Augmented reality application in nursing simulation: a review of its impact as educational support

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Abstract: **Recent studies have recommended mixed reality (MR) for nursing simulation training. In contrast, few studies have examined the use of and evaluation of MR nursing simulations. The term virtual reality is also used, which has been around since the late 1950s. However, its use in education has been limited due to the high cost of equipment, accessibility issues, usability issues, and a lack of appropriate educational content. Some of these limitations have been resolved by technological advances. Moreover, affordable virtual reality equipment for nursing education, primarily used with adults, shows promising results, highlighting this technology's potential. An overview of mixed reality and immersive virtual reality as learning tools for nurses is presented in this paper. This paper also discusses their current uses, research for educational purposes, and barriers to implementing them in university settings.**

Keywords: **Educational Technology, Immersive Virtual Reality, Mixed Reality, Nursing Simulation.**

1. INTRODUCTION

Simulation is a proven method of preparing nursing students for situations they will likely encounter in practice. Despite the high cost of traditional nursing simulation devices, augmented reality (AR) and holograms offer an educational support system that is not intended to replace conventional skill training, but rather to support student self-learning. By using this immersive technology, students can be engaged in a safe learning environment and achieve higher levels of self-efficacy, satisfaction, and engagement. Students can learn at their own pace through this AR program since they are able to use devices they already own without adapting to headset VR programs.

2. SIMULATION EVOLUTION IN KSA

Saudi Arabia's nursing profession has undergone several transformations since 1948, and it is still undergoing development. According to the latest published statistics by the Ministry of Health (MOH) in Saudi Arabia, nurses comprise 41% (83,596) of the workforce. In particular, 63% of all MOH nurses are Saudi citizens (Annual report of the Ministry of Health, 2019). To develop students' knowledge and skills, nursing colleges in Saudi Arabia offer courses in clinical nursing, basic nursing, and basic sciences (Aljohani K., 2020).

3. SIMULATION IN NURSING

By debriefing the process after solving problems in various simulated scenarios that may occur in clinical settings, nursing simulation provides learners with the opportunity to improve their nursing knowledge, critical thinking skills, and problem-solving skills (Kim M.K., et al, 2019).

Through the interaction between an instructor and a student, Jeffries, 2005 proposes a theoretical framework for achieving education, intervention, and evaluation of simulations, which can be evaluated based on knowledge, performance, satisfaction, critical thinking, and confidence (Jeffries P.R., 2005). Nevertheless, most prior simulation methods in nursing have occurred in school practice rooms.

For simulator education in such settings, separate space and management are required. Due to the limited number of participants per session, repeated sessions require additional time and money (Kim Y.J., et al., 2020).

4. VIRTUAL SIMULATION INTEGRATION IN NURSING EDUCATION

In education, AR-based learning is designed to simplify complex information delivery and enhance comprehension.

To overcome these shortcomings, virtual reality (VR) or mixed reality (MR) can be used. By combining the virtual and real worlds using devices such as computers, MR simulation can provide education regardless of location. Through the simulation of various scenarios, users can view the learned activities from different perspectives, and MR increases their engagement in education. MR simulation education is not costly, unlike high-fidelity simulation, and is flexible regarding environmental constraints, as it can be conducted in any space with a computer. In addition, the user can repeat the learning individually, reducing the time constraints for the instructors (Kim KJ, 2021).

With the rapid growth of technological advances such as high-speed computing, high-resolution graphics, and interface devices, virtual reality (VR) technology has become an exciting gaming technology with many potential new applications (Allcoat & Adrian, 2018). Through simulation education, learners experience situations similar to those they will encounter in real life, but in a safe learning environment (Choi M.J. and Kim K.J., 2021).

By combining virtual reality technology with active participation, collaboration, and exploration, students can create an active learning environment that not only helps them construct their knowledge, but also motivates them to be fun while learning. As a result, students' engagement and attention during the learning process is enhanced (Connolly, 2005; Farahmand, Yadav, & Spafford, 2013).

Students are able to learn effectively with VR as a pedagogical tool and an immersive learning environment. As a result, they are able to expand their scope of learning, visualize situations and concepts that are difficult to depict in other media, and gain a deeper understanding of concepts (Chen, 2016).

"In mixed reality (MR), virtual objects or information is projected into the user's field of vision to expand their perception of their surroundings. Examples are virtual reality (VR) and augmented reality (AR), two aspects of the same continuum. Many successful trials have shown that MR technology can be applied in a clinical setting (Davis MC, et al., 2016).

MR is an efficient tool and a promising technology for teaching practical medical tasks in general, as it delivers learning outcomes resembling those of a human instructor (Schoeb, D.S., et al., 2020).

However, focus has typically been on visual displays, while the real world consists of more than visual stimuli. Thus, the definition of mixed reality has often been limited. Speicher et al. identified five factors in addition to visual stimulation: audition, motion, haptics, taste, and smell. (Speicher M., et al., 2019). In addition, experts have defined MR as a combination of reality and virtuality and as strong augmented reality (AR), rather than as AR that uses specific hardware, such as HoloLens.

MR can reproduce CG images at an interactive level, as if they were part of the real world. The concept of MR is different from that of AR, which provides additional information to reality using only visual information. MR is also distinct from immersive VR, which completely blocks the external world (Park K.C., 2018). MR is understood as a technology that is combined with AR; this immersive technology was selected as one of the top 10 technology trends in 2018, with the expectation that it would contribute greatly to relevant fields. Previous studies have reported anatomy education using AR with only visual images and no interaction (Wüller H., et al., 2019). The use of MR in nursing simulation education is rare, and it is most often used to teach doctors skills during surgical procedures such as in many respiratory surgeries (Shen Y., et al., 2016; Barber S.R., et al., 2018).

5. NURSING STUDENTS' EXPERIENCE AND LEARNING WITH VIRTUAL SIMULATION

During the past few decades, technological advancements have transformed practical medical and surgical skills training. A variety of training models are now available (Landes CA, et al., 2014; Schoeb DS, et al., 2016).

Several studies have evaluated AR in nursing, with overwhelmingly positive results, although these devices pose several technical challenges. Additionally, most applications are recognizable as prototypes during the early stages of development (Wüller, H. et al., 2019).

In order to achieve higher learning/academic performance, students expect AR to be used (Mendez KJW, et al., 2020). The use of AR technology can enhance academic performance and facilitate self-learning, according to several studies (Lewis CC, et al., 2013; Akgul Y., 2021).

6. CONCLUSION

Similar to other countries, the Kingdom of Saudi Arabia's nursing education had traditional beginnings. A gradual increase in interest in VR, AR, and MR has followed the growing interest in contact-free interactions. MR nursing simulation scenarios mostly involved judgment-based scenarios, but few included procedures and techniques. Simulation programs are generally evaluated by measuring knowledge, but critical thinking is insufficiently assessed.

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