Fizyoterapi Öğrencilerinin Yapay Zekaya Yönelik Tutumları ve Okuryazarlığı: Yapay Zeka Eğitiminin Etkisi

Attitudes and Literacy of Physiotherapy Students Toward Artificial Intelligence: The Impact of Artificial Intelligence Education

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ÖZ

Amaç: Bu çalışma, fizyoterapi öğrencilerinin yapay zekâya (YZ) yönelik tutumlarını, YZ okuryazarlık düzeylerini ve teknoloji kullanım eğilimlerini değerlendirmek ve YZ eğitiminin bu faktörler üzerindeki etkisini araştırmayı amaçladı.
Gereç ve Yöntem: Bu prospektif kesitsel çalışmaya 279 fizyoterapi öğrencisi katıldı. Katılımcılara demografik ve akademik bilgilerinin yanı sıra bir YZ dersine katılımları hakkında sorular soruldu. YZ'ye yönelik tutumları Yapay Zekâya Yönelik Genel Tutumlar Ölçeği (GAAIS) ile, YZ okuryazarlıkları ise Yapay Zekâ Okuryazarlığı Ölçeği (AILS) ile teknoloji kullanım eğilimleri Teknoloji Kullanım Ölçeği (TUS) ile değerlendirildi.
Bulgular: Pozitif GAAIS puanı ile AILS alt boyutları (AILS_Etik hariç) arasında düşük-orta düzeyde korelasyon bulundu ($p<0,05$; rho=0,251-0,324). Pozitif GAAIS ve TUS puanları arasında düşük düzeyde korelasyon bulundu ($p<0,05$; rho=0,255). Negatif GAAIS ile AILS alt boyutları arasında düşük düzeyde korelasyon bulundu ($p<0,05$; rho=-0,127--0,204). Negatif GAAIS ve TUS puanları arasında düşük düzeyde korelasyon bulundu ($p=0,009$; rho=-0,156). YZ eğitimi alan öğrencilerin pozitif GAAIS puanı ve AILS alt boyutları puanları, almayanlardan daha yüksek iken ($p<0,05$), TUS skorları benzerdi ($p>0,05$).
Sonuç: YZ'ye yönelik pozitif tutum arttıkça YZ okuryazarlığı ve teknoloji kullanım eğiliminin de arttığı bulundu. Ayrıca, YZ eğitimi almanın YZ'ye yönelik tutum ve okuryazarlık üzerine olumlu etkisi olduğu görüldü. Bu sebeple, YZ'ye yönelik eğitimlerin lisans müfredatlarına eklenmesi fizyoterapi öğrencilerinin YZ'ye yönelik okuryazarlığını ve tutumunu olumlu yönde etkileyebilir.
Anahtar Kelimeler: Fizyoterapist; Müfredat; Öğrenci sağlık hizmetleri; Yapay zekâ

ABSTRACT

Aim: This study aimed to evaluate the attitudes of physiotherapy students toward artificial intelligence (AI), their level of AI literacy, and their tendency toward technology use, as well as to investigate the effect of an AI course on these factors.
Material and Method: 279 physiotherapy students participated in this prospective cross-sectional study. Participants were questioned about their demographic and academic information, as well as their attendance in an AI course. Their attitudes towards AI with the General Attitudes toward Artificial Intelligence Scale (GAAIS), AI literacy with the Artificial Intelligence Literacy Scale (AILS), and tendency toward technology use with the Technology Use Scale (TUS) were evaluated.
Results: A low to moderate correlation was found between positive GAAIS score and the sub-dimensions of AILS scores (except AILS_Ethics) ($p<0.05$; rho=0.251-0.324). A low correlation was found between positive GAAIS and TUS scores ($p<0.05$; rho=0.255). A low correlation was found between negative GAAIS and the sub-dimensions of AILS scores ($p<0.05$; rho=-0.127--0.204). A low

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correlation was found between negative GAAIS and TUS scores (p=0.009; rho=-0.156). The positive GAAIS score and sub-dimensions of AILS scores of students who took the AI course were higher than those who did not (p<0.05), while the score of TUS was similar (p>0.05).
Conclusion: It was found that as positive attitudes toward AI increase, AI literacy and tendency toward technology use increase. Furthermore, receiving AI courses has been shown to have a positive impact on attitudes toward and literacy in AI. Therefore, incorporating AI courses into undergraduate curricula may positively impact physiotherapy students' literacy and attitudes toward AI.
Keywords: Artificial intelligence; Curriculum; Physical therapist; Student health services

INTRODUCTION

Artificial intelligence (AI) refers to computer systems and machines that mimic human intelligence, allowing them to perform tasks that require cognitive functions such as problem solving, learning, language processing, perception, and decision making (1). As AI becomes more integrated into our daily lives, we are also seeing a parallel increase in its use within the healthcare sector. Many healthcare professionals are now utilizing these technologies for clinical decision-making, diagnosis, and patient management (2). AI-based applications in physiotherapy and rehabilitation, including video analysis, robotic devices, virtual assistants, predictive algorithms, and risk assessment tools, have been gaining popularity dramatically (3).

The rise of AI-supported healthcare technologies necessitates that healthcare professionals use these tools appropriately and understand their impact on patient care, the healthcare system, and society (2, 4). As AI technology has been evolving, healthcare professionals will inevitably encounter various technologies and applications in clinical settings (4). It is anticipated that health profession students will utilize AI tools as they complete their education and begin their careers. Therefore, educators and administrators must focus on how to effectively incorporate AI technologies into the training of future healthcare professionals (5, 6). Recently, the Council of Higher Education in Turkey highlighted the importance of AI-focused education in its 2024-2028 strategic plans, emphasizing that "Encouraging students to enroll in courses on data science and AI, as well as establishing undergraduate and associate degree programs to provide skills in AI-based technologies."
(https://www.yok.gov.tr/kurumsal/stratejik-plan).

As the reliance on AI grows in the healthcare sector, including physiotherapy and rehabilitation, it becomes increasingly important to incorporate AI-based training into the education of healthcare professionals. Examining the factors that influence healthcare candidates' attitudes toward AI and investigating the effects of AI training will be crucial in this context (7-10). However, studies investigating the factors related to AI attitudes of physiotherapy students are scarce. Moreover, to the authors' knowledge, no study has examined the effect of an AI course on attitudes toward AI, AI literacy, and technology tendency in physiotherapy and rehabilitation students. Therefore, we focused on two aims: 1. To investigate the factors related to the AI attitudes of physiotherapy and rehabilitation students, including AI literacy and technology tendencies. 2. To examine the impact of an AI course on attitudes toward AI, AI literacy, and technology tendencies in physiotherapy and rehabilitation students.

MATERIAL AND METHODS

Study design and participants

This prospective cross-sectional study was conducted online using a web-based assessment. Data collection took place between May 2024 and February 2025. Students enrolled in the physiotherapy and rehabilitation program were invited to participate through verbal announcements and social media. The study involved participants from seven universities in the Black Sea, Central Anatolia, and the Aegean region. Inclusion Criteria: (a) Enrollment in a Bachelor of Physiotherapy program; (b) Ability to read and understand Turkish; (c) Willingness to participate. Exclusion Criteria: (a) Individuals who have already graduated from a physiotherapy program; (b) Those who refuse to provide consent to participate; (c) Individuals who are unable to understand the Turkish language. Ethical approval was obtained from

the Health Sciences Ethics Committee of Ankara Yildirim Beyazit University, with the approval date and number being 21.03.2024/2024-616.

Outcomes

Demographic information, including age and gender, and educational details such as grade level, course on AI, AI course resources, and academic grade point averages (AGPA) were recorded. Researchers used a semi-structured questionnaire (Table 1) to get descriptive information about participants' awareness and knowledge of AI, and opinions on AI in physiotherapy. Attitudes toward AI were measured using the Turkish version of the General Attitudes toward Artificial Intelligence Scale (GAAIS). AI literacy was evaluated using the Turkish version of the Artificial Intelligence Literacy Scale (AILS). Additionally, technology use tendence was assessed using the Turkish version of the Technology Usage Scale**.**

Table 1. Awareness and Knowledge of AI and Opinion on AI in Physiotherapy of Participants

Questions	Yes	Undecided	No
Awareness and knowledge			
Are you familiar with the concept of A1?			
Can you define what AI is?			
Are you familiar with the applications of AI in physiotherapy and rehabilitation?			
Opinion on AI in physiotherapy			
Do you think AI will reduce the workload for physical therapists?			
Do you believe AI will make it more difficult for physical therapists to find jobs?			
What do you think AI means for the physical therapy profession			
(Opportunity, threat, or both)			

AI: Artificial intelligence

Attitudes toward AI

The GAAIS was used to assess participants' attitudes toward AI. The Turkish version of GAAIS was performed by Kaya et al. reported that it had good validity and reliability. It consists of 20 items, with 12 positive statements and 8 negative statements. Each item is rated on a five-point Likert scale, where 1 indicates "strongly disagree" and 5 indicates "strongly agree." The score for positive attitudes ranges from 12 to 60, while the score for negative attitudes ranges from 8 to 40. Higher positive scores represent more positive attitudes towards AI; moreover, negative ones are vice versa (11).

AI literacy

The AI literacy was evaluated with AILS. It has been found reliable through a cultural adaptation study conducted by Çetinkaya et al. Its Cronbach's alpha coefficients of total and sub-dimension range from 0.72 to 0.85. It is a seven-point Likert-type scale comprising four factors and 12 items. Participants are asked to indicate their level of agreement with the research questions using the following response options: "Strongly Agree, Agree, Somewhat Agree, Undecided, Somewhat Disagree, Disagree, Strongly Disagree." As a result, the lowest possible score on the scale is 12, while the highest score is 84 (12).

Technology use tendence

The participants' technology use tendencies were evaluated using the Technology Use Scale (TUS), developed by Zincirkıran and Tiftik, with its validity in university students reported by Aksoy. The scale includes 13 questions, each rated on a 5-point Likert scale. The response options range from "Strongly Agree" to "Strongly Disagree," which correspond to scores from 5 to 1, respectively. The total score on the scale can vary from 13 to 65, with higher scores indicating a greater inclination towards technology (13, 14).

Statistical Analysis

Data analysis and calculations were carried out using SPSS Statistics 22.0 software (IBM Corp. Version 2012, IBM SPSS Statistics for Windows, Version 22.0, Armonk, NY: IBM Corp.). Distributions of continuous variables were examined using skewness and kurtosis coefficients, Kolmogorov-Smirnov test, histogram plots, variance coefficients, and trended normal Q-Q plots. Normally distributed continuous variables are reported as mean ± standard deviation (X ± SD), while non-normally distributed ones are reported as median and interquartile range (IQR). Ordinal variables are presented as frequency (n) and percentage (%). The Mann-Whitney U test was used to compare AI attitudes and literacy, and technology use tendence between groups that took and did not take an AI course. Spearman correlation coefficient was used to analyze the relationship between positive and negative attitudes towards AI, AI literacy, and technology use tendence. A p-value of less than 0.05 was considered statistically significant. The interpretation of correlation values was as follows: 0.05–0.30 indicated "low correlation," 0.30–0.40 indicated "low to moderate correlation," 0.40–0.60 indicated "moderate correlation," 0.60–0.70 indicated "good correlation," 0.70–0.75 indicated "very good correlation," and 0.75–1.00 indicated "excellent correlation." (15).

The sample size for the study was determined using the G*Power program (G*Power, Version 3.0.10, Franz Faul, Universität Kiel, Germany). Initially, 10 participants were included in the pilot study. The correlation coefficient between the positive AI score and total AI literacy score was determined. It was calculated that a minimum sample of 200 individuals would be required to achieve a power of 95%, with an effect size of r = 0.260, a type I error rate (α) of 0.05, a type II error rate (β) of 0.05, and accounting for a potential dropout rate of 10% (16).

RESULTS

Two hundred seventy-two physiotherapy and rehabilitation bachelor's students were involved. The mean ages were 21.14 ± 2.04 years. Among the participants, 60 were male and 219 were female. The breakdown of participants by class year was as follows: 40 in the first year, 79 in the second year, 113 in the third year, and 47 in the fourth year. Additionally, 40 participants reported having taken a course on AI, while 239 had not. Those who attended an AI course identified their learning resources as follows: lessons (n=17), congresses or symposiums (n=9), and training courses (n=14) (Table 2).

Table 2. Demographic and Educational Information of Participants

	All participants (n: 279)
Age (X±SD)	21.14±2.04
AGPA (X±SD)	2.85±0.45
Gender (n (%))	
Male	60 (21.5)
Female	219 (78.5)
Grade level (n (%))	
First	40 (14.3)
Second	79 (28.3)
Third	113 (40.5)
Fourth	47 (16.8)
Course on AI (n (%))	
Available	40 (14.3)
Not available	239 (85.7)
AI course resource (n (%))	**(n:40)**
Lesson	17 (42.5)
Congress	9 (22.5)
Training course	14 (35.0)

AI: Artificial intelligence, AGPA: Academic Grade Point Averages, X: Mean, SD: Standard deviation, N: Number

Almost all participants (n=275, 98.6%) confirmed that they are familiar with the concept of AI. Out of these, 165 participants (59.1%) reported that they can define what AI is. However, only 70 participants (25.1%) indicated that they are familiar with the applications of AI in physiotherapy and rehabilitation. Most participants (n=189, 67.7%) believed that AI would reduce the workload for physical therapists. Regarding the concern that AI might make it more difficult for physical therapists to find employment, a significant portion of participants (n=100, 35.8%) expressed uncertainty. Furthermore, most participants (n=194, 69.5%) perceived AI as both an opportunity and a threat to the physical therapy profession (Figure 1).

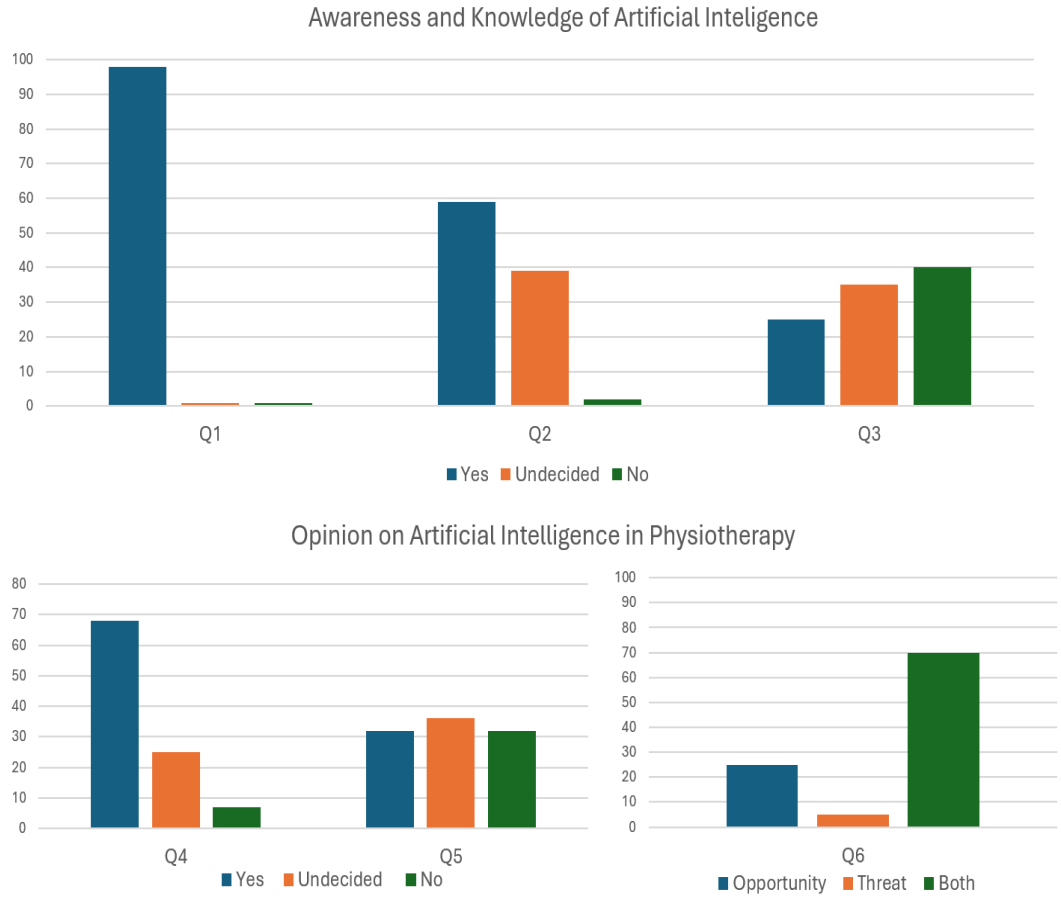


Figure 1. The Results of Awareness, Knowledge, and Opinion about Artificial Intelligence of Participants

With the positive GAAIS score, the AILS_Awareness score exhibited a low positive correlation ($p<0.001$; rho=0.251), while the AILS_Usage score also showed a low positive correlation ($p<0.001$; rho=0.261). The AILS_Evaluation score demonstrated a moderate positive correlation ($p<0.001$; rho=0.320), and the AILS_Total score had a moderate positive correlation as well ($p<0.001$; rho=0.324). In contrast, no correlation was observed with the AILS_Ethics score ($p=0.547$; rho=0.036). With the negative GAAIS score, the AILS_Awareness score exhibited a low negative correlation ($p=0.007$; rho=-0.161), while the AILS_Usage score also showed a low negative correlation ($p=0.031$; rho=-0.129). The AILS_Evaluation score demonstrated a low negative correlation ($p=0.001$; rho=-0.204) and AILS_Ethics score showed a low positive correlation ($p=0.002$; rho=0.181). The

AILS_Total score also had a low negative correlation (p=0.034; rho=-0.127) with negative GAAIS score. The positive GAAIS score showed a low positive correlation with TUS score (p<0.001; rho:0.255); whereas the negative GAAIS score showed a low negative correlation with it (p=0.009; rho=-0.156) (Table 3).

Table 3. The Relationship between Positive and Negative Attitudes to Artificial Intelligence and Artificial Intelligence Literacy, and Technology Tendency

	Artificial Intelligence Attitudes	
	Positive GAAIS Score (p; rho)	**Negative GAAIS Score (p; rho)**
Artificial Intelligence Literacy		
AILS_Awareness Score	**<0.001**; 0.251**	**0.007*; -0.161**
AILS_Usage Score	**<0.001**; 0.261**	**0.031*; -0.129**
AILS_Evaluation Score	**<0.001**; 0.320**	**0.001*; -0.204**
AILS_Ethics Score	0.547; 0.036	**0.002*; 0.181**
AILS_Total Score	**<0.001**; 0.324**	**0.034*; -0.127**
Technology Tendency		
TUS Score	**<0.001**; 0.255**	**0.009*; -0.156**

GAAIS: The General Attitudes toward Artificial Intelligence Scale, AILS: Artificial Intelligence Literacy Scale, TUS: Technology Usage Scale, N: Number; *p<0.05, **p<0.001, Spearman correlation coefficient

The positive GAAIS score was higher for students taking an AI course compared to those who were not (p=0.010). Conversely, the negative GAAIS score showed the opposite trend (p=0.003). Scores for AILS_Awareness, AILS_Usage, AILS_Evaluation, and AILS_Total were all higher among students taking an AI course than those not, with p-values of <0.001, 0.001, 0.001, and 0.001, respectively. However, the AILS_Ethics score was lower for students taking an AI course compared to those not (p=0.033). The TUS score was similar between the two groups (p=0.262) (Table 4).

Table 4. Comparison of the Artificial Intelligence Attitudes and Literacy, and Technology Tendency between Groups

	Group 1 (n=40)	**Group 2 (n=239)**	**p**
Artificial Intelligence Attitudes			
Positive GAAIS Score	45.0 (8.75)	42.0 (7.0)	**0.010***
Negative GAAIS Score	22.0 (7.0)	24.0 (6.0)	**0.003***
Artificial Intelligence Literacy			
AILS_Awareness Score	16.0 (3.75)	14.0 (4.0)	**<0.001****
AILS_Usage Score	16.50 (4.0)	14.0 (4.0)	**0.001***
AILS_Evaluation Score	17.0 (3.75)	15.0 (5.0)	**0.002***
AILS_Ethics Score	9.50 (2.0)	10.0 (3.0)	**0.033***
AILS_Total Score	59.0 (12.0)	54.0 (8.0)	**0.001***
Technology tendency			
TUS Score	39.0 (7.75)	39.0 (9.0)	0.262

GAAIS: The General Attitudes toward Artificial Intelligence Scale, AILS: Artificial Intelligence Literacy Scale, TUS: Technology Usage Scale, N: Number; Group 1: Students taking an artificial intelligence course, Group 2: Students not taking an artificial intelligence course; *p<0.05, **p<0.001 Mann-Whitney U test

DISCUSSION

The current study has yielded the attitudes and literacy of physiotherapy students toward AI and the impact of AI courses on them. The study concluded that as positive attitudes towards AI increased, so did AI literacy (except ethics) and technology use tendence. Conversely, negative attitudes led to lower literacy and reduced technology use tendence. Additionally, students who took an AI course exhibited more positive attitudes towards AI and demonstrated greater literacy about it compared to those who did not take the course, even though both groups had similar technology use tendence.

We examined the relationship between AI attitudes and literacy, and the technology use tendency of physiotherapy students. Although no study has been performed for physiotherapy students, a similar hypothesis and methodological design in nursing students was performed. Sumengen et al. (17) focused on investigating the relationship between AI attitudes and literacy by using GAAIS and AILS; respectively. They also concentrated on the effects of the previous AI courses on these parameters. They found a positive correlation between positive GAAIS and the AILS_awareness, AILS_usage, AILS_evaluation and AILS_total scores. Additionally, as the total AILS score increased, the negative GAAIS score decreased. They recommended that improving AI literacy among nursing students leads to more positive attitudes toward AI. Raising awareness and encouraging the use of AI helps diminish negative perceptions. These results highlight the necessity of incorporating AI education into nursing programs, which will better equip students for the changing landscape of healthcare (17). Lee and Yoon examined the relationship between AI attitude and literacy in nursing students who are stakeholders of health science education reported that AI attitude and literacy had a positive correlation (18). Ozden et al. found that there was a weak positive relationship between AI attitudes and literacy in the teacher candidates. However, they commented that AI literacy alone may not be sufficient to improve the general attitudes toward AI. So, they suggested that to enhance AI literacy and positive attitudes toward AI, more practical AI education could be provided in education programs; even they can begin from primary school (19). Similarly, Çayak found a positive, high-level relationship between teachers' positive attitudes toward AI and their AI literacy. He emphasized that teachers' positive attitudes toward AI significantly predicted their AI literacy level (20). Kaya et al. indicated that positive attitudes toward AI were significantly predicted by the technological tendency regarding the level of computer use (11). Park and Woo researched the personality predictors of attitudes toward AI. They stated that personal innovation, in the tendency to adopt technology consistently, showed positive attitudes to AI (21).

We also focused on examining participants' knowledge and awareness of AI, we found that while nearly all participants were familiar with the concept of AI, only about half were able to define it. When we focused specifically on the professional use of AI technology, we discovered that only one-quarter of the participants recognized AI applications in the field of physical therapy and rehabilitation. Although participants believed that AI could help reduce their workload in the future, they were uncertain about its implications for future employment, expressing mixed feelings about whether AI poses a threat or presents an opportunity. Similarly, the recent study conducted with physiotherapy students examined their knowledge and use of AI chatbots. The study's findings revealed that while nearly all students had heard of AI, above half of them never used it (9). Alsobhi et al. indicated that, even though physiotherapists are optimistic about AI, their knowledge of AI applications in rehabilitation is lower than their general knowledge of AI (22). These findings may be commented that while physiotherapy students are aware of AI, they lack knowledge in AI, especially in the occupational field, leading to uncertainty about their future careers.

Based on our literature research, many studies have focused on the effects of AI courses on attitudes towards AI, AI literacy, and technology use tendencies among physiotherapy students. Our findings indicate that students who participated in an AI course displayed more positive attitudes towards AI and exhibited greater AI literacy. Therefore, we can conclude that AI-related courses may enhance students' understanding of AI and generate increased interest, ultimately improving their AI literacy and fostering a more positive outlook on technology. Previous

studies have emphasized the significance of AI courses and have suggested incorporating AI education into the curriculum. Yıldız and Kırdı reported that one in every two students encounters technological tools during their education, and these experiences increase as students approach graduation. They emphasized the importance of raising students' awareness of technological tools from an early age through semester information sessions, seminars, and curriculum modifications. This will contribute to the development of modern physiotherapists. Therefore, education in AI intelligence, one of the most significant advancements in professional technologies today, is essential (23). Yılmaz et al. reported that health science students are aware of AI and its use in healthcare and want to use AI tools, but they have concerns and a lack of knowledge about it. They believe it is important to include AI-related content in the curriculum to prepare future healthcare professionals for AI technologies (24). A cross-sectional study that examined AI awareness and literacy among physiotherapists emphasized the importance of incorporating AI courses into physiotherapy curricula. They found that physiotherapists generally experience low anxiety and exhibit a high readiness to adopt AI technologies. Additionally, the study revealed that physiotherapists have positive attitudes toward AI and are enthusiastic about using AI-based applications in their practice. The authors concluded that integrating AI-based applications into undergraduate programs would enhance the preparedness of future physiotherapists (25). The qualitative study examining physiotherapists' perceptions and attitudes towards AI in healthcare and rehabilitation concluded that AI positively impacts rehabilitation. It aids the decision-making process and saves time and effort. These findings emphasize the importance of implementing protocols and guidelines for the adaptation of advanced technologies in healthcare. Additionally, a variety of educational materials should be provided to all therapists to ensure the professional application of these technologies (26). The systematic review includes 38 studies on the topic of attitudes, knowledge, and skills towards AI among healthcare students, stating that healthcare students generally have a positive and promising outlook on the role of AI in healthcare services. However, many lack knowledge and skills with AI technologies. Research indicates that this low level of understanding among healthcare students is primarily due to their failure to complete training courses and the absence of relevant coursework in this area. Consequently, face-to-face training, comprehensive training manuals, and clear instructions are essential for effectively implementing AI technology and enhancing students' comprehension of its benefits (27). Therefore, as mentioned above, the AI courses in the curricula of bachelor's education may provide increasing knowledge and positive attitudes towards AI in physiotherapy and rehabilitation.

Limitations and Further Directions

Firstly, the distribution of groups taking an AI course versus those who have not was unequal, primarily due to the limited number of bachelor's programs incorporating AI-based courses into their curriculum. However, with the anticipated increase in AI-based courses in physiotherapy and rehabilitation programs, we can more accurately test our hypothesis regarding the impact of AI courses on attitudes towards AI, literacy in the subject, and technology use tendence, using a more numerically homogeneous sample. Secondly, online data collection method was performed. The reliability of participants' responses could be compromised if they answered honestly under unknown conditions. Additionally, we conducted a purely quantitative research study. Incorporating a qualitative design could offer new insights into participants' attitudes and literacy concerning AI. Therefore, we recommend that future studies be conducted in face-to-face settings, utilizing both quantitative and qualitative approaches.

Conclusion

The study found that although almost all physiotherapy students had heard of AI, they lacked sufficient knowledge about its application in their field. Positive attitudes towards AI are linked to higher levels of AI literacy and technology use tendence. Courses focusing on AI may have a positive impact on students' AI attitudes and literacy. Providing courses on AI and integrating AI-based tools into physiotherapy and rehabilitation curricula can enhance students' awareness and knowledge

about AI. This prepares graduates to excel in the technological age and stay current with advancements in clinical practice. Therefore, the study suggested that AI-based courses be included in the physiotherapy and rehabilitation curriculum.

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Conflict of interest: All authors, hereby declare to have no conflict of interest.

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