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Original Research Article

A Qualitative Study to Explore Healthcare Providers' Experiences Using Digital Health Technologies in Patient Education

Norah Fahad Humud Aljunaini[1], Eman Mohammed Al Hazim[2*], Mansour Ahmed Alsari[3], Mohammad Mana Hamad Al Zmanan[4], Hamad Saleh Al Kubiabah[5], Ali Saleh Alswar[6], Mahdi Makhfoor Soule Al Geshanien[7], Abdullah Ahmad Al Sari[8], Hassan Ali Duhiman Alsgoor Al Yami[9], Mahdi Saleh Shettah Al Abbas[9], Hussein Hamad Al Mansour[10], Amal Mohammed Alsharqi[11], Hadi Mahdi Al Abbas[12], Saad Masooud Al Harthy[13], Reem Abdullah Al Soma[14], Ashwaq Abdullah Al Soma[15]

[1]Nursing Specialist, Seha Virtual Hospital, Ministry of Health, Riyadh, Saudi Arabia
[2]Nursing Specialist, Riyadh First Health Cluster, Riyadh, Saudi Arabia
[3]Nursing Technician, Najran General Health Affairs, Prince Sultan Cardiac Center, Najran, Saudi Arabia
[4]Lab Technician, Khobash Hospital, Ministry of Health, Najran, Saudi Arabia
[5]Pharmacy Technician, Najran General Health Affairs, Public Health, Najran, Saudi Arabia
[6]Radiology Technician, Najran General Health Affairs, Aba Al Saud Healthcare Center, Najran, Saudi Arabia
[7]Nursing Technician, Najran General Health Affairs, Aba Al Saud Healthcare Center, Najran, Saudi Arabia
[8]Lab Technician, Najran General Health Affairs, King Khaled Hospital, Najran, Saudi Arabia
[9]Nutrition Specialist, Najran General Health Affairs, Eradah Hospital and Mental Health, Najran, Saudi Arabia
[10]Public Health, Najran General Health Affairs, Eradah Hospital and Mental Health, Najran, Saudi Arabia
[11]Registered Nurse, Eastern Health Cluster, Granada Health Center, Dammam, Saudi Arabia
[12]Medical Secretary, Najran General Health Affairs, King Khaled Hospital, Najran, Saudi Arabia
[13]Health Administration, Ministry of Health, Riyadh, Saudi Arabia
[14]Registered Nurse, General Directorate of Health Affairs in Najran, Najran Region, Saudi Arabia
[15]Registered Nurse, General Directorate of Health Affairs in Najran, Najran Region, Saudi Arabia

Abstract: Adult education is integrative education right that promotes lifelong learning among adults. It entails education and learning forms, ensuring that adults actively participate in social activities and employment (Caena & Redecker, 2019). The integration of digital technologies has had a profound impact on the global landscape of patient education. In Saudi Arabia, there has been a notable emphasis on embracing digital technologies in healthcare system. The government and educational institutions in the country recognize the importance of incorporating digital tools and platforms into patient education to enhance the quality of care and produce competent healthcare professional. This qualitative study explores the experiences of healthcare providers in Saudi Arabia as they utilize digital health technologies for patient education. Through semi-structured interviews, we delve into the perceived benefits, challenges, and strategies employed by healthcare professional in effectively integrating these technologies into their patient education practices. Our findings reveal a growing adoption of digital health technologies among healthcare providers, who recognize their potential to personalize education, enhance engagement, and improve accessibility. However, challenges such as limited access to resources, technological illiteracy, and data security concerns remain. Healthcare providers emphasize the need for tailored training, user-friendly interfaces, and robust data protection measures to optimize the use of digital health technologies in patient education. Our study provides valuable insights for healthcare providers, policymakers, and technology developers to enhance the integration of digital health technologies into patient education initiatives in Saudi Arabia.

Keywords: patient education, digital health, qualitative study, healthcare provider's experiences.

1 INTRODUCTION

The healthcare landscape in Saudi Arabia is undergoing a rapid transformation driven by advancements in digital health technologies. These

*Corresponding Author: Eman Mohammed Al Hazim
Nursing Specialist, Riyadh First Health Cluster, Riyadh, Saudi Arabia

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technologies have the potential to revolutionize patient education, providing healthcare professional with innovative tools and resources to enhance patient understanding, engagement, and adherence to treatment plans (Guo et al., 2020). In this qualitative study, we explore the experiences of healthcare providers in Saudi Arabia as they utilize digital health technologies for patient education. The growing adoption of digital health technologies in Saudi Arabia has been fueled by several factors, including government initiatives, increasing internet penetration, and a growing demand for patient-centered care. These technologies encompass a wide range of tools, including mobile health applications, online educational platforms, and wearable devices (Lombardo et al., 2021). Each of these tools offers unique capabilities for patient education, providing personalized, interactive, and accessible learning experiences.

Effective patient education is a cornerstone of successful healthcare management (Aungst & Patel, 2020). It empowers patients to make informed decisions about their health, improves treatment outcomes, and reduces healthcare costs. Despite the vast potential of digital health technologies, their integration into patient education practices is not without challenges. Healthcare professional may face obstacles such as technological illiteracy, limited access to resources, and concerns about data privacy and security. Additionally, ensuring patient adoption and utilization of these technologies requires addressing factors such as digital literacy, cultural barriers, and trust in healthcare professionals (Arambepola et al., 2016).

The integration of digital technologies aligns with Saudi Arabia's Vision 2030, which emphasizes the role of technology in driving innovation, improving healthcare outcomes, and advancing the overall quality of care for patients. Healthcare system in Saudi Arabia is increasingly incorporating technology-based approaches such as telehealth platforms, virtual simulations, and digital resources to enhance patient care experiences, foster critical thinking, and ensure the competence of future professionals (Adler et al., 2017). By embracing digital technologies, Saudi Arabia aims to position itself as a leader in healthcare education, preparing a highly skilled nursing workforce capable of meeting the evolving healthcare needs of its population. This integration enhances educational practices and contributes to the overall advancement of healthcare in the country (Hall & Bernhardt,2015). Nevertheless, it is essential to understand the principles and strategies for teaching with technologies to ensure that adult learners make the most of these tools.

This qualitative study delves into the experiences of healthcare providers in Saudi Arabia as they navigate the implementation of digital health technologies for patient education. We seek to understand their perceptions of the benefits and challenges associated with these technologies, their strategies for overcoming implementation obstacles, and their recommendations for optimizing their use in patient education practices. Our findings will provide valuable insights for healthcare providers, policymakers, and technology developers to enhance the integration of digital health technologies into patient education initiatives in Saudi Arabia.

Our aim is to gain insights into the perceived benefits, challenges, and strategies employed by healthcare providers in effectively integrating these technologies into their patient education practices.

Purpose and objectives:
Within this specific setting, the objectives of this research were to:
1. To identify the perceived benefits and challenges of using digital health technologies for patient education in Saudi Arabia.
2. To understand the strategies employed by healthcare providers to effectively integrate digital health technologies into their patient education practices.
3. To gather recommendations from healthcare providers for optimizing the use of digital health technologies in patient education initiatives in Saudi Arabia.

Research Questions:
- How do healthcare providers in Saudi Arabia experience the use of digital health technologies for patient education?
- What are the perceived benefits and challenges of using digital health technologies for patient education in Saudi Arabia?
- What strategies do healthcare providers employ to effectively integrate digital health technologies into their patient education practices?

2 MATERIALS AND METHODS

Design
The study employed a qualitative research approach using semi-structured interviews, specifically phenomenological inquiry, to explore the experiences of healthcare providers in Saudi Arabia as they utilize digital health technologies for patient education. Phenomenological inquiry aimed to understand human experiences from the perspective of the individuals themselves, focusing on their perceptions, meanings, and interpretations of their lived experiences.

A purposive sampling strategy employed to recruit participants from a diverse range of healthcare settings, including hospitals, primary care clinics, and specialized clinics. Participants will be selected based on their experience in using digital health technologies

for patient education, ensuring a rich and varied range of perspectives.

Participants and setting

The participants were included in the study if they met the following criteria: (a) they were a healthcare providers working in Saudi Arabia (b) they were clinical experience ≥ 5 years, and (c) they were fluent in spoken Arabic or English. Participants were contacted by phone or in person, and were first asked demographic questions.

Data Collection Methods:

In-depth semi-structured interviews will be conducted with participants to gather qualitative data on their experiences with digital health technologies for patient education. The interviews will be guided by an interview protocol that includes open-ended questions to elicit detailed responses about their perceptions, challenges, and strategies.

Table1: Guide of interview questions

- Can you tell me a bit about your experience in using digital health technologies for patient education?
- What are your overall impressions of using digital health technologies for patient education?
- What do you consider to be the main benefits of using digital health technologies for patient education?
- What do you consider to be the main benefits of using digital health technologies for patient education?
- What recommendations do you have for optimizing the use of digital health technologies in patient education initiatives in Saudi Arabia?
- What recommendations do you have for optimizing the use of digital health technologies in patient education initiatives in Saudi Arabia?

Ethical consideration

Informed consent obtained from all participants prior to their involvement in the study. Participants were informed of the purpose of the study, the confidentiality of their responses, and their right to withdraw from the study at any time. Data was stored securely and in accordance with ethical guidelines.

Data analysis:

Thematic analysis was used to analyze the transcribed interview data. This method involves identifying recurring themes, patterns, and meanings within the data. The themes will be organized into a coherent narrative that captures the essence of the participants' experiences.

3 RESULTS

Characteristics of the participants

The participants in this study were 29 healthcare providers in Saudi Arabia who had experience using digital health technologies for patient education. The majority of the participants were female (70%) and between the ages of 30 and 59 (62.5%). Most of the participants (60%) worked in hospitals, and the rest worked in primary care clinics or specialized clinics. The participants had varying levels of experience with digital health technologies. Majority of participants had (10-15 years) experience (70%), while others had less than 10 years' experience (30%). The most common types of digital health technologies used by the participants were mobile health applications (80%), online educational platforms (70%), and wearable devices (40%).

- **Benefits of using digital health technologies for patient education**

Participants perceive several benefits to using digital health technologies for patient education. One of the most commonly cited benefits is the ability to provide personalized education. Digital health technologies can tailor educational content to individual patient needs and preferences, taking into account their learning styles, cultural backgrounds, and health conditions.

"Digital health technologies allow me to personalize patient education by providing information in a way that is relevant and easy to understand for each patient," said one healthcare provider. Another perceived benefit of digital health technologies is their ability to enhance patient engagement. Interactive multimedia content, gamification elements, and social media integration can increase patient motivation and participation in the learning process (Conard, 2019). *"Digital health technologies make patient education more engaging and interactive, which helps patients stay focused and retain information,"* remarked another healthcare provider.

Additionally, Participants believe that digital health technologies can improve accessibility to patient education resources. Online platforms and mobile applications provide 24/7 access to educational materials, overcoming geographical barriers and time constraints (Kononowicz et al., 2019). Most of the participants (64%) believe that mobile health applications and online platforms enable patients to access educational materials whenever and wherever they need them, promoting self-directed learning and empowering patients to take control of their health. *"Digital health technologies make it easier for patients to access educational resources whenever and wherever they need them,"* said one healthcare provider.

Studies have shown that the use of these technologies can lead to positive patient outcomes, including increased adherence to treatment plans, improved symptom management, and reduced healthcare costs.

"*Digital health technologies have the potential to improve patient outcomes by providing personalized education that leads to better adherence to treatment plans and improved self-management of health conditions,*" observed one healthcare provider.

Participants have expressed their positive views on the perceived benefits of digital health technologies for patient education. Their perspectives highlight the transformative potential of these technologies in enhancing patient care. One participant claimed that "*Digital health technologies are a valuable tool for improving patient education and empowering patients to take charge of their health*" while his colleague said *"The future of patient education lies in utilizing digital health technologies to provide effective, tailored, and patient-centered learning experiences."*

- **Challenges and Barriers of using digital health technologies for patient education**
  The integration of technology in adult education and teaching have some challenges exist. As claimed by (Pegrum, 2016) one significant challenge is the digital divide, not all adult learners have access to technology and the internet. Hence, this makes it difficult for these learners to benefit from the flexibility and accessibility that comes with online learning. In addition, the lack of digital literacy skills among adult learners, many learners lack basic skills such as: creating and managing email accounts, using word processing software, and emailing attachments, this makes it difficult for these learners to access online resources and engage in online discussions (Hassan & Yasin, 2017).

Despite the perceived benefits, healthcare professionals in Saudi Arabia also face challenges and barriers in using digital health technologies for patient education. One of the main challenges is limited access to resources. Healthcare providers may not have the necessary hardware, software, or training to effectively implement these technologies. One healthcare provider said "*Lack of access to resources, such as tablets or computers, can limit the use of digital health technologies in patient education,*".

Another challenge is technological illiteracy among patients. Some patients may not have the digital skills or literacy to use digital health technologies effectively. "*Not all patients are comfortable or familiar with using digital devices, which can make it difficult for them to access and utilize digital health education resources,*" said another healthcare provider.

Data security and privacy concerns are also a challenge for healthcare providers. They must ensure that patient data is protected and secure when using digital health technologies. One healthcare provider said "*Data security is a top priority when using digital health technologies, as we need to protect patient confidentiality and privacy,*"

Participants have shared their experiences with the challenges and barriers associated with using digital health technologies for patient education. Their insights illuminate the obstacles that need to be addressed to maximize the benefits of these technologies. One participants said *"Digital health technologies have the potential to revolutionize patient education, but we need to overcome the challenges of limited access, technological illiteracy, and data security concerns."* Participant claimed that "*Standardization and interoperability are crucial for ensuring that digital health technologies can be effectively integrated into our patient education practices.*"

- **Strategies for Effective using digital health technologies for patient education**
  Participants have shared their insights on effective strategies for using digital health technologies for patient education. Their perspectives highlight the importance of tailored training, user-friendly design, data security, collaboration, cultural sensitivity, and continuous evaluation (Lombardo & Ferguson, 2021). One of the most important strategies is to provide tailored training to healthcare providers on the use of these technologies.

"*Healthcare providers need to be trained on how to use digital health technologies effectively for patient education,"* said one healthcare provider.

Another strategy is to develop user-friendly interfaces that are easy for patients to navigate. "*Digital health technologies should be designed with the patient in mind, ensuring that they are easy to use and understand,*" said another healthcare provider.

Participants also emphasize the importance of robust data protection measures to ensure patient privacy and security. "*Data security measures should be in place to protect patient information when using digital health technologies,*" said one healthcare provider.

Regular evaluation and assessment of digital health technologies are crucial for optimizing their effectiveness in patient education. Healthcare providers should monitor patient engagement, comprehension, and adherence to treatment plans. The collected data can then be used to refine and improve digital education strategies, ensuring that they continue to meet the evolving needs of patients. "*Continuous evaluation and improvement are essential for ensuring that digital*

health technologies are used effectively and efficiently for patient education," observed another healthcare provider.

Finally, digital health education resources should be culturally sensitive and relevant to the specific needs and preferences of the Saudi Arabian population. This includes tailoring content to local customs, beliefs, and language barriers. Additionally, considering the diverse cultural backgrounds within the country can ensure that digital health education is inclusive and accessible to all patients. One participant stated "*Cultural sensitivity is essential for ensuring that digital health education resources are relevant and effective for the Saudi Arabian population,"*.

- **Recommendations for Improvement**

Participants on this study have several recommendations for improving the use of digital health technologies for patient education. One recommendation is to increase funding for the development and implementation of these technologies. "*More funding is needed to develop and implement innovative digital health technologies for patient education,"* said one healthcare provider.

Another recommendation is to develop culturally appropriate digital health education resources. "*Digital health education resources should be culturally sensitive and relevant to the needs of the Saudi Arabian population,"* said another healthcare provider. Participants also recommend collaboration between healthcare professionals, technology developers, and policymakers to optimize the use of digital health technologies for patient education. "*Collaboration between healthcare professionals, technology developers, and policymakers is essential to ensure that digital health technologies are effectively used for patient education*," said one healthcare provider.

In addition, according to Car et al (2019), data security and privacy remain paramount when using digital health technologies for patient education. Strengthening data encryption, implementing robust access control mechanisms, and conducting regular security audits are essential measures to protect patient confidentiality and instill trust among healthcare providers and patients. One participant explained *"Data*

security and privacy are top priorities for healthcare providers, and we need to ensure that patient information is protected at all times when using digital health technologies,".

4 DISCUSSION

The use of digital health technologies for patient education is gaining traction, driven by several factors, including the increasing penetration of mobile devices and internet connectivity, the growing demand for personalized and accessible healthcare information, and the recognition of the potential of these technologies to enhance patient engagement and outcomes (Kataria & Ravindran,2018). Healthcare professionals in Saudi Arabia are utilizing a range of digital health technologies for patient education, including mobile health applications, online educational platforms, wearable devices, and social media. These technologies offer interactive multimedia content, gamification elements, and personalized learning experiences, making patient education more engaging and effective.

Moreover, the use of technology in adult education especially for patients must be comprehensive, including oriented to learn and able to access to hardware, software, and the internet. As (Burns& MacFadyen, 2017) mentioned that, there could be challenges of access due to almost 10-20% of patients have low digital literacy. As well as older adults may not have the same level of technology access or experience as younger ones. Finally, motivation and experiential Adults learn by doing, and technology can provide opportunities for learners to apply new knowledge and skills in real-world settings. To illustrate that online simulations, case studies, and role-playing activities can help learners develop practical skills and prepare for real-world scenario (Wu, 2017). However, teaching with technologies in adult education requires careful planning and consideration of learners' needs and preferences. The strategies such as: identifying learning needs, using interactive multimedia, and promoting collaborative learning can enhance learning outcomes based on their principles and methods of learning. To more summarized the principles outlined as shown that used technology in principles of adult education **Figure 1.**
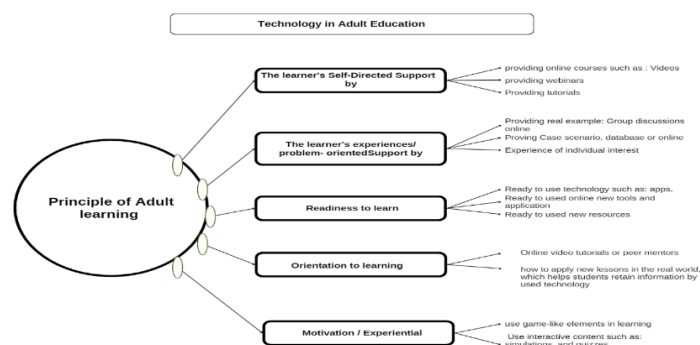
Figure: Used Technology by Principle of Adult Learning

According to Kohut et al (2011), digital health technologies enable healthcare providers to tailor educational content to individual patient needs, preferences, and learning styles. This personalized approach ensures that patients receive information relevant to their specific health conditions and cultural backgrounds. Interactive multimedia content, gamification elements, and social media integration further enhance patient engagement, making the learning process more stimulating and effective. Moreover, digital health technologies provide 24/7 access to educational resources, overcoming geographical barriers and time constraints. Patients can access educational materials whenever and wherever they need them, promoting self-directed learning and empowering them to take control of their health. This accessibility is particularly beneficial for patients residing in remote areas or those with limited mobility.

To maximize the benefits of digital health technologies for patient education in Saudi Arabia, healthcare professionals can implement several effective strategies. Tailored training and support are essential to equip healthcare providers with the necessary skills and knowledge to select, implement, and utilize these technologies effectively. User-friendly interfaces and culturally sensitive content should be developed to cater to the needs and preferences of the Saudi Arabian population. Additionally, robust data security measures must be implemented to protect patient confidentiality and privacy. Collaboration among healthcare providers, technology developers, and policymakers is crucial for optimizing the use of digital health technologies in patient education. This collaboration can facilitate the development of evidence-based practices, identify emerging trends, and address challenges collectively. Furthermore, continuous evaluation and improvement are essential to ensure that digital health technologies are used effectively and efficiently for patient education, maximizing patient outcomes.

Despite the challenges and barriers, digital health technologies hold immense promise for enhancing patient education in Saudi Arabia. Addressing these obstacles through targeted initiatives and collaborative efforts will enable healthcare professionals to harness the full potential of these technologies, leading to improved patient understanding, engagement, and health outcomes. As the healthcare landscape in Saudi Arabia continues to evolve, digital health technologies are poised to play a pivotal role in shaping the future of patient education.

5 CONCLUSION

The rapid advancement of digital health technologies has revolutionized healthcare delivery worldwide, and Saudi Arabia is no exception. These technologies offer innovative tools and resources to enhance patient education, leading to improved patient understanding, engagement, and adherence to treatment plans. While there are challenges associated with integrating digital health technologies into patient education practices, the potential benefits are undeniable.

Healthcare professionals in Saudi Arabia are increasingly utilizing digital health technologies for patient education, employing mobile applications, online platforms, wearable devices, and social media to provide personalized, engaging, and accessible educational content. These technologies have the potential to overcome geographical barriers, address cultural sensitivities, and cater to diverse learning styles.

However, challenges remain in optimizing the use of digital health technologies for patient education in Saudi Arabia. Healthcare providers may lack access to resources, patients may face technological illiteracy, and data security concerns need to be addressed. By implementing effective strategies, such as tailored training, user-friendly design, robust data security measures, and collaboration among stakeholders, healthcare professionals can harness the full potential of digital health technologies to transform patient education and improve health outcomes in Saudi Arabia.

REFERENCES

1. Kataria, S., & Ravindran, V. (2018). Digital health: a new dimension in rheumatology patient care. *Rheumatology international*, *38*(11), 1949-1957.
2. Kohut, A., Wike, R., Horowitz, J. M., Simmons, K., Poushter, J., Barker, C., ... & Gross, E. M. (2011). *Global digital communication: Texting, social networking popular worldwide*. Washington, DC: Pew Research Centre.
3. Aungst, T. D., & Patel, R. (2020). Integrating digital health into the curriculum—considerations on the current landscape and future developments. Journal of medical education and curricular development, 7, 2382120519901275.
4. Burns, M., & MacFadyen, L. P. (2017). Principles for teaching with technology. Teaching in higher education, 22(7), 771-779.
5. Anugu, P., Ansari, M. A. Y., Min, Y. I., Benjamin, E. J., Murabito, J., Winters, K., ... & Correa, A. (2022). Digital Connectedness in the Jackson Heart Study: Cross-sectional Study. *Journal of Medical Internet Research*, *24*(11), e37501.
6. Hall, A. K., Cole-Lewis, H., & Bernhardt, J. M. (2015). Mobile text messaging for health: a systematic review of reviews. *Annual review of public health*, *36*, 393-415.
7. Adler, A. J., Martin, N., Mariani, J., Tajer, C. D., Owolabi, O. O., Free, C., ... & Perel, P. (2017). Mobile phone text messaging to improve medication adherence in secondary prevention of cardiovascular disease. *Cochrane database of systematic reviews*, (4).
8. Hassan, G. M., & Yasin, M. N. (2017). Impact of technology on education. International Journal of Research in Education and Science, 3(2), 335-342.
9. Arambepola, C., Ricci-Cabello, I., Manikavasagam, P., Roberts, N., French, D. P., & Farmer, A. (2016). The impact of automated brief messages promoting lifestyle changes delivered via mobile devices to people with type 2 diabetes: a systematic literature review and meta-analysis of controlled trials. *Journal of medical Internet research*, *18*(4), e86.
10. Caena, F., & Redecker, C. (2019). Aligning teacher competence frameworks to 21st-century challenges: The case for the European Digital Competence Framework for Educators (Digcompedu). *European Journal of Education*, *54*(3), 356-369.
11. Kononowicz, A. A., Woodham, L. A., Edelbring, S., Stathakarou, N., Davies, D., Saxena, N., ... & Zary, N. (2019). Virtual patient simulations in health professions education: systematic review and meta-analysis by the digital health education collaboration. *Journal of medical Internet research*, *21*(7), e14676.
12. Schooley, B., Singh, A., Hikmet, N., Brookshire, R., & Patel, N. (2020). Integrated digital patient education at the bedside for patients with chronic conditions: observational study. *JMIR mHealth and uHealth*, *8*(12), e22947.
13. Pegrum, M. (2016). Inclusion and innovation in education technology. A Handbook of Children and Young People's Participatory Practices, 209-224.
14. Conard, S. (2019). Best practices in digital health literacy. *International journal of cardiology*, *292*, 277-279.
15. Mesko, B., & Győrffy, Z. (2019). The rise of the empowered physician in the digital health era. *Journal of medical Internet research*, *21*(3), e12490.
16. Car, J., Carlstedt-Duke, J., Tudor Car, L., Posadzki, P., Whiting, P., Zary, N., ... & Digital Health Education Collaboration. (2019). Digital education in health professions: the need for overarching evidence synthesis. *Journal of medical Internet research*, *21*(2), e12913.
17. Shan, R., Sarkar, S., & Martin, S. S. (2019). Digital health technology and mobile devices for the management of diabetes mellitus: state of the art. *Diabetologia*, *62*, 877-887.
18. Lombardo, L., Wynne, R., Hickman, L., & Ferguson, C. (2021). New technologies call for new strategies for patient education. *European Journal of Cardiovascular Nursing*, *20*(5), 399-401.
19. Guo, Y., Lane, D. A., Wang, L., Zhang, H., Wang, H., Zhang, W., ... & Lip, G. Y. (2020). Mobile health technology to improve care for patients with atrial fibrillation. *Journal of the American College of Cardiology*, *75*(13), 1523-1534.
20. Wu, D. (2017). A learner-centered approach to e-learning. In Handbook of Research on Emerging Practices and Methods for K-12 Online and Blended Learning (pp. 1-23).