

Investigation of Dental Students' Knowledge Levels on Artificial Intelligence

Diş Hekimliği Öğrencilerinin Yapay Zeka Hakkında Bilgi Düzeylerinin İncelenmesi

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ABSTRACT

Objective: The present study was conducted to investigate the knowledge of dental students about artificial intelligence (AI) in dental healthcare.

Methods: This study utilized a descriptive online survey, where respondents completed a Survey Monkey® questionnaire that evaluated their perceptions and opinions regarding the integration of AI in dentistry. The survey questionnaire included 20 questions designed to assess participants' demographic characteristics and their comprehension of AI. In statistical analyses, rates between groups were compared using the chi-square test.

Results: The study involved a total of 226 student participants, with 31.4% (71) being first-year students, 15.5% (35) second-year, 23.5% (53) third-year, 11.1% (25) fourth-year, and 18.6% (42) fifth-year students. The average age of the participants was 20.86±3.40, and 66.4% were female. 97.3% of participants (220) had prior knowledge of AI, while just 68.1% (154) reported no concerns regarding AI. While 58.4% of students (132) reported having no knowledge of AI applications in dentistry, an overwhelming 92.5% (209) indicated a willingness to integrate AI into their future practice. Less than half of the participants said they were informed about AI, while 90.7% thought it should be included in the curriculum. There was statistically significant difference in knowledge level of the use of AI in dentistry between the fourth and fifth grades compared to the first grades ($P<.05$).

Conclusion: This study concluded that students' knowledge about AI was insufficient and revealed that upper-grade students had more knowledge about the areas of AI usage in dentistry compared to lower-grades.

Keywords: Artificial Intelligence, Awareness, Computer-Assisted Diagnosis, Deep Learning, Dental School

ÖZ

Amaç: Bu araştırma, diş hekimliği fakültesi öğrencilerinin sağlıkta yapay zekanın (YZ) kullanımına yönelik görüşlerinin incelenmesi amacı ile yapılmıştır.

Yöntemler: Bu tanımlayıcı online anket çalışması, 19 ile 30 yaş arasında 226 diş hekimliği öğrencisi katılımı ile gerçekleştirilmiştir. Katılımcılar Survey Monkey anket programında hazırlanan, öğrencilerin diş hekimliğinde YZ kullanımına ilişkin görüş ve tutumlarını inceleyen anketi cevaplamışlardır. Anket formu, katılımcıların demografik özelliklerini ve YZ konusundaki bilgi düzeylerini ölçmeyi hedefleyen soruları içeren toplam 20 sorudan oluşmuştur. İstatistiksel analizlerde gruplar arası oranlar ki-kare testi kullanılarak karşılaştırılmıştır.

Bulgular: Katılımcıların yaş ortalamasının 20,86±3,40 olduğu, %66,4'ünü kadınların oluşturduğu gözlemlenmiştir. Çalışmaya katılan öğrencilerin %31,4 (71) birinci sınıf, %15,5 (35) ikinci sınıf, %23,5 (53) üçüncü sınıf, %11,1 (25) dördüncü sınıf (25) ve %18,6 (61) beşinci sınıf öğrencilerinden oluşmaktadır. Öğrencilerin %97,3 (220) YZ'yi daha önce duyduğunu, %68,1 (154) YZ'nin kendisini endişelendirmediğini bildirmiştir. Öğrencilerin %58,4 (132) diş hekimliğinde YZ uygulamaları hakkında bilgi sahibi olmadığını, %92,5 (209) ise ileride hekimlik hayatında YZ kullanmayı istediğini beyan etmiştir. Katılımcıların yarısından azı YZ ile ilgili bilgi sahibi olduğunu ifade ederken, %90,7 eğitim müfredatına eklenmesi gerektiğini bildirmiştir. Dördüncü ve beşinci sınıflar arasında, birinci sınıflara kıyasla diş hekimliğinde yapay zeka kullanımına ilişkin bilgi düzeyi açısından istatistiksel olarak anlamlı bir fark saptanmıştır ($P<.05$). Katılımcıların yaklaşık %80'i YZ'nin diş hekimliğinde kullanımının yaygınlaşacağını düşünürken, bu uygulamaların ileride diş hekimlerinin yerini alması konusunda endişe duymadıkları görülmüştür.

Sonuç: Bu çalışmada öğrencilerin YZ konusundaki bilgilerinin yetersiz olduğu saptanmıştır YZ'nin diş hekimliğinde kullanım alanları konusunda büyük sınıf öğrencilerinin alt sınıflara göre daha fazla bilgisi olduğu belirlenmiştir.

Anahtar Kelimeler: Bilgisayar yardımlı tanı, Derin öğrenme, Diş hekimliği fakültesi, Farkındalık, Yapay zeka

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INTRODUCTION

Artificial intelligence (AI) was defined by John McCarthy, one of the pioneering figures in the field, as "the science and engineering of making intelligent machines, especially intelligent computer programs."¹ Machine learning, which constitutes the backbone of modern AI, involves training an algorithm on large data sets to predict appropriate outputs when given an input.² In recent years, significant advancements have been made in the AI domain and supported by AI technology.³ The increasing complexity and volume of data in healthcare have drawn attention to the use of AI in this sector. It is anticipated that AI will significantly influence various fields of healthcare in the future and has the potential to improve many aspects of healthcare services.⁴ It's known that AI technologies in healthcare are used in areas such as early diagnosis, preliminary diagnosis, and maintaining health.⁵ Recently, with advancements in computer technology, subfields of AI, like deep learning and machine learning, are being utilized in many sectors, including healthcare. Deep learning is a field that processes vast and complex datasets through artificial neural networks (ANNs) in a system similar to the human brain's information processing technique.⁶ Deep learning is widely used in medicine and dentistry, especially for the analysis of medical images. With deep learning technology, conditions like diabetic retinopathy from fundus images and skin cancer from skin images can be diagnosed.⁷ Potential advantages of AI technology include reducing the workload of healthcare professionals, significantly decreasing diagnostic costs and time, and achieving precise diagnoses.⁸ AI applications in dentistry have been explored since 1992.⁵ Studies in the literature show that the developed models need larger datasets before they can be applied clinically.⁹ With necessary ethical and legal adjustments, AI applications will become available for dental practices in the near future. There are a limited number of studies exploring the attitudes and knowledge levels of students in Turkey regarding AI.¹⁰

The present study was conducted to evaluate the knowledge levels of dental students regarding AI, who will be the potential future healthcare professionals.

METHODS

Study design

The present descriptive study was conducted between 30 September 2021 and 30 October 2021. A survey form, which was created based on a literature review by the researchers, was used to obtain the study data. The survey form was disseminated to participants as an online survey via social media. The present study was approved by the Non-interventional Clinical Research Ethics Committee of Istanbul Aydin University, under decision number 21/9-8 and document registration number E.1064, dated September 28, 2021.

Study population

The study population consists of dental students from the first grade (n:71), second grade (n:35), third grade (n:53), fourth grade (n:25), and fifth grade (n:61). As a result of the power analysis, the minimum number of participants was determined to be 112, considering a 5% margin of error and a 95% confidence level.

Survey content

A 20-question survey form was prepared, drawing upon the literature.^{11,12} After explaining the content and objectives of the study to the students, the survey, prepared using the Survey Monkey® online survey platform, was sent to 226 students who verbally consented to participate voluntarily. The first part of the survey consists of nine questions examining the students' socio-demographic characteristics

and certain factors that might influence their perspectives on AI. These questions inquire about their age, gender, academic grade, personality type, the availability of internet access where they reside, their self-assessment and their families' socioeconomic status, educational levels of their parents, regular newspaper/book reading habits, and the time they spend on the internet daily. The second part of the survey encompasses questions about opinions, knowledge, and comments on AI and its utilization in dentistry.

Statistical analyses

Data were analyzed using IBM SPSS 21.0 statistical software (IBM SPSS Corp., Armonk, NY, USA). The results were evaluated using descriptive statistics. Attitudes toward AI and knowledge levels about applications used in dental radiology were examined based on academic grade subgroups. Descriptive statistics were presented as numbers and percentages for categorical variables. Proportions between groups were compared using the chi-squared test. The alpha level of statistical significance was accepted as $P < .05$.

RESULTS

Among the 226 students who participated in the study, ages ranged from 19 to 30 with a mean±SD of 20.86±3.4. 66.4% (n:150) of the study group were female, and first-grade students represented the highest participation rate at 29% (n:71). The distribution of the students based on socio-demographic characteristics is presented in Table 1.

Table 1. Distribution of the participants based on socio-demographic characteristics.

		n	%
Education Grade	1	71	29
	2	35	14
	3	53	22
	4	25	10
	5	61	25
Gender	Male	76	33.6
	Female	150	66.4
Mother's educational background	Elementary Education	46	20.4
	High School	75	33.2
	University	105	46.5
Father's educational background	Elementary Education	35	15.5
	High School	50	22.1
	University	141	62.4

n: Number, %: Percentage

94.4% (n:184) of the participants in the study group stated they had internet access where they resided, and 48.2% (n:90) mentioned that they have a habit of regularly reading newspapers/books. The average time they spent on the internet daily was 3.56±1.74 hours. 62.4% (n:141) of the students were not concerned about robots integrating into our lives, 97.3% (n:220) had heard of AI, and 68.1% (n:154) were not worried about AI. The distribution of participants' views on technological advancements is provided in Table 2.

While 59.2% (n:242) of students admitted to a lack of knowledge about AI applications in dentistry, 79.2% (n:324) expressed a clear intention to incorporate AI into their future practice. Furthermore, 86.32% (n:192) believed that AI should be included as part of dental education (Table 3).

Students reported gaining knowledge about the use of AI in everyday life from a variety of sources. Media such as television and radio were cited by 60 students, while social media was the source for 105 students. In addition, 10 students reported learning about AI in their classes, and 32 students cited family or friend groups as a source of information (Figure 1).

Table 2. Distribution of participants' views on technological advancements

		n	%
How do you rate your knowledge level on computers?	Good	78	34.5
	Poor	20	8.8
	Average	128	56.6
Have you received any training related to computers?	Yes	54	23.9
	No	172	76.1
Does the integration of robots into our lives and their communication with people concern you?	Yes	85	37.6
	No	141	62.4
Have you heard of AI before?	Yes	220	97.3
	No	6	2.7
Are you concerned about AI's ability to perform many tasks today?	Yes	72	31.9
	No	154	68.1
Are you informed about the AI applications used in dentistry?	Yes	94	41.6
	No	132	58.4
Would you like to use AI in your future medical practice?	Yes	209	92.5
	No	17	7.5
Are dental clinics that use AI more advantageous in diagnosis?	Yes	200	88.5
	No	26	11.5
Are dental clinics that use AI more advantageous in treatment?	Yes	197	87.2
	No	29	12.8
Should there be courses related to AI in dental education?	Yes	205	90.7
	No	21	9.3
Would you like AI applications to be available at dental school?	Yes	212	93.8
	No	14	6.2
Should AI applications used in dentistry be utilized more intensively?	Yes	180	79.6
	No	46	20.4
Do you find AI applications used in dentistry reliable?	Yes	173	76.5
	No	53	23.5

n: Number, %: Percentage

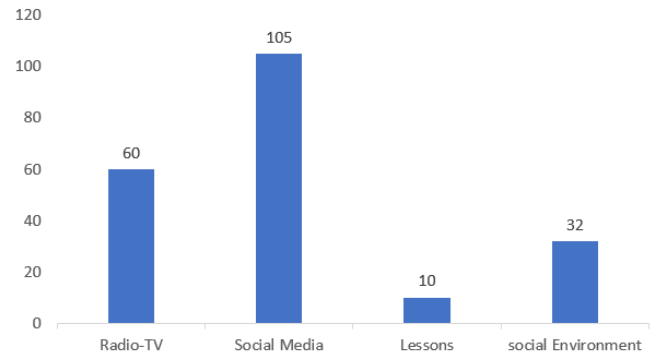
Table 3. Distribution of the students' views on AI applications used in

		n	%	P
How do you rate your knowledge level on computers?	Good	78	34.51%	0.844
	Poor	20	8.84%	
	Average	128	56.63%	
Have you received any training related to computers?	Yes	54	23.89%	0.258
	No	172	76.10%	
Does the integration of robots into our lives and their communication with people concern you?	Yes	85	37.61%	0.120
	No	141	62.38%	
Have you heard of AI before?	Yes	220	97.34%	0.413
	No	6	2.65%	
Are you concerned about AI's ability to perform many tasks today?	Yes	72	31.85%	0.116
	No	154	68.14%	
Are you informed about the AI applications used in dentistry?	Yes	94	41.59%	0.013
	No	132	58.40%	
Would you like to use AI in your future medical practice?	Yes	209	92.47%	0.373
	No	17	7.52%	
Are dental clinics that use AI more advantageous in diagnosis?	Yes	200	88.49%	1.000
	No	26	11.51%	
Are dental clinics that use AI more advantageous in treatment?	Yes	197	87.49%	0.718
	No	29	11.50%	
Should there be courses related to AI in dental education?	Yes	205	90.70%	0.229
	No	21	9.30%	
Would you like AI applications to be available at dental school?	Yes	212	93.80%	0.614
	No	14	6.20%	
Should AI applications used in dentistry be used more intensively?	Yes	180	79.64%	0.016
	No	46	20.36%	
Do you find AI applications used in dentistry reliable?	Yes	173	86.5%	0.257
	No	53	13.5%	

Chi-Square test, $P < .05$,

n: Number, %: Percentage

Statistical data revealed significant differences in attitudes about AI applications used in dentistry between fifth, fourth, and third-grade students and first and second-grade students. These results suggest that upper-grade students (fifth, fourth, and third grades) possess more knowledge about AI applications compared to lower-grade students (second and first grades). The participants' opinions and attitudes regarding the use of AI in the field of dentistry are depicted in Table 4.

**Figure 1.** Distribution of participants' information sources about AI.**Table 4.** Attitudes about AI based on the education level of participants.

Education Grade												
		1		2		3		4		5		p
		n	%	n	%	n	%	n	%	n	%	
GENERAL INFORMATION												
How do you rate your knowledge level on computers?	Good	25	35.2	13	37.1	17	32.1	7	28.0	16	38.1	.871
	Poor	7	9.9	4	11.4	3	5.7	1	4.0	5	11.9	
	Average	39	54.9	18	51.4	33	62.3	17	68.0	21	50.0	
Have you received any training related to computers?	Yes	18	25.4	10	28.6	13	24.5	3	12.0	10	23.8	.652
	No	53	74.6	25	71.4	40	75.5	22	88.0	32	76.2	
Does the integration of robots into our lives and their communication with people concern you?	Yes	30	42.3	11	31.4	21	39.6	9	36.0	14	33.3	.796
	No	41	57.7	24	68.6	32	60.4	16	64.0	28	66.7	
Have you heard of AI before?	Yes	70	98.6	32	91.4	52	98.1	25	100.0	41	97.6	.293
	No	1	1.4	3	8.6	1	1.9	0	0.0	1	2.4	
Are you concerned about AI's ability to perform many tasks today?	Yes	27	38.0	8	22.9	16	30.2	9	36.0	12	28.6	.554
	No	44	62.0	27	77.1	37	69.8	16	64.0	30	71.4	
AI IN DENTAL PRACTICE												
Are you informed about the AI applications used in dentistry?	Yes	28	39.4	16	45.7	14	26.4	12	48.0	24	57.1	.040*
	No	43	60.6	19	54.3	39	73.6	13	52.0	18	42.9	
Would you like to use AI in your future medical practice?	Yes	66	93.0	33	94.3	51	96.2	22	88.0	37	88.1	.503
	No	5	7.0	2	5.7	2	3.8	3	12.0	5	11.9	
Are dental clinics that use AI more advantageous in diagnosis?	Yes	65	91.5	31	88.6	47	88.7	23	92.0	34	81.0	.550
	No	6	8.5	4	11.4	6	11.3	2	8.0	8	19.0	
Are dental clinics that use AI more advantageous in treatment?	Yes	64	90.1	30	85.7	45	84.9	23	92.0	35	83.3	.758
	No	7	9.9	5	14.3	8	15.1	2	8.0	7	16.7	
Should AI applications utilized in dentistry be utilized more intensively?	Yes	56	78.9	28	80.0	44	83.0	18	72.0	34	81.0	.853
	No	15	21.1	7	20.0	9	17.0	7	28.0	8	19.0	
Do you find AI applications used in dentistry reliable?	Yes	55	77.5	28	80.0	44	83.0	17	68.0	29	69.0	1.429
	No	16	22.5	7	20.0	9	17.0	8	32.0	13	31.0	
DENTAL EDUCATION												
Should there be courses related to AI in dental education?	Yes	63	88.7	32	91.4	47	88.7	24	96.0	39	92.9	0.865
	No	8	11.3	3	8.6	6	11.3	1	4.0	3	7.1	
Would you like AI applications to be available at dental school?	Yes	66	93.0	33	94.3	48	90.6	25	100.0	40	95.2	0.644
	No	5	7.0	2	5.7	5	9.4	0	0.0	2	4.8	

Chi-Square test, $P < .05$,

n: Number, %: Percentage

DISCUSSION

As Artificial Intelligence becomes more integrated into our daily lives, its growth in the health sector also shows a parallel trend.¹³ Due to this rise in AI-supported healthcare technologies, it's essential for healthcare professionals to utilize these technologies appropriately and familiarize themselves with their impacts on patient care, the healthcare system, and society in general.¹⁴ The present study examined the views of dental school students regarding AI in healthcare. The survey used in the research was adapted from a similar study conducted by Pauwels et al.¹⁵ on dentists and dental students. AI technology is becoming increasingly integrated into the internet technologies we use daily. In the present study, 97.3% of the students stated they had heard of the AI concept before, while 41.6% reported being informed about its use in dentistry. The vast majority of the students (50.72%) said they learned this information through social media. Similarly, other studies studying university students' perceptions of AI found that students learned about the AI concept through social media.^{16,17} This might be interpreted as a result of AI's increased presence in various fields, leading to more extensive media coverage in recent years. In the present study, most students expressed excitement about AI developments in healthcare and believed it's crucial to follow AI advancements related to their professions. The students' interest in AI developments related to their professions might have influenced this result. In the present study, the dental students primarily believe that AI applications will enrich their professional skills and enable them to provide better healthcare services to patients. Moreover, as students' education levels increase, both their knowledge about AI and their inclination to use it also seem to rise, consistent¹⁸ with the literature findings. Upon reviewing the relevant studies, medical and dental school students expressed their desire to use AI in their medical careers and believe that AI in healthcare will facilitate their practice.¹⁹⁻²¹ AI technologies are initially embraced by younger individuals. This is associated with younger individuals' familiarity with technology use.²¹ In the current investigation, it is evident that students have a strong inclination toward utilizing AI within their professional life. The positive attitudes of future healthcare professionals towards using AI technology are expected to influence how this technology will be shaped in the healthcare sector. AI in healthcare can substantially address medical errors in diagnosis or treatment planning, enhancing efficiency and reducing the malpractice rate.²² Most participants in the present study expressed the view that AI systems would offer advantages in diagnosis and treatment. While it's anticipated that AI technology can reduce the number of clinical errors, the impact of diagnostic or decision-making AI tools must be evaluated based on patient outcomes. One of the significant discussion points about using AI in healthcare relates to the ethical dimension concerning who would be responsible for any erroneous medical practices resulting from AI applications.²³⁻²⁵ Indeed, most students in the present study believe AI systems are reliable and express a desire for education on AI, indicating their awareness of their lack of sufficient training on the topic. A study conducted with medical students in Canada found that the majority believe AI will introduce new ethical challenges.²⁶ As future healthcare professionals, students must prioritize patient advocacy roles to protect vulnerable populations through technological advancements.²⁷ Therefore, curriculum planning that includes theoretical training and case examples on how to manage ethical issues can make students aware of potential ethical challenges brought by AI technology.

Contrary to survey studies conducted with health science students in the literature, participants in this study reported not being worried about the increasing use of AI.²⁸ Recently, one of the major concerns

about AI technology is the notion that people will lose their jobs to robots. There are predictions that unemployment will increase as robots enter the workforce and that automation in the production sector will perform tasks more efficiently than humans.²⁹ The findings of the present study and literature data indicate that health faculty students are willing to receive education to increase their awareness about future AI applications and their use in healthcare.³⁰ Therefore, it's evident that reviewing the current curriculum elements is essential.²⁸

Students' views can guide the design and implementation of AI tools that will be used in future healthcare services. And educators will play significant roles in helping students utilize this potential. Another consideration is that teaching AI-focused course content requires well-equipped educators. Consequently, there's a need for studies on educators' awareness or feelings of adequacy about AI and its application in healthcare.

It is anticipated that AI will influence various areas of health services, including diagnosis, treatment, care, research, and education. The present study, which examines the views of dental school students on AI in health, found that dental school students are aware of AI and its applications in dental care. They are also aware of how the future of their profession may be impacted by the dynamics of these applications. There is a lack of information in the literature regarding the views and attitudes of dental students on AI applications. In the present study, while a large portion of the students had knowledge about the AI applications used in daily life, it was observed that they had limited knowledge about its applications, specifically in the field of dentistry. Upper-grade students were found to be more knowledgeable about this topic compared to the lower grades.

The positive attitudes of future dentistry professionals towards using AI technology are expected to influence how this technology will be shaped in the dentistry sector

Ethics Committee Approval: Ethics committee approval was obtained from Istanbul Aydin University Local Ethics Committee (Date: September 28, 2021, Number: 21/9-8/ E.1064)

Informed Consent: In the questionnaire, participants were required to indicate their consent to participate in the study.

Peer-review: Externally peer-reviewed.

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