

# Use of Technology in Enhancing Learning Among Nurses in Saudi Arabia; a Systematic Review

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**Abstract:** The landscape of teaching and learning, particularly in the realm of technology-supported education, is being transformed by the ongoing presence of portable digital assistant devices and other technological tools. Such technologies have become an integral aspect of learning these days. The use of Virtual Reality, Augmented Reality, cloud computing, and social media through platforms such as Twitter, Dropbox, Google Apps, and YouTube has become the norm in modern education and has greatly enhanced the quality of higher nursing education. Therefore, this study aims to synthesize evidence on the effectiveness of technology in nursing education in Saudi Arabia. The study used a systematic review methodology to extract relevant studies from databases and reference lists of related literature reviews. Two independent reviewers screened the title, abstract, and full texts based on predefined eligibility criteria. The review identified four themes from the data retrieved from 15 published articles. The themes include attitude towards e-learning, challenges and quality related to e-learning, social media and smart phones usage, virtual reality and simulation experience. Mixed attitudes have been identified among the participants of the selected studies. Various challenges linked with e-learning, social media usage, smart phones, and simulation have been identified inclusive of technical issues, lack of awareness, lack of training, etc. The findings have also stated that awareness level should be increased related to e-learning for better outcomes in Saudi Arabia. The findings suggest that technology has the potential to improve learning outcomes for nurses, including those involved in research. Therefore, it is crucial to ensure that both educators and students receive adequate training on how to effectively use the upcoming technology in Saudi Arabia.

**Keywords:** technology use, learning, nurses, Saudi Arabia

## Introduction

Technology has become an essential part of the modern learning landscape, providing nurses and other learners with engaging, accessible, and effective educational experiences that can help them stay up to date on the latest trends and best practices in their field.<sup>1</sup> Technology-supported learning in the field of nursing has been transformed by the proliferation of portable digital assistant (PDA) devices and other technological tools.<sup>2</sup> Technology allows for interactive learning experiences that engage learners through visual, auditory, and tactile methods. For example, online nursing courses often include multimedia elements like videos, interactive simulations, and virtual reality experiences that provide learners with hands-on, experiential learning.<sup>2</sup> The COVID-19 pandemic and social distancing measures have led to an unprecedented surge in the adoption of technology for learning purposes. Nursing education institutions and other higher education providers around the world have had to shift to online learning in response to the pandemic.

The utilization of technology is crucial in enabling learning across institutions of higher education.<sup>3</sup> The use of technology has become a critical part of the recent learning and teaching.<sup>4</sup> Technology has the potential to greatly enhance learning among nurse researchers by providing tools and resources to facilitate access to information, collaboration, and networking opportunities. Studies have shown that the use of online databases, search engines, and electronic health records can improve access to information for nurse researchers, allowing them to stay up to date with the latest research and findings.<sup>5</sup> Augmented reality overlays digital information onto the physical world, while virtual reality

creates a completely immersive digital environment.<sup>6</sup> Simulation technology provides a safe and controlled environment for nurse researchers to practice clinical skills and procedures, allowing them to refine their skills and gain confidence before working with real patients.<sup>7</sup> Simulation technology, such as virtual patient simulations and task trainers, has been found to be an effective way to enhance skills development among nurses.<sup>8</sup> Studies have shown that simulation training can improve clinical skills and decision-making abilities.<sup>9</sup>

Students have become increasingly reliant on technology and devices for various aspects of their education, such as browsing the web and preparing for classes, as well as for documenting and recording class sessions for future reference.<sup>5</sup> The integration of technology in nursing education has been proven to have numerous benefits, as indicated by several studies that underscore its rapid expansion<sup>10–12</sup> The Technology Acceptance Model (TAM), a theory developed in 1989 to explain user acceptance of technology, is particularly relevant to nursing education.<sup>13</sup> TAM is based on two factors that determine technology adoption: perceived usefulness and perceived ease of use. By utilizing TAM in the integration of technology in nursing education, user-friendly and practical tools can be designed that can significantly enhance the learning experience of nursing students.<sup>14</sup> Perceived usefulness refers to how technology can help people perform their job more efficiently, while perceived ease of use relates to how easy technology is to learn and use. This model can be used to understand the factors influencing nurses' attitudes towards technology in their learning. By understanding these factors, educators and policymakers can design strategies to increase the adoption and implementation of technology in nursing education.<sup>14</sup>

The integration of technology in clinical settings has been found to promote creativity and facilitate sound decision-making processes.<sup>15</sup> While technology-assisted teaching and learning in nursing education offer considerable benefits, there are still obstacles that hinder the advancement of this rapidly developing educational method. Although technology has the potential to enhance nursing education, certain nurse managers and educators are doubtful about its efficacy and perceive it as disruptive, especially in clinical settings.<sup>16</sup> Some educators even still prefer traditional teaching and learning methods to technology-based approaches.<sup>3</sup> A lack of face-to-face engagement, connectivity problems, problems with hardware and software, data security and privacy issues, and other difficulties prevent technology from being used effectively in teaching and learning.<sup>17</sup> Moreover, a lack of proficiency in Information and Communication Technology (ICT) and PDAs is another major obstacle to the successful adoption of technology in nursing education, which can lead to counterproductive outcomes. This is particularly evident in students who have had little or no exposure to computers during their primary education.<sup>18</sup> This study aims to explore if using technology can support teaching and learning in nursing. Moreover, this review provides a comprehensive look at the impact of technology on nursing education from multiple perspectives, including both students, as well as the nursing profession in general.

## Methods

### Design

We conducted a systematic review of literature. The objective of conducting this systematic review was to collect, evaluate, and integrate information regarding technology that facilitates the acquisition of learning and evidence-based practice in nursing education.

### Data Collection Strategy

We conducted a literature search in the Scopus, CINAHL, and PubMed databases, spanning from January 1, 2012, to February 17, 2023, in pursuit of relevant information. Our search strategy, including the search terms used and the resulting outcomes, alongside the criteria for inclusion and exclusion. Two researchers independently screened the titles, abstracts, and full texts to ensure adherence to the criteria. Ultimately, we identified 15 articles that satisfied the selection criteria for the final analysis.

### Data Extraction

The authors conducted a search for both empirical and non-empirical articles in EBSCOhost, CINAHL, and PubMed. Online databases are a reliable and efficient resource for the literature search stage of a review.<sup>19</sup> These internet databases

are considered comprehensive sources of healthcare-related literature and provide access to a wide range of nursing journals. These databases were chosen after a preliminary search of the literature to identify the most used sources for research in this field. The following keywords were used in a Boolean search approach to look for pertinent material in the databases mentioned: Technology use; Learning; Nurses; Saudi Arabia.

## Inclusion Criteria

- Studies conducted in Saudi Arabia.
- Studies focused on the use of technology to enhance learning outcomes among nursing students.
- Studies published in English language.
- Studies published between 2012 and the present.

## Exclusion Criteria

- Studies conducted outside Saudi Arabia/Non-Arab Studies.
- Studies not focused on the use of technology to enhance learning outcomes among nursing students.
- Studies not published in English language.
- Studies published before 2012.

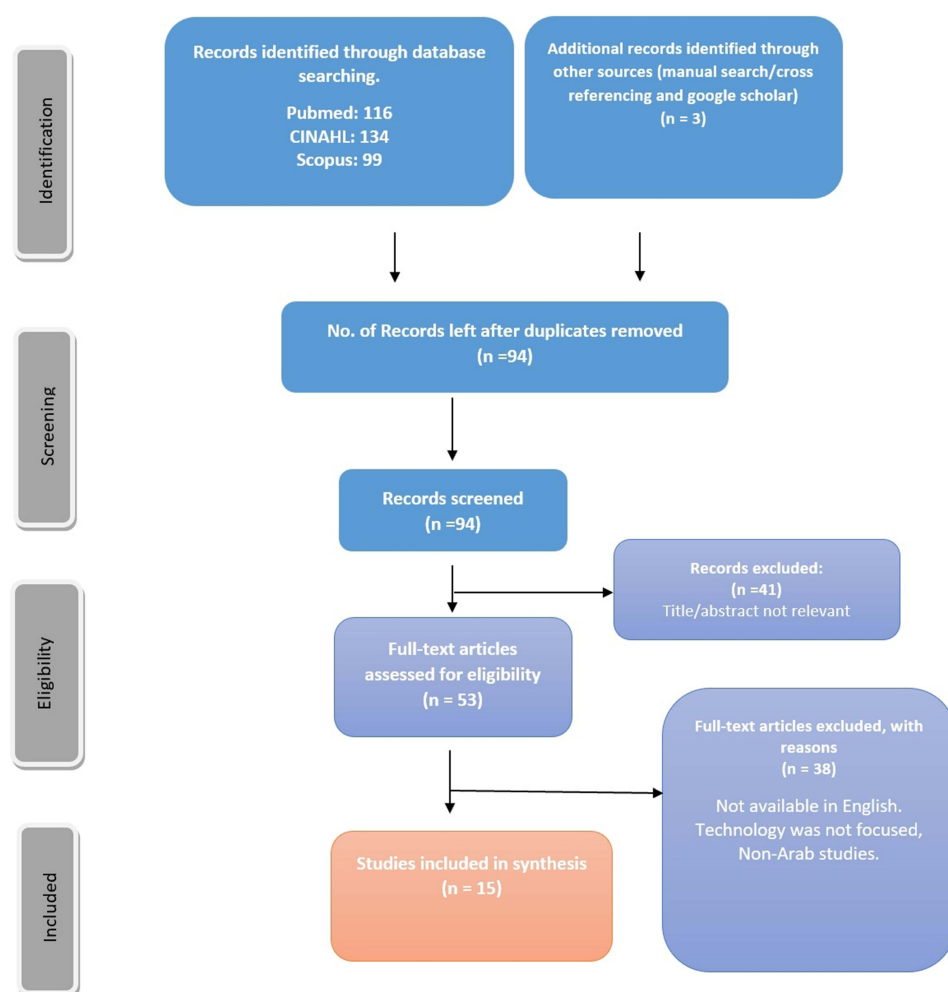
The literature search was conducted using keywords such as “and” and “or”, for instance, the search was conducted using the phrase “Technology use” or “learning” or “Saudi Arabia”. To broaden the scope of the literature search, the authors used synonyms like “e-learning” for “online learning” and “remote learning” for “digital learning”. The review covered the period between 2012 and 2023, to ensure that the review included the most up-to-date and relevant studies on the use of technology in enhancing learning outcomes among nurses in Saudi Arabia. The field of technology in nursing education has undergone significant advancements and changes over the last decade, and it was important for us to capture the latest evidence on the topic. The inclusion criteria used in this study ensured that the most recent and relevant evidence on the topic is captured. Although the authors acknowledge the influence of COVID-19 on the use of technology in teaching and learning, their goal was to study and summarize the evidence on technology use in nursing education, not just COVID-19. To achieve specificity in the literature search, relevant keywords and synonyms were used, and a timeframe was set to ensure comprehensiveness. The retrieved articles were filtered using criteria like “English” and “full texts only” to screen out irrelevant studies. A PRISMA flow diagram (Figure 1) adapted from Stovold et al<sup>20</sup> was used to assess the studies for relevance to the aims of the study and potential inclusion criteria. To ensure rigor, the conduct of this review was supervised by knowledgeable scholars.

## Data Analysis and Synthesis

The authors conducted an initial search and retrieved a total of 352 (116 from PubMed, 134 from Embase, 99 from Scopus) articles. To supplement the search, a secondary query was carried out using the same keywords on Google Scholar and through cross referencing/local journals, yielding 3 additional articles that were not obtained in the initial search. Duplicate records were removed, resulting in 94 unique records, out of which 41 were deemed irrelevant after a title/abstract screening. The authors screened the titles and abstracts of these articles against the inclusion and exclusion criteria and excluded 38 articles that did not meet the criteria. The remaining articles underwent full-text screening. Finally, 15 articles were included in the systematic review. A systematic and rigorous approach was followed. Two independent researchers screened the titles, abstracts, and full texts of the identified studies to ensure adherence to the inclusion and exclusion criteria. Any discrepancies were resolved through discussion and consensus. The data collected was summarized through narrative with an overview of the year, country, setting/sampling technique, study design, and study key findings. Figure 1 represents the process of the research.

## Quality Assessment

To evaluate the quality of the research papers, a critical appraisal tool developed by Morrison et al was used.<sup>21</sup> This instrument, which was specifically designed for educational interventions, consists of nine statements, each presented in



**Figure 1** PRISMA flowchart depicting the process of article retrieval and screening.

**Notes:** PRISMA figure adapted from Stovold, (E), Beecher, (D), Foxlee, (R) and Noel-Storr, (A) Study flow diagrams in Cochrane systematic review updates: An adapted PRISMA flow diagram, *Systematic Reviews* 2014; 3(1): 1–5. Creative Commons.<sup>20</sup>

the form of three alternative questions (yes, no, and no idea). While the tool lacks a predetermined scoring system, the authors concluded that five “yes” answers would indicate sufficient paper quality. For a visual representation of the quality assessment results, please refer to (Figure 2).

## Ethics

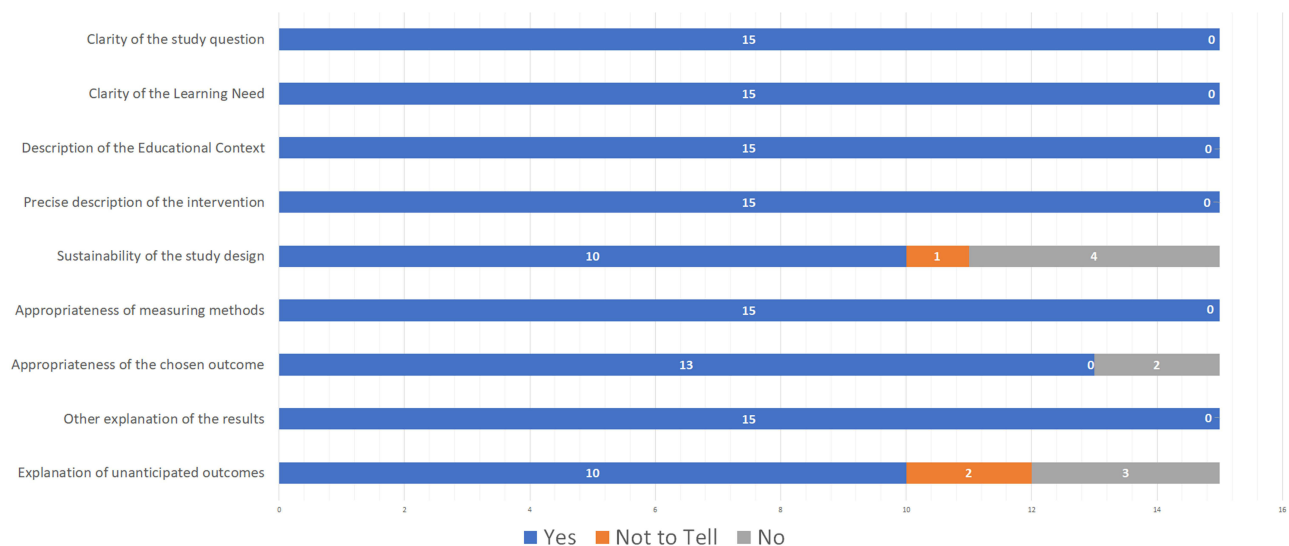
Ethical approval was not required.

## Results and Discussion

Fifteen research articles have been chosen for a comprehensive systematic review, with their summaries provided in Table 1. Based on these selected articles, four categories have been established to identify relevant findings pertaining to the aims and objectives of the study.

## Attitude Towards E-Learning

The findings have shown that the use of e-learning has become increasingly popular among nursing students in Saudi Arabia, providing them with flexible access to educational resources and opportunities. However, the attitudes towards



**Figure 2** Quality assessment performed on the studies included in the analysis.

e-learning among nursing students in Saudi Arabia are varying, with both positive and negative attitudes being expressed.<sup>22,26</sup>

One of the positive attitudes towards e-learning is the convenience it offers to nursing students. E-learning platforms allow students to access learning materials at their own pace and in their own time, providing them with flexibility and convenience. Students can also access e-learning resources from anywhere with an internet connection, which is especially beneficial for students who live in remote areas or who have other responsibilities such as work or family commitments.<sup>24</sup> O'Doherty et al has supported these outcomes about attitudes towards e-learning.<sup>37</sup> Another positive attitude towards e-learning among 140 nursing students. The results indicate that effectiveness and high acceptance of E-learning for enhancing knowledge were acknowledged, but its usefulness for practical courses was contested.<sup>26</sup> Elfaki, Abdulraheem, Abdulrahim has supported these outcomes, and further added that awareness related to e-learning approach must be improved.<sup>38</sup>

The findings have also identified that nursing students in Saudi Arabia have expressed negative attitudes towards e-learning. One of the main concerns is the lack of face-to-face interaction with the instructors and peers.<sup>29</sup> Some students feel that e-learning does not provide the same level of support and engagement as traditional classroom learning.<sup>28,31</sup> Additionally, some students may experience technical difficulties or may lack the necessary technology or internet connection to access e-learning resources. About 61.5% of the students who participated expressed dissatisfaction with their e-learning experience. The factors that had the most significant impact on their satisfaction were their attitudes of students towards computers, anxiety related to using technology, course flexibility, course quality, technology quality, perceived usefulness, ease of use, variety in assessments, and perceived interaction with other learners.<sup>39</sup> Ahmed mentioned that online learning experience was found to be satisfactory by nursing students, with significantly higher levels of satisfaction reported by female students and those aged between 22 and 24 years.<sup>40</sup> On the contrary, nursing students at the undergraduate level reported higher-than-average satisfaction levels in all five areas of education provision. Even though they were in an unfamiliar environment with a blended e-learning curriculum, they showed proficiency in technology, satisfactory communication with teachers and peers, and active participation in the learning process.<sup>41</sup> Chandra highlighted the hazard of academic stress due to e-learning methods. This study further recommended to increase awareness and training sessions for teachers and students.<sup>42</sup>

## Challenges and Quality Related to E-Learning

The findings have identified that while e-learning offers numerous benefits to nursing education in Saudi Arabia, it also presents several challenges related to quality and implementation. One of the main challenges related to e-learning is

**Table 1** Summary of Each Study Included in the Review

Author/Year/Reference	Aim	Study Design	Settings	Study population/Sample	Key Findings	Future Implications Or Study Recommendations
Abraham, B. K, and Abdeldafie, S. Y. <sup>22</sup>	The aim is to examine the attitudes of the nursing professionals towards the computers.	Quantitative research design	The study was conducted at Al batin, Saudi Arabia	Undergraduate nursing students (110) enrolled in diploma or degree program; 5-points Likert scale was used to record the responses;	The finding has shown that the nursing students showed positive attitude toward using the computers. However, the factors inclusive of anxiety, access to computer, and lack of confidence are also existing.	Computer knowledge and skills of the nursing students must be developed by providing them proper training during undergraduate programs.
Alsaqri, Alkweiese, Dayrit, <sup>23</sup>	To investigate Impact of usage of Social Networking Sites (SNS) on Students' Studying and behaviour Among Saudi Nursing Students in Ha'il University.	Quantitative non-trial	University of Ha'il.	180 Saudi nursing students	WhatsApp ranks as the most widely utilized web-based social networking tool, followed by Twitter and Snapchat.	The findings suggest that social media can have a significant impact, as demonstrated by this study's careful examination of its effects. However, faculty members should be able to guide students in the appropriate use of social networking sites and integrate SNS into nursing education programs to enhance communication and learning.
Algahtani et al <sup>24</sup>	The study has aimed to investigate the perceptions of the students, enrolled in King Saud bin Abdulaziz University about e-learning.	Cross sectional study using quantitative study	The study is conducted at King Saud bin Abdulaziz University	387 students have participated in this study, who were studying at King Saud bin Abdulaziz University	61.8% of the participants have mentioned that they have heard about e-learning. However, remaining students had no idea about it. Moreover, more than 70% of the students were in favor that cell phones must be used as a teaching modality.	Level of acceptance is needed to be increased among the students so that e-learning approaches can be used easily.
Alamrani et al, <sup>25</sup>	In this study, the impact of simulation-based and conventional teaching approaches on students' critical thinking and self-assurance during electrocardiogram interpretation sessions is analyzed.	Randomized Controlled Trial	Saudi Arabia	Thirty undergraduate nursing students	Both the control and experimental groups demonstrated progress in terms of critical thinking and self-confidence, which was confirmed by the outcomes of the paired samples t-test and the Wilcoxon signed-rank test.	It is recommended that nurse educators create educational programs with specific goals aimed at enhancing their students' critical thinking and self-assurance. Further investigation should compare the impact of multiple teaching sessions utilizing each method on a larger sample.
Khalil AMSM. Alamri A, Aljeldah M, Al-Dossary R, Albaqawi H, Al Hosis K. et al <sup>26</sup>	The study aimed to assess the practice and attitude of nursing students towards electronic learning during the COVID-19 pandemic	Cross-sectional descriptive study	Hafr Al Batin City	140 nursing students were included at the College of Applied Medical Science, Hafr Al Batin University	The effectiveness and high acceptance of E-learning for enhancing knowledge were acknowledged, but its usefulness for practical courses was contested.	To effectively incorporate online learning into the educational program, a carefully planned approach and a proactive stance are necessary.
AL-Dossary et al <sup>27</sup>	The objective of this study was to investigate the use of social media in nursing education in Saudi Arabia.	Cross-sectional quantitative study	All private and MoH hospitals in Eastern province were considered for the study.	104 participants have responded to the questionnaire; however, 300 nursing professionals were initially contacted.	Most of the nursing students have identified that social media usage is helpful in the study process. Educational content can easily be shared on social media platforms.	There is a need to increase awareness among education sector to start using social media for educational purposes.

Innab, Alqahtani <sup>28</sup>	This study aims to explore the mediating role of e-learning motivation in the relationship between technology access and satisfaction with e-learning among nursing students.	Cross-sectional, descriptive design	Public and private nursing colleges in Saudi Arabia.	Convenience sample of students (N = 139)	The relationship between technology access and satisfaction with e-learning was partially mediated by e-learning motivation.	It is recommended that future studies employ qualitative research methods to gain a more comprehensive understanding of the variations in e-learning implementation across nursing programs and to assess its effects on students' academic performance.
Castro et al <sup>29</sup>	The study has aimed to identify the perspective of nursing educators and students about online learning during COVID19 in Saudi Arabia.	Cross sectional study	Five colleges and universities in Saudi Arabia	120 nursing educators and 350 students were recruited in the study.	Overall, the nursing educators have a good perception about online education or learning. It shows that positive attitudes exist among nursing educators towards online learning	It is recommended to provide trainings to the nursing educators about online learning so that they can easily use it.
Barnawi, A, Mutair, A, Ghadeer, H. <sup>30</sup>	The study has aimed to assess the experience of the full Distance Learning approach among nursing students during COVID-19 Outbreak at KSAU-HS in the three regions.	Cross sectional study	The study is conducted in KSAU-HS in the three regions (Riyadh, Jeddah, and Al-Ahsa	800 nursing students in the CON campuses have been selected as participants.	Majority of the participant were satisfied towards the integration of e-learning.	Full distance learning approach is an effective approach; however, appropriate awareness is necessary to be raised.
INNAB et al <sup>31</sup>	The study has aimed to identify E-learning Readiness and Academic Performance among nursing students in Saudi Arabia	Quantitative survey	Private universities of Saudi Arabia	139 nursing students have been selected to collect data.	The survey has identified that the students are ready for e-learning approach because their academic performance is improving.	There is a need to identify the core issues linked with e-learning approaches along with the obstacles for better processes.
Hakami et al <sup>32</sup>	The study has aimed to identify E-Learning stress and coping strategies among nursing students at Albaha University during COVID-19 pandemic, Saudi Arabia	Descriptive cross-sectional study	Nursing Department, Faculty of Applied Medical Sciences at Al-Baha University, Saudi Arabia	110 male and female nursing students at Albaha University were selected as the participants.	The findings have identified that majority of the students were suffering from stress during COVID19. Help from lecturer, help from fellow students, and physical activities have been identified as foremost coping strategies.	Effective guidelines are necessary to be developed for better learning approaches through online platforms.
Benjamin et al. <sup>33</sup>	To explore the challenges that are being encountered related to online education for nursing students	Correlational study using cross-sectional approach	College of Nursing, King Khalid University, Abha, Saudi Arabia	150 participants selected through convenient sampling technique.	The results of the study indicate that students have a favorable view of the advantages of online learning despite its limitations. Therefore, it can be concluded that a blended approach utilizing online teaching and learning can be effectively employed in the future.	The outcomes of this study may be considered by faculty and educational institutions for future improvements.

(Continued)



**Table 1** (Continued).

Author/Year/Reference	Aim	Study Design	Settings	Study population/Sample	Key Findings	Future Implications Or Study Recommendations
Ali et al, <sup>34</sup>	The aim of the study was to evaluate the level of satisfaction among e-learners and analyze the factors that impact nursing students' satisfaction with their e-learning experience at King Khalid University.	Descriptive exploratory design	King Khalid University	135 female nursing students	The factors that had the most significant impact on their satisfaction were their attitudes towards computers, anxiety related to using technology, course flexibility, course quality, technology quality, perceived usefulness, ease of use, variety in assessments, and perceived interaction with other learners.	Facilitating students in developing their computer skills can enhance their enjoyment of e-learning. Additionally, to improve learner satisfaction and enhance the implementation of e-learning, course content should be pertinent, well-organized, user-friendly, thoughtfully crafted, and presented in moderation.
Aljohani, M.S, Tubaishat, A. and Shaban, I, <sup>35</sup>	The study has aimed to examine the effect of simulation-based learning experiences on the acquisition of knowledge regarding Advance Cardiac Life Support (ACLS).	Quasi-experimental design	College of Nursing (CoN) at Taibah University in the City of Madinah in the Kingdom of Saudi Arabia	123 students have participated in the study.	The findings have shown that simulation has an effect on increasing the ACLS knowledge of nursing students	In regards of future implications, it is recommended to conduct similar sort of study in a larger population.
Alharbi, Almutairi, Alhelih, Alshehry <sup>36</sup>	The objective of this study was to ascertain the prevalent learning preferences of nursing students in Saudi Arabia and examine how certain demographic factors relate to these preferences.	Descriptive cross-sectional study	College of nursing, King Saud University, Saudi Arabia	Convenience sample of undergraduate nursing students	The most prevalent learning preferences among nursing students are the visual, active, and sequential styles.	Being mindful of their students' learning preferences can aid educators in advancing the field of nursing education in Saudi Arabia and promoting an evidence-based culture.

**Abbreviations:** PDA, Portable digital assistant; WIL, Work-integrated learning; ICT, Information and Communication Technology.



ensuring the quality of the learning experience. E-learning platforms and resources must be designed and developed to ensure that they meet the same standards of quality and rigor as traditional classroom-based learning.<sup>32</sup> Tirziu and Vrabie have supported the outcomes and further mentioned e-learning requires careful planning, development, and evaluation of e-learning resources, as well as ongoing quality assurance and improvement measures.<sup>43</sup>

The study found that nursing students faced various obstacles to their learning. Notably, some respondents expressed concerns regarding the absence of social interaction among their peers and instructors, which they felt hindered their ability to learn effectively. Additionally, several students reported feeling a lack of personal connection with their teachers, which they felt further impeded their learning progress. Some respondents also mentioned physical barriers, such as eye strain, neck problems, and typing difficulties.<sup>32,38</sup> Additionally, e-learning requires a significant amount of self-discipline and motivation from nursing students. Without the structure and accountability of traditional classroom-based learning, some students may struggle to stay engaged and motivated. Nursing educators must develop strategies to encourage student motivation and engagement, such as regular communication, feedback, and interactive learning activities and styles.<sup>36</sup> Finally, e-learning requires significant investment in technology infrastructure, professional development, and ongoing support. Nursing schools and universities in Saudi Arabia must ensure that they have the necessary resources, expertise, and support to effectively implement and sustain e-learning initiatives.<sup>36</sup>

## Social Media and Smart Phones Usage

The findings have identified that social media and smartphones have become ubiquitous, with a high percentage of the population using social media platforms such as WhatsApp, Instagram, and Twitter. The widespread use of social media and smartphones has had a significant impact on nursing education, offering numerous opportunities and challenges.<sup>23</sup> WhatsApp ranks as the most widely utilized web-based social networking tool, followed by Twitter and Snapchat. One of the main benefits of social media and smartphones in nursing education is the ability to connect and communicate with peers and instructors. AL-Dossary et al have supported the outcomes of the above study and further mentioned that social media platforms such as Facebook and WhatsApp enable nursing students to collaborate and share resources, providing them with a supportive and engaged learning community. Additionally, smartphones can be used to access e-learning resources and other educational materials from anywhere, at any time. However, social media and smartphones also present several challenges related to distraction and addiction.<sup>27</sup> Nursing students may be easily distracted by social media notifications or spend excessive amounts of time on their smartphones, which can impact their ability to focus and engage with course materials. Additionally, social media addiction and smartphone overuse can have negative effects on mental health, sleep quality, and overall wellbeing.<sup>44</sup>

## Simulation Experience

Virtual reality and simulation experiences are emerging technologies that have the potential to revolutionize nursing education in Saudi Arabia. These technologies offer a unique and immersive learning experience that can help nursing students develop clinical skills and knowledge in a safe and controlled environment.<sup>25</sup> Simulation experiences can provide a range of benefits to nursing education. These technologies can enhance clinical decision-making and critical thinking skills, promote teamwork and communication among nursing students, and provide a safe environment to practice clinical skills and procedures without the risk of harm to real patients. In the study, the impact of simulation-based and traditional teaching approaches on students' critical thinking and self-confidence during electrocardiogram interpretation session was discussed. The results suggested that both the control and experimental groups demonstrated progress in terms of critical thinking and self-confidence, which was confirmed by the outcomes of the paired samples *t*-test and the Wilcoxon signed-rank test.<sup>25</sup> Additionally, simulation experiences can be used to teach cultural competency and address health disparities by providing access to diverse patient populations and scenarios.<sup>35,45,46</sup> The factors associated to Saudi nursing students' satisfaction with e-learning. The findings of this study may improve faculty members' comprehension of the factors that impact students' satisfaction with e-learning.<sup>30,34,47</sup>

## Strengths and Limitations

One potential strength of the review is that its sourced data from published articles that were obtained from reputable databases. By conducting a quality assessment of the studies included in our research, we were able to identify any possible biases or limitations that may have affected the findings. This step can contribute to enhancing the credibility and accuracy of the review. Therefore, the data is highly reliable in terms of quality and relevance. Furthermore, the comprehensive synthesis of the findings of the included studies, guided in providing a clear and concise summary of the existing evidence on the topic. This in turn helped to guide future research and inform clinical practice. The study's major limitations are the restricted timeframe for conducting the research. The search was limited to studies published in English language, and studies conducted outside of Saudi Arabia were excluded. Additionally, the studies included in our review were limited to those published between 2012 and present, which may have excluded some relevant studies. Moreover, the study's findings may only be applicable to the context of Saudi Arabia and may not be generalizable to other countries or settings. Hence, expanding the study's duration and scope would undoubtedly yield more comprehensive results. One area that warrants critical evaluation is the cross-sectional methods used in the reviewed papers. While cross-sectional studies can provide useful information about the prevalence of certain phenomena, they are limited in their ability to establish cause-and-effect relationships. Additionally, cross-sectional studies may suffer from selection bias, as participants may not be representative of the target population.

## Conclusion

This study provides valuable insights into how technologies have played a significant role in supporting nursing teaching and learning in recent years and overview of the use of technology in nursing across Saudi Arabia. The study is grounded in relevant literature and theory, which helps to establish the importance of using technology in nursing education.

Technologies such as simulation software, EHRs, mobile applications, and virtual reality have supported nursing teaching and learning by providing hands-on experience, access to real-time patient data, collaboration opportunities, and immersive learning experiences. As technology continues to evolve, it is likely that new technologies will emerge to support nursing education in even more innovative ways. Overall, the research suggests that technology can be a valuable tool in enhancing learning among nurses, including nurse researchers. By leveraging technology, nurses can improve access to information, enhance skills development, and collaborate with other professionals, ultimately improving patient outcomes and advancing the field of nursing research. Moreover, the lack of adequate training is a significant contributor to the challenges encountered in the deployment and implementation of technology. On-the-job training for teachers can facilitate the incorporation of augmented reality in e-learning environments, reducing resistance to technology and hastening its adoption. Integrating the importance and application of innovative technologies, including augmented reality, into teacher training courses and student curricula is crucial. This approach will furnish future educators and students with the requisite knowledge of emerging technologies and guarantee their continued use.

The review highlights the potential benefits of using technology, such as improving knowledge retention, increasing student engagement, and providing flexible learning options. The authors also discuss the challenges associated with technology use, such as lack of access, inadequate training, and technical difficulties. Despite the potential benefits of technology in nursing field, there are still gaps in the literature. For example, there is limited research on the effectiveness of specific technologies in improving learning outcomes among nursing students. Additionally, the impact of technology on the development of critical thinking skills and clinical judgment in nursing students is not well understood. Future research in this area could focus on evaluating the effectiveness of specific technologies, such as simulation software, virtual reality, and mobile applications, in enhancing learning outcomes among nursing students. Additionally, studies could explore the impact of technology on the development of critical thinking skills and clinical judgment in nursing students.

To address the limitations, future research in this area could consider using longitudinal methods, which can provide a more robust understanding of the relationship between technology use and learning outcomes over time. Additionally, studies could employ randomized controlled trials, which can help to establish causality and minimize the impact of confounding variables.

Overall, the systematic review provides a comprehensive overview of the use of technology in nursing education in Saudi Arabia. While there are some limitations to the cross-sectional methods used in the reviewed papers, the study highlights the potential benefits of using technology in nursing education and provides insights into how this technology can be effectively implemented to enhance learning outcomes.

## Implications of Findings for Future Research

The findings can be used further in future to develop a foundation and conduct comprehensive primary research in different cities of Saudi Arabia to get more real-time data. Most studies included in the review were cross-sectional and did not provide information on the long-term impact of technology-enhanced learning on nurses' knowledge and skills. Future research should focus on longitudinal studies to examine the sustained impact of technology-enhanced learning on nurses' learning outcomes. Future studies should incorporate validated instruments to measure learning outcomes consistently across studies, allowing for more reliable comparisons. Another important area for future research is the identification of barriers to technology adoption in nursing education. While technology has the potential to improve nursing education, there are still challenges associated with its implementation, such as lack of resources, inadequate training, and resistance to change. Understanding these barriers and developing strategies to address them can help facilitate the effective implementation of technology in nursing education.

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