

EFFECTS OF ARTIFICIAL INTELLIGENCE ON THE FUTURE OF HEALTH: A QUALITATIVE STUDY AMONG UNIVERSITY STUDENTS

Gonul BODUR, Ph.D., Associate Professor (Corresponding Author)

Istanbul University-Cerrahpasa Florence Nightingale Nursing Faculty, Nursing Education Department, Istanbul, Turkey
E-mail: gonul.bistanbul@gmail.com, gnlbodur@iuc.edu.tr ORCID: 0000-0002-2811-534X

Melisa DİNÇER, Nurse (Postgraduate Student)

Tekirdağ Dr. İsmail Fehmi Cumalıoğlu City Hospital Covid-19 Intensive Care Unit, Tekirdağ/Turkey
melisa.dincer@ogr.iuc.edu.tr ORCID:0000-0002-2331-8252

Zeynep TUTAK, Nurse

Başakşehir Çam ve Sakura City Hospital Department of Urology, Istanbul/Turkey
zeynep.tutak16@gmail.com ORCID:0000-0002-9149-3300

Gonca ERTAŞ AKYÜZ, Nurse (Postgraduate Student)

Sultan Abdülhamid Han Educational and Research Hospital Department of Cardiology, Istanbul/Turkey
goncaertas77@gmail.com ORCID:0000-0001-5073-1168

Selda UYANIK, Nurse

Bakırköy Dr. Sadi Konuk Educational and Research Hospital Department of Internal Medicine, Istanbul/Turkey
selda041095@gmail.com ORCID:0000-0003-4442-318X

Dilek KUVAN, Nurse (Postgraduate Student)

Dr. Lütü Kırdar City Hospital Department of Thoracic Surgery, Istanbul/Turkey
dilekkuvan@gmail.com ORCID:0000-0002-1891-7525

Abstract

To determine the opinions of university students about the effects of artificial intelligence on the future of nursing and healthcare. Artificial intelligence-generated changes will have a major impact on healthcare and nursing. In-depth qualitative interviews were conducted with university students. The study included 12 senior-level students' participants, who were selected by simple random sampling from different departments of Turkish universities in Istanbul. The data were analyzed using qualitative thematic analysis. The participants defined artificial intelligence in terms of robots, robotized intelligence, machine learning and personal assistants. The participants listed the effects of artificial intelligence on nursing as a decrease in the number of nurses, a reduced workload for nurses, more effortless patient follow-up, a decreased margin of error, the use of robots for patient transport, the use of robots to position patients, the use of robots to measure vital signs, the use of robots in psychomotor skill training, use of robots in surgical operations, use of robots in elderly care and follow-up. In line with these results, it can be recommended that new subjects on artificial intelligence and its role in the future of healthcare be added to relevant educational programs. Nurse educators should develop courses in the curriculum that will increase student awareness of artificial intelligence.

Keywords: artificial intelligence; future; health; qualitative research; university student; Turkey

YAPAY ZEKÂNIN SAĞLIĞIN GELECEĞİNE ETKİLERİ: ÜNİVERSİTE ÖĞRENCİLERİ ARASINDA NİTEL BİR ÇALIŞMA

Öz

Araştırmanın amacı; üniversite öğrencilerinin yapay zekânın hemşirelik ve sağlık hizmetlerinin geleceği üzerindeki etkilerine ilişkin görüşlerini belirlemektir. Yapay zekâ tabanlı değişimlerin gelecekte sağlık hizmetleri ve hemşirelik üzerinde büyük bir etkisi olacaktır. Araştırma tanımlayıcı ve nitel araştırma tasarım tipindedir. Üniversite öğrencileri ile derinlemesine nitel görüşmeler yapılmıştır. Araştırmaya İstanbul'daki üniversitelerin farklı bölümlerinden basit tesadüfi örnekleme yoluyla seçilen 12 son sınıf öğrencisi katılmıştır. Veriler nitel tematik analiz kullanılarak analiz edilmiştir. Katılımcılar yapay zekâyı robotlar, robotize zekâ, makine öğrenme ve kişisel asistanlar olarak tanımlamışlardır. Katılımcılar yapay zekânın sağlık ve hemşirelik üzerindeki etkilerini hemşire sayısının azalması, hemşirelerin iş yükünün azalması, hasta takibinin daha kolay olması, hata payının azalması, hasta taşımada robotların kullanılması, yaşamsal belirtileri ölçmek için robot kullanılması, psikomotor beceri eğitiminde robot kullanılması, cerrahi operasyonlarda robot kullanılması, yaşlı bakımı ve takibinde robot kullanılması olarak sıralamışlardır. Bu sonuçlar doğrultusunda, ilgili eğitim programlarına yapay zekâ ve sağlığın geleceğindeki rolü ile ilgili yeni konuların eklenmesi önerilebilir. Hemşire eğitimciler müfredatta yapay zekâyı yönelik öğrenci farkındalığını artıracak dersler geliştirmelidir.

Anahtar Kelimeler: yapay zekâ; gelecek; sağlık; nitel araştırma; üniversite öğrencisi; Türkiye

1. INTRODUCTION

The technological advances that have been made in the 21st century have the potential to drastically change lives socially, culturally, economically and even politically. By force of circumstance, much individual, organizational, professional and social effort has been directed towards adapting to changes in today's hi-tech communication and information age, which is marked by very rapid and comprehensive scientific and technological changes. Growth in global welfare, developments in information and communication technologies, and advancements in genetic studies have contributed to significant transformations in the healthcare sector of the 21st century, including the transformation from a physician-and-hospital-driven healthcare system to an individual-centered healthcare system. Soon, biotechnology, nanotechnology, artificial intelligence (AI), robotic studies, the internet of things and developments in health informatics are predicted to determine the dynamics of the healthcare system (1,2,3,4,5).

2. BACKGROUND

Artificial intelligence (AI) is defined as the ability of a computer or computer-controlled robot to perform various activities in a way similar to intelligent living things; in other words, artificial intelligence allows computers to think like humans and helps machines to solve complex problems in the same manner human beings do. As an interactive scientific field, artificial intelligence is associated with many disciplines, from computer science, medicine, and psychology to finance, military, logic and philosophy (2,6,7,8). The term artificial intelligence (AI) is generally used to denote a field of science and engineering where computational understanding, which can be expressed as intelligent behavior, and related mechanisms (such as robots and speaking computers) are generated (8,9). The main techniques for creating artificial intelligence systems involve mixed processes, such as *fuzzy logic*, *genetic algorithms*, *artificial neural networks (ANN)*, *expert systems*, *robotics*, *simulated annealing*, *computer vision*, *speech recognition* and *chaotic modeling* (8).

The AI applications adopted to the healthcare sector are mainly related to medical diagnosis, patient follow-up, telemedicine, biochemical laboratory analysis, radiological analysis, hemodynamic follow-up systems, remote health services, and robotics (7,10,11,12,13). Recent studies suggest that along with the advances in robotic technology, new treatment possibilities for paralyzed patients will increase, artificial organ production will become widespread, and organ production will be possible by using 3D printers (6,9,11,14,15,16). Robotic technology can facilitate the collection of vital parameters, such as blood glucose levels, using fetal monitors, electrocardiograms and temperature monitors, and thus give healthcare personnel the ability to monitor patients and conduct interactive follow-up on them. AI-assisted robots can assist in monitoring patients and help people with motor problems to sit and stand. Furthermore, they can automatically carry and distribute drugs and supplies, assist healthcare personnel in various jobs, track human movements, and help people in emergency and life-threatening situations. Smart objects and robots with AI and portable medical devices for continuous blood pressure measurement are among the applications that enable vital signs to be sent to healthcare personnel via SMS, and that are capable of detecting the falls of the elderly at home via sensors located on the walls and immediately alert the nearest healthcare center. Many of these innovations have already been implemented, with many others expected to be implemented in the near future (4,6,7,12,17,18).

Only recently have studies started to be conducted on the effects of AI's futuristic technology in healthcare. These studies are not yet widespread in either Turkey or throughout the world. AI is taught only in university undergraduate and graduate courses within mathematics, machine and electrical engineering departments. The future effects of AI practices on individuals and the healthcare system are uncertain. Although innovative studies on robotic applications have been conducted in Turkey, there have been no sociological studies involving the opinions of university

students – who will design the future – about the future effects of AI. Therefore, examining the opinions of university students about the effects of AI on the future of the healthcare system is very important, insofar as it relates to the young generation gaining awareness of and being ready for new technologies.

This study aims to determine the opinions of university students about the effects of AI on the future of healthcare nursing.

3. METHODS

3.1.Design

A descriptive qualitative study design was used to examine the opinions of university students about the effects of AI.

3.2.Sample and Setting

To select the university students who would participate in the study, purposeful sampling was applied. Purposive sampling allows for an in-depth study of cases considered to be able to provide rich information. In the purposive sampling process, the researcher uses their judgment to select the study group most suitable for the study's purpose (19). For the present study, the inclusion criteria were students who were: (1) studying at a university, (2) living in Istanbul, (3) studying in different departments at university, (4) senior-level university students (as this year-level best enables prediction of the students' future plans). The study included 12 student participants selected by simple random sampling. Students were selected randomly from the students attending the information and communication technologies symposium held in Istanbul. The symposium is not a special lesson, but rather, a social event that is open to all students. It was decided that senior-level university students, in particular, be included in the sample, for which random sampling was used, as it is they who would be the professionals working in different disciplines of the future, and because it is at this time of their academic career that they tend to have a more future-oriented vision. After interviewing the 12 participants, data saturation was achieved. All 12 interviews were included in the study analysis.

3.3. Data Collection

Data were collected by applying the in-depth personal interview method, which involved the “*Information Form*” and the “*Semi-Structured Interview Guidance Form*”.

The *Information Form* was developed by the researchers in accordance with the literature (13,20). This form consists of seven questions on the socio-demographic characteristics of the students (the department of study, age, gender, secondary education, the residence of most prolonged duration, level of information, if any, about artificial intelligence, whether artificial intelligence applications in the healthcare sector are followed).

The *Semi-Structured Interview Guidance Form* was developed by the researchers with the aid of the relevant literature (3,4,11,16,20). It focuses on the basic concepts of AI and includes the following open-ended questions:

- What do you think about the concepts of AI?
- What are the priority areas that AI will affect in the future?
- What will be the effects of AI on the healthcare system in the future?
- What will be the effects of AI on nursing in the future?
- What do you think about the opportunities of AI in the future?

- What do you think about the threats of AI in the future?

3.4. Procedure

The participants were selected from among senior-level students in different departments of universities using the simple random sampling method. The interviews were conducted in a quiet area in the cafeteria, where students gather to socialize outside their dormitories before the symposium they attended. Everything was prepared before conducting the in-depth personal interviews, including the semi-structured interview form, a voice recorder, and the environment. The average duration of the recorded interviews was 45 min (range: 30-60 min). The semi-structured interview times were, when possible, extended until data saturation was ensured. All participants were allowed to express their thoughts without interruption. Digital voice recorders were used during the interviews, all of which were conducted by the primary researcher. Data were collected between January 2018 and May 2018. During any part of the research, the participants were exposed to harm.

3.5. Ethical considerations

The research project was approved by a university ethical committee (date of approval: 19.01.2018, protocol code: 2018-24). Written and verbal informed consent was obtained before they took part in the research. The students were informed that their names would be kept confidential and that the interviews would not affect their professional positions and/or tasks. Participants had the right to refuse to answer any question during the interview or to withdraw from the study at any time without negative consequences.

3.6. Data Analysis

Data analysis was completed using qualitative content analysis, which involved the identification of sub-themes from the interviews (19). All interview records were manually decoded and transferred to the computer environment. Before starting the data analysis, researchers reviewed the notes collected during the interview. The interviews were read carefully by five researchers to acquire a global vision of the experience. The primary researcher formed the main themes on the basis of the responses to the semi-structured interview questions. The conceptual meanings of all responses were then examined and the data were coded according to the concepts established. After all data derived from the interviews were coded, a code list was prepared. The code list was grouped as main themes and sub-themes.

3.7. Methodological rigor

Rigor was checked by having four credibility, dependability, transferability, and confirmability (19). The credibility of the process was secured by: (1) using purposive sampling method, whereby students studying under different departments and universities and specialties were selected (2) students did not know each other (3) these interviews were audio-recorded, listened to and then discussed by five researchers (4) asking clear, concise and pointed questions during the interview process and (5) involving five researchers in the analysis process and discussing results with five researchers (6) having all the interviews conducted by the primary researcher who has a great experience and certificate in research methodologies. The primary researcher, whose native language is Turkish, did data analysis to ensure dependability and confirmability. The coding tree, which included detailed meaning units, along with codes, subthemes and themes was reviewed by a Turkish co-researcher. All codes and the entirety of the manuscript were transcribed and translated into English and then checked by researchers before being edited by a professional editing institution.

4. RESULTS AND DISCUSSION

The purpose of this research was to determine the opinions of university students about the effects of AI on healthcare and nursing in Turkey. This study is one of the first qualitative studies involving university students in Turkey to be conducted AI. The study involved the participation of 12 students between the ages of 21 and 24. Among the total number of participants, five were male, seven were female and all of them single. All 12 participants were senior-level students at a university, with three being nursing students, one medical student, one a computer engineering student, one a mechanical engineering student, one a sociology student, one a mathematics sciences student, one a physics engineering student, one an economics student, one an electrical engineering student, and one a law student. Six themes and related sub-themes were identified from the thematic analysis, as shown in the following table (Table 1).

Table 1. The themes and codes obtained in the research

THEMES	CODES
The basic concepts of artificial intelligence	Robot Machine learning Personal assistant Human device Robotized intelligence
Priority areas that artificial intelligence will affect in the future.	Healthcare Defense Social life Security Transportation
Effects of artificial intelligence on the healthcare system.	Increased use of robots in healthcare Easier patient follow-up Use of robots in surgical operations Use of robots in elderly care and follow-up More straightforward medical diagnosis and treatment Use of robots for patient transport Use of robots for assisting bedridden patients
Effects of artificial intelligence on nursing.	Decreased number of nurses Reduced workloads of nurses Easier patient follow-up The decreased margin of error Use of robots for patient transport Use of robots to position patients Use of robots to measure vital signs Use of robots in psychomotor skill training
Opportunities for artificial intelligence in the future.	Savings on time Benefit to humanity Reduction of burdens of life Use of robots in research/studies Benefit to nurses
Threats of artificial intelligence in the future.	Robots endowed with emotions Possibility of robots going outside of human control Replacement of humans by artificial intelligence Reduced socialization of people Leaving people unemployed

4.1. Theme 1: The basic concepts of AI

This theme had the following five sub-themes: robots, human devices, robotized intelligence, machine learning and personal assistants. The participants stated that they had knowledge about AI,

and that they had learned this information through social media, famous inventors, science-fiction films and scientific publications.

“If we can integrate a robot into a machine through AI, I think it can control everything.” (Mathematics Sciences student, 24)

“Actually, we always say that human beings are the only ones who can think, yet we try to transfer this thinking ability onto machines for the purpose of their continuous improvement. That’s why AI is the device of human.” (Electrical Engineering student, 22)

“Yes, I have heard about AI. I have seen so much about it on social media. As you know, Elon Musk came to Turkey. We all saw him on the news. He visited Atatürk’s mausoleum. I’ve been hearing about it more and moreover the last few years.” (Nursing student, 22)

4.2. Theme 2: Priority areas that AI will affect in the future.

This theme had the following five sub-themes: healthcare, defense, social life, security and transportation.

“I think it (AI) will affect the health sector the most. I think it can actually be used in cases of hard works, like patient transport.” (Mathematics student, 24)

“It (AI) can also have a big influence on transportation, especially in big cities like Istanbul.” (Computer Engineering student, 23)

The first two themes in this study addressed the perceptions of the participants regarding the basic concepts of AI and priority areas that AI will affect in the future. The participants defined AI in terms of robots, human devices, robotized intelligence, machine learning and personal assistants. In addition, they listed the priority areas that artificial intelligence would affect in the future as health, defense, social life, security and transportation. In the literature, AI is defined as systems thinking like human beings, such as robotic applications and machine learning (6,8,11). When considered from this point of view, the students’ opinions about the concept of AI are in parallel with the literature. It is frequently emphasized in the literature that AI affects many areas via a transdisciplinary approach, that is, it intersects with many areas of specialization, including engineering, computer science, biology, neuroscience, sociology, education, mathematics and medicine. According to futurists, AI will directly affect many different fields of expertise in the future, most prominently industry, defense, health, safety, education, and business life (8,9,14,21). Many fields of expertise and applied techniques, from smart home technologies, smart home appliances, driverless vehicles, unmanned aerial vehicles, and diagnosis and treatment of diseases (such as cancer) to avatarized health professionals and robots, intelligent communication systems, banking operations, intelligent classrooms and virtual learning environments, are already used in daily life and will continue to spread quickly (21,22). The students’ opinions on the extent of AI are consistent with the literature. These results suggest that students have a relatively high awareness of artificial intelligence, despite it being a recent topic of the world agenda.

4.3. Theme 3: The effects of AI on the healthcare system.

This theme had the following seven sub-themes: the increased use of robots in healthcare, more effortless patient follow-up (home care, elderly care, chronic diseases etc.), the use of robots in surgical operations, the use of robots in elderly care and follow-up, more straightforward medical diagnosis and treatment, the use of robots for patient transport, and the use of robots for assisting bedridden patients.

“I think that if there ever was such a personal assistant, I mean, a personal health assistant, it could be widely used for the elderly.” (Mathematics student, 24)

“I think, (with AI) diseases will be diagnosed and able to be prevented easier, and that tissues will be able to be repaired more easily.” (Physics Engineering student, 23)

“I mean, everyone cannot keep and follow their vital records at home, that is, they have to go to a medical facility. Instead of going to the hospital, everything would be within arm’s reach thanks to devices with AI. It would also have a lot of influence inpatient follow-up, making this process easier.” (Nursing student, 22)

“Chronic diseases are also a major problem in the follow-up of patients, especially diabetic patients. For example, attending regular check-ups poses a major problem for patients with chronic diseases.” (Medical student, 24)

In this study, students listed the effects of AI on the healthcare system as the increased use of robots in healthcare, more effortless patient follow-up (home care, elderly care, chronic diseases etc.), the use of robots in surgical operations, the use of robots for elderly care and follow-up, more straightforward medical diagnosis and treatment, the use of robots for patient transport, and the use of robots for assisting bedridden patients. Technological developments and the introduction of electronic health records have both complicated and increased patient data and information. Machine learning and big data have become essential in classifying, using and analyzing patient data. In this area, AI and machine learning will help physicians/health professionals in disease diagnosis and treatment options and the use of clinical decision support systems, medical imaging, and image interpretation. Studies emphasize that AI, together with artificial neural networks, as one of its usage areas, focuses on modeling the human body and screening for disease diagnosis. In particular, when used in combination with expert systems and neural network systems, this algorithm can facilitate applications for early diagnosis, quick and safe screening of individuals, diagnosis of chronic diseases, and medical imaging. Studies report that these systems can be used especially in the diagnosis and screening of diseases, such as cardiac diseases, coronary artery disease, myocardial infarction, and rhythm imaging devices, such as ECGs. (12,23,24). Besides artificial neural networks and expert systems, robotic applications are also used in medicine. In particular, the use of robotic applications in surgery offers a promising start for further developments in the healthcare sector. Studies show that robots can be used in carrying bed-dependent patients, providing care to the elderly, and performing patient transport, and that they can even be employed as a care assistant in the care services and practices provided by physicians and nurses (3,4,23,25,26,27). The need for robots in the healthcare system comes to the fore as a response to the need for time-saving measures, patient safety, care cost reductions, and the increase in the number of individuals receiving healthcare (20,27,28). The results from this study reveal that the university students’ predictions about the revolutionary impact AI will have on the healthcare system are parallel to those reported in the literature. The results also point to the possibility that since the participants were Y generation students who had technology literacy and studied in different departments, they had discovered different uses of AI and applied them in predicting their effects on the healthcare system.

4.4. Theme 4: The effects of AI on nursing.

This theme had the following eight sub-themes: decreased number of nurses, reduced workloads of nurses, more effortless patient follow-up, decreased margin of error, use of robots for patient transport, use of robots to position patients, use of robots to measure vital signs, and use of robots in psychomotor skill training.

“Perhaps, we could use it (AI) in positioning patients, considering that positioning patients can be too physically demanding for nurses and cause them injuries. Obese patients can be particularly challenging in this sense, so maybe we could use it for them, or inpatient transfer, or in establishing vascular access or something like that...” (Nursing student, 22)

“I think robots can be effective if they are enhanced with AI and used in education for simulation.” (Nursing student, 22)

“I think there is a much greater need for nurses rather than for doctors in terms of workload, that is, I think artificial intelligence and robots will decrease their workload.” (Medical student, 24)

The participants listed the effects of AI on nursing as a decrease in the number of nurses, a reduced workload for nurses, more effortless patient follow-up, a decreased margin of error, the use of robots for patient transport, the use of robots to position patients, the use of robots to measure vital signs, and the use of robots in psychomotor skill training. Studies report that AI-assisted robots can help monitor patients, support patients with motor problems in daily life activities, carry and distribute medicines and supplies automatically, assist staff with various tasks, track human movements, and help in emergencies, and that intelligent robots and portable medical devices can measure blood pressure constantly, perform SMS reporting of individuals' vital signs to healthcare staff and function as fall monitors for the elderly using wall-mounted sensors (4,13,18,20,25,29). In the qualitative research conducted by Bodur and Kaya (3) on the predictions of nurses and nurse educators for the year 2050 in Turkey, participants stated that robots would become widespread in the healthcare system in the future. Today, robotic studies are expected to become widespread due to the increased use of AI. Studies on robotics are new, and the number of descriptive and social studies in this field is limited. Although it is an increasingly developing field, robotics studies have not yet had the widely expected impact in Turkey. The present study's results suggest that students' opinions about the effect of AI on nursing are consistent with the related literature, and that they are aware of the potential effects of AI on the healthcare system and nursing. The results may also suggest that students from different departments, such as engineering, mathematics and medicine, have the potential to create opportunities for developing artificial intelligence technologies and implementing them in the nursing profession.

4.5. Theme 5: Opportunities for AI in the future.

This theme had the following five sub-themes: savings on time, benefit to humanity, reduction of burdens of life, the use of robots in studies, benefits to nurses.

“I think our work will be easier; I mean, I feel that it will reduce our burden, yet I think it may have negative effects too.” (Nursing student, 22)

4.6. Theme 6: Threats of AI in the future.

This theme had the following five sub-themes: robots endowed with emotions, the possibility of robots going outside of human control, replacement of humans by AI, the reduced socialization of people, leaving people unemployed.

“As for the robots, I think they would make us even more asocial. I also think that they could replace doctors and nurses.” (Computer engineering student, 23)

In this study, students listed the opportunities of AI in the future as savings on time, benefit to humanity, reduction in burdens of life, the use of robots in studies, and benefit to nurses. They also listed the threats of AI, which included endowing robots with emotions, the possibility of robots going outside of human control, replacement of humans by artificial intelligence, the reduced socialization of people, and leaving people unemployed. Two of the most controversial issues related to AI-assisted robotic applications are undoubtedly the risks associated with endowing machines with emotions and the possibility of machines going outside human control. The use of robots for 24/7 follow-up care of individuals, as well as for treatment and care services, such as dispensing medicine and performing nursing functions, should be addressed with a degree of skepticism, especially considering that the use of robots in these areas, where professional and ethical values, like empathy, compassion,

altruism, strong communication skills, problem-solving ability, and emotional intelligence capacity, are required, could be viewed as a threat today. The present study suggests that students are aware of the opportunities and threats of AI. It is vitally essential that university students, who will form different professional groups in the future, consider these opportunities and threats to understand better how to reflect the positive developments in their professions.

4.7. Limitations

The study was limited to senior-level university students who study a university in Istanbul between January 2018 and May 2018 and attend our study. Lastly, data were collected in in-depth interviews, which limited the findings with the participants' statements.

4.8. Author contributions

Study conception/design: GB

Data collection/analysis: GB, MD, ZT, GEA, SU, DK

Drafting of the manuscript: GB

Critical revisions for important intellectual content: GB

4.9. Acknowledgements/Funding Statements

We gratefully acknowledge the support from the Research Fund of Istanbul University-Cerrahpasa (Project No: SLO-2018-27966) and the students who participated in this research.

This research was presented as a poster presentation at the 17th National Nursing Students Congress, held in Canakkale, Turkey between 04-06 April 2018.

4.10. Conflict of interest

The authors declare no conflict of interest.

5. CONCLUSION

The results showed that university students had favorable opinions, in parallel with futurists and the related literature, about the effects AI will have on the future of healthcare and nursing. Their opinions about how AI will be reflected on the future of the healthcare system are significant for the young generation, as they will be the ones responsible for designing the future and therefore must be aware of new technologies, be ready for these technologies, and implement them in their professions. In line with these results, it can be recommended that new subjects on AI and its role in the future be added to relevant educational programs. Furthermore, how AI courses should be taught to understand the best AI technologies, which techniques should be used in specific areas of expertise, and the training requirements for different areas of application according to each area of expertise should be determined. Finally, there should be an increase in the number of relevant undergraduate and graduate education programs, seminars, and projects prepared by global and national researchers and academicians working on AI, an increase in the number of scientific research projects on AI, the integration of study results into health and nursing practices by taking advantage of the opportunities offered by artificial intelligence.

REFERENCES

1. TUSIAD (Turkish Industry and Business Association) (2016) *An innovative perspective on health: Mobile health report*. Available at: <http://tusiad.org/tr/tum/item/8677> (accessed 5 January 2018)
2. OECD (2016) *An OECD Horizon Scan of Megatrends and Technology Trends in the Context of Future Research Policy*, Danish Agency for Science, Technology and Innovation, Denmark, Available at: <https://ufm.dk/en/publications/2016/files/an-oecd-horizon-scan-of-megatrends-and-technology-trends-in-the-context-of-future-research-policy.pdf> (accessed from 27 May 2019).

3. Bodur, G. & Kaya, H. (2017) The future of Turkish nursing 2050: Perceptions of nurses and nurse educators, *International Nursing Review*; 64, 511–519.
4. Archibald, M.M. & Barnard, A. (2017) Futurism in nursing: Technology, robotics and the fundamentals of care, *Journal of Clinical Nursing*; 27(11-12):2473-2480
5. Vänni K. J. & Salin S.E. (2017) A need for service robots among health care professionals in hospitals and housing services. In: Kheddar A. et al. (eds) *Social Robotics*. Lecture Notes in Computer Science, 10652:178-187.
6. Artificial Intelligence Innovation Report (2018) Deloitte Springwise Intelligence Ltd. Available at: <https://www2.deloitte.com/content/dam/Deloitte/de/Documents/Innovation/Artificial-Intelligence-Innovation-Report-2018-Deloitte.pdf> (accessed 30 January 2018)
7. Weidlich V. & Weidlich G. A. (2018) Artificial intelligence in medicine and radiation oncology. *Cureus* 10(4): e2475.
8. Elbagoury, B.M., Bakr, A.A., Roushdy, M. & Schrader, T. (2018) *Mobile doctor brain AI app: Artificial intelligence for IoT healthcare*, (Le, D.N., Le, V.C., Tromp, J.G., Nguyen, G.N., eds.) Emerging Technologies for Health and Medicine: Virtual Reality, Augmented Reality, Artificial Intelligence, Internet of Things, Robotics, Industry 4.0, Wiley-Scrivener Publisher; 1 edition.
9. World Economic Forum, (2018b) *Harnessing Artificial Intelligence for the Earth Fourth Industrial Revolution for the Earth Series*, Available at: http://www3.weforum.org/docs/Harnessing_Artificial_Intelligence_for_the_Earth_report_2018.pdf (accessed 5 January 2018)
10. Erikson, H. & Salzman-Erikson, (2016) Future challenges of robotics and artificial intelligence in nursing: What can we learn from monsters in Popular Culture? *The Permanente Journal*, 20(3): 15-243.
11. Stanford University Report (2016) “One Hundred Year Study on Artificial Intelligence Study panel, “*Artificial Intelligence and Life in 2030*” Available at: <https://ai100.stanford.edu> (accessed 1 August 2018)
12. Jiang, F., et al. (2017) Artificial intelligence in healthcare: past, present and future, *Stroke and Vascular Neurology*; 21;2(4):230-243
13. Robert, N. (2019). How artificial intelligence is changing nursing. *Nursing Management*, 50(9), 30.
14. Burmaoglu, S., Saritas, O., Kidak, L.B. & Berber, I.C. (2017) Evolution of connected health: a network perspective, *Scientometrics*; 112: 1419.
15. World Economic Forum (2018a) *The future of jobs*. Available at: http://www3.weforum.org/docs/WEF_Future_of_Jobs.pdf. (accessed 5 January 2018)
16. American College of Healthcare Executives (2018) *Futurescan 2018-2023: Healthcare Trends and Implications 2018-2023*, Health Administration Press: US. Available at: <http://newsroom.acep.org/download/Futurescan+2018+%28Reduced+File+Size%29.pdf> (accessed 27 May 2019)
17. Erikson, H. & Salzman-Erikson, M. (2017) The digital generation and nursing robotics - A netnographic study about nursing care robots posted on social media. *Nursing Inquiry*. 24:e12165.
18. Hamet, P. & Tremblay, J. (2017) Artificial intelligence in medicine, *Metabolism Clinical and Experimental*, 69:536-540.
19. Vaismoradi, M., Turunen, H. & Bondas, T. (2013). Content analysis and thematic analysis: Implications for conducting a qualitative descriptive study, *Nursing and Health Sciences*,15: 398-405
20. Ronquillo CE, Peltonen L-M, Pruinelli L, et al. (2021). Artificial intelligence in nursing: Priorities and opportunities from an international invitational think-tank of the Nursing and Artificial Intelligence Leadership Collaborative. *J Adv Nurs*. 77:3707–3717.
21. Frey, C.B. & Osborne, M.A. (2017) The future of employment: How susceptible are jobs to computerisation? *Technological Forecasting and Social Change*, 114: 254-280.
22. Michelis, G.D. (2017) Intelligent machine or knowledge technology? *Systemic Intelligent* 29(3):559-578.
23. Skiba, D.J. (2017) Horizon Report: Knowledge obsolescence, artificial intelligence, and rethinking the educator role, *Nursing Education Perspectives*, 38(3): 165-167.
24. Murali, N. & Sivakumaran, N. (2018) Artificial intelligence in healthcare- A review, *International Journal of Modern Computation, Information and Communication Technology*, 1(6):103-110.
25. Krings, B. & Weinberger, N. (2018) Assistant without Master? Some conceptual implications of assistive robotics in healthcare, *Technologies*, 6 (1) 13:1-11.
26. Erikson, H. & Salzman-Erikson, M. (2018) Twitter discussions about the predicaments of robots in geriatric Nursing: forecast of Nursing robotics in aged care. *Contemporary Nurse*, 54(1): 97-107.
27. Stokes, F., & Palmer, A. (2020). Artificial intelligence and robotics in nursing: Ethics of caring as a guide to dividing tasks between AI and humans. *Nursing Philosophy*, 21(4), e12306.
28. Wahl, B., Gantner, A.C., Germann, S. & Schwalbe, N.R. (2018) Artificial intelligence (AI) and global health: How can AI contribute to health in resource-poor settings? *BMJ Glob Health*. 2018; 3(4): e000798.
29. Bodur, G. & Aydoğan, Y. (2017) Biotechnology, health, nursing and future: Views of society in Turkey, *International Journal of Caring Sciences*; 10(3): 1554.