was instructed to create five questions assessing concern levels and five questions related to AI ethics for the study titled "Evaluation of Dentistry Faculty Students' and Academicians' Levels of Anxiety Regarding Artificial Intelligence Applications and Their Opinions on Artificial Intelligence Ethics: A Pilot Study". Each question was designed to include five response options.

Information Provided to AI

The AI was supplied with the following keywords and explanatory details:

- AI applications in dentistry
- Concern levels of students and academicians
- General concepts related to AI ethics

Based on these inputs, the AI was asked to generate questions categorized under these topics.

Question Development Process

The AI was instructed to create a total of ten multiple-choice questions (five related to anxiety levels and five related to AI ethics), each with five response options, ensuring that they aligned with the study's objectives and were comprehensible to participants.

Survey Review and Finalization

The AI-generated survey questions were carefully reviewed by the authors to assess their relevance and clarity. Necessary revisions and additions were made to refine the questionnaire, ensuring that it met the study's objectives before final implementation.

Data Collection Tools

The data were collected using an online survey form called Google Forms. The survey consists of three sections. The first section includes the demographic information of the participants. This information includes age, gender, whether the participant is a dental student or an academician, the class information if the participant is a student, and professional experience for the academicians. The second section of the survey is designed to measure the participants' anxiety about artificial intelligence applications. This section contains 5 multiple-choice questions. It is specified that each question can have multiple answers, and the participant can select more than one option based on their subjective evaluation. The options A, B, C, and D for each question are worth 1 point. The E option represents "I have no concerns about this issue" and is worth 0 points. Each individual's score is calculated in this way, and the scores were not scaled or grouped. The maximum anxiety score that can be obtained from this section is 20, and the minimum anxiety score is 0. The anxiety scores obtained from the second section were compared between dental students and academicians. Dental students were categorized by class level as preclinical (1st and 2nd years) and clinical (3rd, 4th, and 5th years). The anxiety level of academicians was compared based on their professional experience (0-5 years, 6-10 years, and 11 years or more). The third section of the survey contains questions related to AI ethics. These questions concern the ethical acceptability of AI applications in dentistry, privacy and data security in AI applications, responsibility for potential errors in AI applications, the importance of AI applications in dental education, and the training related to ethical rules provided to dental students regarding AI. Participants were asked to select only one option, and their responses were given as percentages. There is no scoring system in this section.

Data Collection

The research began in October 2023 and was completed in December 2023. Participants were sent an explanatory text and a survey link via email. They completed the survey at their convenience and using their preferred devices. The anonymity and confidentiality of the participants were ensured, and the data were accessible only to the researchers.

Data Analysis

Data analysis was performed using IBM SPSS Statistics 22 (SPSS IBM, Turkey). The normality of the parameters was evaluated using the Shapiro-Wilk test. In addition to descriptive statistical methods, the Kruskal-Wallis test was used for comparing quantitative data with non-normal distribution. The Mann-Whitney U test was preferred for comparing non-normally distributed parameters between two groups. Spearman's rho correlation analysis was used to examine relationships between non-normally distributed parameters. A significance level of $p<0.05$ was considered.

RESULTS

A total of 315 participants took part in the study (180 women, 57%; 135 men, 43%; mean age = 22.45, SD = 2.97) (Table 1.). 85% of the participants were dental students from Istanbul Gelişim University Faculty of Dentistry or Istanbul Medeniyet University Faculty of Dentistry. The remaining 15% were academicians from the following universities: Istanbul Gelisim University, Istanbul Medeniyet University, Marmara University, Inonu University, Ataturk University, Istanbul University Cerrahpasa, Cukurova, Akdeniz, Igdir, Sakarya, Bolu Abant Izzet Baysal, Istanbul Atlas University, and Istanbul Aydin University Faculty of Dentistry.

When the anxiety regarding the use of artificial intelligence (AI) in dentistry were examined, nearly half of the participants (47.3%) expressed concern about the possibility of AI making incorrect diagnoses or treatments. Regarding ethical concerns, the highest response rate (54.6%) was for the option "Failure to establish the doctor-patient relationship (lack of emotional connection/personal touch, etc.)", followed by "Uncertainty about the responsibility in the decision-making process of AI" (45.1%). Regarding privacy and data security, more than half of the participants (59%) indicated concerns about the risk of "hacking or misuse of AI algorithms". The common opinion regarding the potential conflict of AI use with ethical principles in dental practice (59.4%) was "Human doctors must maintain their position in important decisions and evaluations." When concerns about the potential impact of AI on dental education or practice were examined, the highest rate (53.7%) expressed concern about "the risk of dental students not being able to adequately develop their practical skills" (Table 2.). The mean AI anxiety score for dental students was 7.49±4.51, while for academicians, it was 8.47±4.34. Although academicians had higher anxiety levels, there was no statistically significant difference between the anxiety levels of students and academicians. As students' academic levels increased, their anxiety levels also increased, and a borderline significant correlation was found ($p=0.05$, $r=0.11$) (Table 3.). However, as academicians' years of experience increased, their anxiety levels decreased significantly ($p=0.02$, $r=-0.37$) (Table 4.).

Table 1. Demographic data of the participants

		Min-Max	**Mean±SD**
Age		17-65	22,45±2,97
		n	**%**
Gender	**men**	135	43
	women	180	57
Student		267	85
Academician		48	15
Student years	**1st year**	99	31,4
	2nd year	64	20,3
	3rd year	54	17,1
	4th year	39	12,4
	5th year	11	3,5
Group	**Preclinical (1,2)**	163	61
	Clinical (3,4,5)	104	39
Academicians' years of professional experience	**1-5**	28	8,9
	6-10	7	2,2
	11 years or more	8	2,5

Table 2. Distribution of Participants' Responses Regarding Concerns About AI Applications in Dentistry

Questions	Answers	n	%
What are your concerns regarding the use of AI in dental applications?	The inadequacy of AI in terms of accuracy and reliability	100	31.7
	The replacement of human doctors by AI	102	32.4
	The risk of AI violating patient privacy	73	23.2
	The possibility of AI making incorrect diagnoses or treatments	149	47.3
	I have no concern	54	17.1
What are your ethical concerns regarding the use of AI-assisted dental applications?	The inability to establish a patient-doctor relationship (lack of emotional connection/personal touch, etc.)	172	54.6
	The use of AI without obtaining a patient consent	66	21
	The ambiguity of responsibility in the AI decision-making process	142	45.1
	The unfair use of AI or the risk of discrimination	77	24.4
	I have no concern	56	17.8
What are your concerns regarding privacy and data security in relation to AI?	The risk of unauthorized access to personal health data	126	40
	The risk of AI algorithms being hacked or misused	186	59
	The inadequacy of data security standards	91	28.9
	The possibility of AI using health data for commercial purposes	141	44.8
	I have no concern	54	17.1
What are your thoughts on the possibility of AI use conflicting with ethical principles in dental practice?	There may be difficulties in protecting patient confidentiality.	120	38.1
	Obtaining informed consent may be challenging.	60	19
	Ensuring that AI algorithms are fair and unbiased can be difficult.	77	24.4
	Human doctors should maintain their role in important decisions and evaluations.	187	59.4
	I have no concern	48	15.2
What are your concerns about the potential impacts of AI on dental education or practice?	The risk of dental students not developing practical skills adequately	169	53.7
	The risk of dental students not reinforcing their theoretical knowledge sufficiently	82	26
	The risk of AI reducing the professional autonomy of dentists	135	42.9
	The risk of unemployment for dentists and auxiliary staff	135	42.9
	I have no concern	48	15.2

Table 3. Spearman rho correlation table between anxiety score and student class

	Anxiety Score	Student Class
Anxiety Score	1.00	0.11
p-value (two-tailed)		0.05*
Student Class	0.11	1.00
p-value (two-tailed)	0.05	

*Note: The result is significant at the two-tailed significance level with p=0.049 ($p < 0.05$).

Table 4. Spearman rho correlation table between anxiety score and academic experience

	Anxiety Score	Academic Experience (Years)
Anxiety Score	1.00	-0.37
p-value (two-tailed)		0.02*
Academic Experience (Years)	-0.37	1.00
p-value (two-tailed)	0.02	

*Note: The result is significant at the two-tailed significance level with p=0.02 ($p < 0.05$).

Regarding the distribution of thoughts on AI ethics in dentistry, the prevailing opinion on the ethical use of AI applications in dentistry was that it should be acceptable with proper education and supervision. More than half of the participants (55%) shared this view. Regarding privacy and data security in AI applications, the most common responses were "It is very important, strict measures must be taken" and "It is important, but data sharing may be acceptable in certain situations". The common concern regarding privacy and data security was "the risk of AI algorithms being hacked or misused". The responsibility for potential errors in AI applications was generally attributed to both the AI system manufacturers and the dentists and healthcare staff. It was emphasized that AI should have an important but limited role in dental education. Regarding the education of dental students on AI ethical rules, it was observed that both students and academicians did not have a clear opinion. After those who answered "Insufficient training is provided, it should be given," the "Undecided" option and "No training is provided, it should be given" response were marked (Table 5).

Table 5. Distribution of thoughts on AI ethics in dentistry

Questions	Answers	n	%
What is your opinion on the ethically acceptable use of AI applications in dentistry?	Definitely acceptable	10	3.2
	Acceptable with education and supervision	176	55.9
	Undecided	77	24.4
	Mostly unacceptable	43	13.7
	Definitely unacceptable	9	2.9
What is your opinion on privacy and data security in AI applications?	A very important issue, strict measures should be taken	143	43.4
	Important, but data sharing may be acceptable in some cases	102	32.4
	Undecided	37	11.7
	Should be considered, but flexibility in practices may be allowed	29	9.2
	Data protection is not important to me	4	1.3
What is your opinion on the responsibility for mistakes in AI applications?	The manufacturers and providers of AI systems are responsible	103	32.7
	The dentist and healthcare professionals are responsible	20	6.3
	Both the manufacturers and providers of AI systems and the dentist and healthcare professionals are responsible	146	46.3
	Undecided	39	12.4
	None of the above	7	2.2
What is your opinion on the importance of using AI applications in dental education?	Very important, should be widely used in education	47	14.9
	Important, but should be used in a limited way	192	61
	Undecided	49	15.6
	Not very important, traditional methods are more effective but can be used	25	7.9
	Not important at all	2	0.6

DISCUSSION

Artificial intelligence (AI) offers many benefits at every stage of the healthcare system, starting with education.[13] However, the need to adapt to this technology in a changing world is a factor that increases the level of anxiety. AI anxiety is defined as a state of panic and fear arising from the unknown aspects of this technology and its products.[8] At the same time, there are concerns that medical AI technology may blunt doctors' diagnostic expertise and critical thinking skills, or make doctors unemployed.[14] With increasing concerns about AI, an appropriate scale has been developed to measure AI anxiety.[15] Terzi adapted this AI anxiety scale to Turkish and conducted a validity and reliability study in 2020.[16] Yüzbaşıoğlu designed a web-based electronic questionnaire to acquire information about dental students' knowledge and attitudes towards AI and its possible applications in dentistry, with the participation of 9 dental faculties and 1103 dental students in Turkey. In this study, the knowledge and attitude questionnaire was self-developed as a result of literature review.[17] In the present study, in order to emphasize the development of AI, the survey questions were prepared using Chat GPT-3, an AI application frequently used by students. Then, the questions were edited by two researchers and necessary corrections were made.

In the present study, approximately one-third of the participants were concerned about “The replacement of human doctors by AI.” Although the options in the studies by Karan-Romero et al.[18] and Yüzbaşıoğlu[17] were structured differently, the rate of those who agreed with this opinion was approximately 1 in 3 in both studies (34% and 28.60%). Also, 54.6% of the participants of the present study were concerned about" The inability to establish a patient-doctor relationship" in the use of AI-assisted dentistry applications. This result proves the concern that AI will replace human doctors is high. In contrast, 73% of participants of Sadeep's study believed that AI will improve the patient-doctor relationship.[19] The inadequate and non-standardized level of education on the use of AI in dentistry leads to these contradictory results.

In evaluating concerns about the potential impact of AI applications on dental education or practice, the high rate of concern about "the risk of unemployment for dentists and auxiliary staff" (42.9%) reinforces “The replacement of human doctors by AI” opinion. The high rate (59.4%) of belief that human doctors should retain their position in important decisions and evaluations if the use of AI conflicts with ethical principles in dental practice, originates from the similar concern. This also indirectly emphasizes that the use of AI as an auxiliary tool is more accurate.

Although the current technology is helpful in improving the clinical skills of doctors by providing advice rather than replacing their positions[14], its use as a tool in diagnosis and treatment is also seen as a concern. Because, 31.7% of participants were concerned that AI is not accurate or reliable enough. In accordance with this, around half of participants believed in “The possibility of AI making incorrect diagnoses or treatments”. Similarly, 41% of participants in Sadeep's study said that “AI cannot make a definitive diagnosis”.[19]

As society becomes more technology-dependent, information security becomes more critical.[20] Because throughout the process of data collection and transfer, there is a risk of data leakage and confidentiality.[21] The current study supports this with a high level of anxiety about privacy and data security related to AI, which also

remains one of the biggest drawbacks of technological advances.

The dental curriculum includes both practical and theoretical training.[22] Uncertainty about the integration of AI into practical training led to a high level of concern about “the risk of dental students not developing their practical skills adequately” (53.7%). Although responses to the question of whether dental students should be educated on AI ethics varied, most participants agreed that education should be provided. Similarly, 61% of participants thought that the use of AI applications in education was important, but that it should be used in a limited way. All these results support the need for detailed and comprehensive curriculum that define the limits of AI applications.

In the question about responsibility for errors that may occur in AI applications, most participants said that “both the manufacturers and providers of AI systems and the dentist and healthcare professionals are responsible”, but the number of those who thought that “the manufacturers and providers of AI systems are responsible” was also high. Although studies also report that awareness of AI is high[18,19], the ethical rules and responsibility limits of these applications should be well defined. This is because the dental curriculum should include the ethical applications of AI, including its risks and limitations, and should not only teach students how to use these programs, but also encourage critical thinking towards correct interpretation. The curriculum should also include issues such as data protection, privacy and potential interference by third parties.[23]

While Terzi reported no relationship between the AI anxiety levels of teachers and the years of professional experience[16], the present study stated that anxiety levels decreased as the years of professional experience increased. This difference can be explained by the fact that the other study included general questions, while the current study included profession-specific questions and the small number of participants. In the student participants, the anxiety level increased with advancing grade level. This may be related to increasing professional knowledge and the clinical practice. In some SCI and SCIE journals affiliated with Elsevier, authors are asked to explain the use of AI and AI-enabled technologies in the writing process under the title 'Declaration of productive AI in scientific articles'. It also states that AI and AI-enabled technologies should not be listed as authors, co-authors or cited as authors.[24]

In the present study, the authors declare that the Chat GPT-3 programme was used to prepare the survey questions. Then, the authors carefully reviewed and edited the questions and are fully responsible for the content of the publication. The use of AI (Chat GPT-3) is limited to the preparation of the survey and the article was written entirely by the authors. The use of technology in dentistry, as in any area of science, should be under human supervision and control. Scientists should carefully review and edit the results, as AI can produce results that appear reliable but may be incomplete, incorrect or biased. According to the results of the present study, both dental students and academicians were concerned about the applications of AI. The general view on the ethically acceptable use of AI applications in dentistry is that they can be used under education and supervision guidance.

CONCLUSION

Both dental students and academicians were concerned about AI applications. While the students' anxiety level was increased with advancing grade level, that of academicians' decreased as their professional experience increased. They believed that education and supervision were important for ethical use. They should be considered in the design of educational programs in order to contribute to the more effective and safe use of AI technologies in dentistry.

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