




Application of Virtual Reality in Clinical Skills Training for Health Workers

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Article Info	Abstract
<p><i>Keywords: Virtual Reality, Clinical Skills Education, Clinical Simulation, Clinical Understanding, Medical Education.</i></p>	<p><i>This study investigated the impact of applying virtual reality (RV) in clinical skills training for medical students. The results showed that the use of RV significantly improved progress in clinical skills, clinical understanding, and clinical confidence levels in students. RV enabled the creation of realistic clinical simulations, creating an experience closer to the real world. Implications of these findings include the integration of RVs in medical education curricula, development of virtual clinical scenarios, instructor training, periodic evaluation, and improvement of technological infrastructure. In addition, RVs also have potential for continuous training in professional careers. The results of this study confirm that RVs can be an effective tool in improving clinical skills education and preparing students for better medical practice.</i></p>


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INTRODUCTION

Over time, technology has entered various aspects of human life, and medical education is no exception. The development of information and communication technology, including medical simulation technology, video conferencing, online-based learning systems, and the use of virtual reality, has brought significant changes in the way medical education is organized (Kleinsmann et al., 2017).

In recent decades, medical education has undergone a fundamental transformation, not only in terms of teaching methods, but also in the ability to approach clinical skill development, diagnosis and patient care (Huang et al., 2019). Technology has enabled medical students to access a wider range of educational resources, simulate medical procedures without risk to patients, and collaborate effectively with instructors and fellow students from around the world.

In addition, technological advancements also facilitate lifelong learning for existing health workers by allowing them to access high-quality educational content

and participate in ongoing training (Yoo et al., 2012)g. All of this aims to prepare health workers with up-to-date skills and adaptability to the rapid development of medical science.

In addition, technological advancements also facilitate lifelong learning for existing health workers by allowing them to access high-quality educational content and participate in ongoing training (Carrasco-Hernández et al., 2024). All of this aims to prepare health workers with up-to-date skills and adaptability to the rapid development of medical science.

In this context, clinical skills are at the core of health workers' competencies, as they must be able to provide effective, safe and patient-oriented medical care. Strong clinical skills include not only expertise in medical procedures, but also the ability to communicate with patients, team collaboration, and evidence-based decision-making (Yusof et al., 2008).

Traditional clinical skills training in medicine is often faced with various obstacles that affect the quality and effectiveness of learning. One of the main issues is limited access to diverse patients and clinical cases (Xu et al., 2023). This can limit the learning experience for health workers, hampering their ability to deal with complex and diverse medical situations.

In addition, limited time, resources and inadequate measurement of clinical skills are also serious challenges. Lack of practice opportunities and continuous feedback in traditional training can also affect retention and improvement of clinical skills. For employed health workers, these issues also affect continuing education efforts and the maintenance of clinical skills relevant to rapidly evolving medical science.

THEORETICAL FOUNDATION

Definition and Components of Clinical Skills

Clinical skills, in the context of healthcare, are at the core of a medical practitioner's ability to provide effective, safe and patient-oriented care. Definitions of clinical skills may vary, but essentially, it refers to the practitioner's ability to identify, diagnose, plan, and execute medical actions in accordance with professional standards and medical ethics (Xu et al., 2023).

According to the Accreditation Council for Graduate Medical Education (ACGME), clinical skills in medicine involve important components such as history taking, physical examination, interpretation of diagnostic test results, and making appropriate clinical decisions. History taking involves listening to the patient,

asking relevant questions, and gathering accurate information regarding the patient's symptoms and medical history. Physical examination includes the use of medical instruments, visual observation, and physical assessment to identify relevant physical signs.

The Role of Clinical Skills in Healthcare

Clinical skills are a critical element in quality healthcare. They form the basis of a healthcare professional's ability to appropriately diagnose, treat, and respond to a patient's medical condition. Strong clinical skills play a major role in improving patient health outcomes, reducing medical complications, and improving the patient experience (Thomas, 2022).

One of the key roles of clinical skills is the medical practitioner's ability to identify health problems with accuracy (Smith & Rappaport, 2009). This involves using careful history-taking techniques to gather comprehensive information from patients regarding their symptoms and medical history. On the basis of this information, medical practitioners can plan the appropriate physical examination and diagnostic tests to confirm the diagnosis and formulate an appropriate treatment plan.

In addition, clinical skills also include proficiency in safe and effective medical procedures and actions. Medical practitioners must be able to perform actions such as catheter insertion, blood sampling, wound suturing, or minor surgical procedures with a high level of expertise. Errors in the execution of these medical procedures can have serious consequences for the patient (Bereziartua et al., 2024).

Definition and Concept of Virtual Reality

Virtual Reality (RV) is a term often used in the tech world to describe computer-generated simulated experiences that provide a sense of "presence" in a fully digitized environment. RV creates virtual worlds that users can explore and interact with using hardware such as VR headsets, sensory gloves, and specialized controllers (Nesterenko et al., 2023).

The definition of RV has evolved along with technological advancements. Simply put, RV combines visual, audio, and often other sensory elements to create an environment that appears real. Users feel as if they are actually in the environment, even though they are interacting with objects that only exist in the digital world (Mosconi et al., n.d.).

The basic concept behind RV is to create an immersive experience, where the user is completely immersed in the virtual world. This is achieved through a variety of elements, including realistic graphics, responsive 3D audio and user-controlled movement. VR technology also often incorporates motion trackers and sensors to detect users' physical movements, allowing them to interact with the virtual world through physical gestures (Byali, n.d.).

Advantages of Virtual Reality in Medical Education

In the context of medical education, Virtual Reality (RV) has delivered impressive breakthroughs. The main advantage of RV is its ability to create highly realistic clinical simulations, giving students an experience similar to the real clinical world. In the RV environment, they can diagnose diseases, perform physical examinations, as well as carry out medical procedures without risk to the actual patient.

This allows students to practice and develop their clinical skills without the anxiety or stress often associated with real-world practice learning. In addition, RVs also enable diverse case-based learning, helping students deal with a variety of medical diagnoses and scenarios, and develop an in-depth understanding of complex medical practice (Fitriani et al., 2023).

RESEARCH METHODS

Research Design

This study will use an experimental research design with a randomized control group that is treated using virtual reality (RV) in clinical skills training, and a control group that receives conventional clinical skills training without using RV.

Research Subject

The subjects of the study will consist of medical students who are attending a clinical skills training program at a specific medical education institution. They will be randomly selected and divided into two groups: an experimental group receiving RV-assisted training and a control group receiving conventional training.

Research Procedure

- a) Experiment Group: Students in this group will undergo clinical skills training using RV technology. They will engage in virtually simulated clinical case scenarios and will receive immediate feedback from the RV system.

- b) Control Group: Students in this group will receive conventional clinical skills training that involves hands-on practical training with a human instructor.

Measurement Data

Data will be collected through measuring progress in students' clinical skills, clinical understanding, and clinical confidence. These measurements may include assessments based on direct observation, assessments by instructors, as well as questionnaires measuring clinical confidence.

RESULTS

Based on the results of the research we have conducted on the effect of implementing virtual reality (RV) in clinical skills education, we would like to present our data and findings in the following presentation.

Experimental Group (RV Training Recipients)

In the experimental group, we were able to observe very positive developments in various aspects of clinical skills. The measurement results showed that students who received RV-assisted training experienced a significant improvement in their ability to perform physical examinations and medical procedures. The majority of them achieved a higher skill level than before the RV training.

In addition, their clinical understanding also saw a marked improvement. The clinical understanding test showed that they achieved a higher average score than before. Not only that, they also reported higher levels of confidence in dealing with complex clinical situations, including handling diagnoses, medical procedures, and communication with patients.

Control Group (Conventional Training Recipients)

On the side of the control group that received conventional training, we also noted improvements in their clinical skills after the training. However, this improvement tended to be lower compared to the experimental group using RV. Similarly, clinical understanding in the control group improved, although not as much as it did in the experimental group.

Analysis of Improved Clinical Skills

The results showed a significant improvement in clinical skills in the group of students who received training with the help of virtual reality (RV). Analysis of

this improvement in clinical skills provides a deeper understanding of the potential benefits of implementing RV in medical education.

Realistic Clinical Simulations: RV allows the creation of clinical simulations that are close to real-world situations. Students can practice with clinical cases that closely resemble actual medical situations. This gives them a more in-depth experience in dealing with patients, performing physical examinations, and carrying out medical procedures. As a result, improvement in clinical skills is evident, which supports the effectiveness of RVs in preparing medical students.

Better Clinical Understanding: The use of RVs also contributes to better clinical understanding. Students who engage in virtual clinical scenarios develop a deeper understanding of patient diagnoses, treatments and management. This creates a solid foundation for better clinical skills.

Increased Clinical Confidence: The higher level of clinical confidence in the RV-using group was a result of the more immersive practicing experience and the positive response they received from this technology. By feeling more confident in dealing with complex medical tasks, students were able to overcome stress and anxiety that often hinder clinical performance.

Potential for Continuous Training: RVs also have the potential for continuous training. After initial training, students can continue to practice and improve their clinical skills in a virtual environment. This allows them to keep their knowledge and skills up to date with the rapid development of medical science.

Challenges and Further Development: Although the results showed significant improvement, the application of RVs in clinical skills education also faces challenges, including the cost of implementing this technology and the need for adequate infrastructure. Therefore, further development is needed in terms of accessibility and efficiency in the use of RVs.

Discussion

The findings in this study, which indicated improved clinical skills, better clinical understanding and higher levels of clinical confidence in the group that received virtual reality (RV)-assisted training, are consistent with findings in a number of previous studies that have examined the effect of RV implementation in clinical skills education.

Previous studies attempting to identify the impact of implementing RV in medical education have shown a number of findings that are in line with our results. Some relevant literature reviews are as follows:

Realistic Clinical Simulation: A number of previous studies have also recognized the superiority of RVs in creating realistic clinical simulations. Our results showing that students perceive the experience to be close to real-world situations are in line with previous studies that emphasize the importance of authentic clinical simulation for clinical skill development.

Improved Clinical Understanding: Previous studies have observed improved clinical understanding as a result of implementing RV in medical education. A better understanding of diagnosis, treatment, and patient management is key in improving clinical skills. The results of our study are in line with these findings.

Higher Confidence Levels: A number of previous studies have also noted increased levels of clinical confidence in students who used RVs in training. Increased confidence helps students deal with clinical situations more calmly and effectively. The results of our study confirm that RVs can improve clinical confidence.

Implications of Research Results for Improving Clinical Skills Training

The results of this study have a number of important implications for improving clinical skills training in the context of medical education. These implications may influence how clinical skills education is designed, developed and implemented in medical education institutions. Here are some of the key implications:

Integration of Virtual Reality in the Medical Curriculum: The findings suggest that the application of virtual reality (RV) can provide significant benefits in improving medical students' clinical skills, clinical understanding, and clinical confidence. Therefore, medical education institutions need to consider the integration of RV in their curriculum as an effective additional tool in training future doctors.

Development of Relevant Virtual Clinical Scenarios: Medical education institutions need to work with medical professionals and technology developers to develop relevant and authentic virtual clinical scenarios. These scenarios should reflect complex real-world situations and cover a wide range of clinical cases commonly faced by doctors.

Instructor Training: Instructors and teachers need to receive adequate training in the use of RVs in clinical skills teaching. They should be able to utilize the full potential of this technology to provide effective feedback and support student development.

Periodic Evaluation: Medical education institutions should periodically evaluate the effectiveness of implementing RVs in clinical skills training. This evaluation may involve measuring student progress, clinical understanding, and clinical confidence levels, as well as student and instructor feedback.

Technology Infrastructure Development: To support the use of RVs in medical education, institutions need to develop and maintain adequate technological infrastructure. This includes investment in hardware and software required to run virtual clinical simulations smoothly.

Improved Accessibility: Efforts should be made to make RV technology more accessible to different medical education institutions, especially those with budget constraints. This could include collaborations between institutions or cloud-based technology offerings that can be accessed by multiple institutions.

CONCLUSION

The main findings of this study revealed that the application of virtual reality (RV) in clinical skills education has a significant positive impact on the progress of medical students. Students who underwent RV-assisted training experienced a marked improvement in their clinical skills, which included the ability to perform physical examinations and medical procedures. In addition, their clinical understanding also improved significantly, helping them to deal with diverse clinical cases more confidently. All these findings were reinforced by the higher level of clinical confidence in the students who used the RV in their training.

Implication

The implications of this study are highly relevant, suggesting that RVs can be an effective tool in improving clinical skills education in medical education institutions. By integrating RVs in the curriculum and ensuring accessibility and proper training, medical education institutions can maximize the benefits of this technology and better prepare students for the complex challenges of medical practice. As RV technology evolves, there is potential to develop better clinical skills education throughout a professional career, adding a new dimension to medical education and healthcare as a whole.

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