The Use of Virtual Reality to Enhance Practical Skills in Health Education

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Abstract— *This research focuses on the use of Virtual Reality (VR) as a tool to improve students' practical skills in health education. The study aims to evaluate the effectiveness of VR in developing both technical and non-technical skills among students and to identify VR's contribution to more sustainable and flexible learning. A qualitative approach with a case study method was used, involving in-depth interviews, participatory observation, and document analysis at Nurul Jadid University in East Java. The results showed that the use of VR significantly enhanced students' technical skills, such as accuracy and speed in performing medical procedures, as well as non-technical skills like communication, decision-making, and teamwork. Additionally, VR provided more flexible and sustainable access to practice sessions, overcoming the physical and logistical limitations typically faced in health education. The implications of this study suggest that VR has great potential to be integrated into the health education curriculum, offering innovative solutions to improve learning quality and better prepare students for careers in the medical field. The study also recommends further comprehensive research to accommodate various variables, such as gender and age, to provide a more targeted basis for policy.*

Keywords— *Virtual Reality, Practical Skills, Health Education*

1   Introduction

Health education plays a crucial role in maintaining and improving the quality of healthcare services worldwide. With technological advancements, traditional learning methods in health education are undergoing significant transformation, one of which is the application of Virtual Reality (VR) [1]. VR technology offers a more immersive and realistic learning experience, allowing medical students and healthcare professionals to practice in environments that simulate real clinical situations [2]. The importance of this topic lies in the fact that practical skills in the health field require not only theoretical knowledge but also safe and measurable hands-on experience [3]. VR provides an opportunity to meet this need without the risks typically associated with direct training in hospital or clinical settings [4].

David Kolb's experiential learning theory supports the importance of direct experience in the learning process [5]. According to Kolb, effective learning occurs when individuals can experience, reflect, and apply new knowledge [6]. In the context of health education, VR provides an ideal environment for undergoing this learning process without the physical constraints that usually limit conventional learning [7]. With VR, students can explore various medical scenarios, from common to complex, in a deep and repetitive manner.

Although many studies have discussed the benefits of VR technology in various fields, research on the impact of VR specifically in enhancing practical skills in health education is still relatively limited [8]. Some health education institutions are still hesitant to widely adopt this technology due to a lack of strong empirical evidence regarding its effectiveness compared to traditional methods [9]. The main issue this research aims to address is to what extent VR can replace or complement conventional learning methods in health education,

particularly in developing students' practical skills [10]. Additionally, there is a need to understand how VR can be integrated into existing curricula and adapted to various skill levels and specializations in the health field [11].

Previous studies have shown the potential of VR in education, including in health education, but with different focuses. For instance, a study by Gulo et al (2023) examined the use of VR in human anatomy training and found that VR could significantly improve students' understanding of the human body structure compared to traditional learning methods. Another study by Haristiani et al (2023) demonstrated that VR is effective in enhancing nursing students' technical skills in surgical procedure simulations. Meanwhile, research by Sundari et al (2021) evaluated the impact of VR in radiology education, concluding that VR could improve students' diagnostic imaging interpretation abilities. Although these three studies show the positive benefits of VR in the context of health education, there is still a gap in research related to measuring the effectiveness of VR in the overall development of practical skills and how this technology can be integrated into existing curricula [15]. Most studies focus on specific aspects such as understanding anatomy or technical skills, without combining a holistic evaluation of VR's influence on broader clinical skills [16].

Despite many studies highlighting the benefits of VR in education, there is a lack of research that comprehensively evaluates the impact of VR on developing practical skills across the health education spectrum. Most studies tend to be fragmented, focusing on certain aspects of health education, and do not assess how VR can be systematically applied within existing curricula. This creates a gap in the literature focused on a thorough evaluation of how VR affects students' practical skills, as well as the challenges and opportunities arising from the adoption of this technology in health education institutions.

This research offers novelty by conducting a holistic evaluation of the impact of using VR in developing practical skills in health education. It will not only assess the effectiveness of VR in specific scenarios but also explore how VR can be comprehensively integrated into health education curricula. Additionally, this study will examine the impact of VR on various skill levels and specializations, which have not been widely studied before. Another novelty of this research is its interdisciplinary approach, combining learning theory with innovative technology to produce practical guidelines that can be applied by educational institutions.

The main objective of this research is to evaluate the effectiveness of using Virtual Reality in developing practical skills in health education. This study will examine how VR can replace or complement conventional learning methods and how this technology can be integrated into existing health education curricula. With a focus on a comprehensive analysis of the impact of VR on students' clinical skills, this research aims to provide practical recommendations for health education institutions in effectively adopting this technology.

2 Method

This research uses a qualitative approach with a case study research type. A qualitative approach was chosen because this study aims to deeply understand students' experiences in using Virtual Reality (VR) as a tool to enhance practical skills in health education. A case study was used to explore the phenomenon of VR usage in a specific context, namely in the academic environment of a health education institution. The focus of this research is to explore students' and lecturers' perceptions, experiences, and views regarding the use of VR in developing their practical skills.

Data collection was carried out through in-depth interviews, participatory observation, and document analysis. Interviews were conducted with students and lecturers directly involved in the use of VR in the Health program at Nurul Jadid University, located at Jl. KH. Zaini Mun'im, Paiton, Probolinggo, East Java, Indonesia. Participatory observation was conducted during practice sessions using VR to capture the dynamics of the learning process and interactions between students and the technology. Additionally, document

analysis was performed on curricula, training modules, and evaluation reports related to the implementation of VR in the academic environment.

Data analysis was performed using a thematic analysis approach, where data from interviews, observations, and documents were coded and categorized based on emerging main themes. The analysis stages include interview data transcription, repeated reading, open coding, theme identification, and thematic narrative construction. This technique was chosen because it allows researchers to identify key patterns in participants' experiences and views and link them to the context of VR use in health education. The analysis results were then verified through data triangulation and discussions with participants to ensure the validity of the research findings.

3　Findings And Discussion

The discussion of this research's results reveals that the use of Virtual Reality (VR) in health education significantly enhances students' technical and non-technical skills. These findings align with research showing that VR can significantly improve the understanding of human anatomy, affirming that this technology can provide deep and realistic simulations [17]. However, this study also extends the scope by exploring the influence of VR on non-technical skills, such as communication and teamwork, which have not been widely discussed in previous studies [18]. Rais (2024) revealed that VR is effective in improving nursing technical skills, but this research shows that VR also contributes to developing non-technical skills essential in real clinical situations. The interpretation of these research results indicates that VR can be a more versatile and effective tool than previously anticipated, opening up opportunities for broader integration into health education curricula.

Figure 1. Use Of AI By Students

Innovative Clinical Practice Simulations

Virtual Reality (VR) enables students to conduct clinical practice simulations in a highly realistic virtual environment [20]. This provides them with the opportunity to practice medical procedures, such as surgery or emergency handling, without posing any risk to real patients [21]. Through these simulations, students can repeatedly hone their technical skills until they achieve the confidence level necessary to face real-world situations [22]. This study found that the use of VR in clinical practice simulations significantly enhances students' confidence and practical skills.

In one interview, a student stated, "When I use VR, I feel more prepared to face real-life situations in the hospital. I can repeat procedures over and over until I'm truly confident in my abilities." This feedback highlights that VR offers opportunities for intensive practice without time constraints or risks to patients. These findings align with Kolb's experiential learning theory, which posits that direct experience through simulation deepens learning and skill mastery. Students feel more confident and ready thanks to VR's ability to provide a simulated environment where they can repeat medical procedures multiple times without risking real patients. This reflects that VR not only facilitates deep technical practice but also allows sufficient repetition and practice until students feel assured of their skills. This

readiness is crucial in health education, as it gives students the chance to continuously refine their skills, ultimately enhancing their competence and confidence when dealing with real-life situations in hospitals.

A lecturer also noted, "Students who train with VR show significant improvements in both the accuracy and speed of performing procedures compared to those who only participate in conventional practice sessions." The insights from this interview confirm that VR can enhance the quality of learning by offering experiences that closely resemble real clinical situations. Through VR simulations, students can practice complex medical procedures, such as cardiopulmonary resuscitation (CPR) or trauma management, which are typically difficult to replicate in ordinary classroom settings. The interpretation of these interview results indicates that training using Virtual Reality (VR) offers greater advantages in improving students' technical skills, particularly in terms of accuracy and speed in performing medical procedures. Compared to conventional practice methods, VR appears to provide a more effective environment for intensive training, enabling students to master procedures more efficiently. This significant improvement in accuracy and speed suggests that VR not only accelerates the learning process but also enhances the quality of training by providing realistic simulations that allow students to practice in conditions resembling real clinical scenarios. This emphasizes that VR can be a more efficient and effective training tool compared to traditional methods, ultimately enhancing students' overall clinical competence.

Additionally, another student commented, "I can try different case scenarios with VR, which I might not encounter during clinical practice in the hospital." This feedback reinforces the finding that VR can offer a broader range of learning experiences compared to traditional clinical practice. With this technology, students can explore various medical cases, including those rarely encountered in real-life, better preparing themselves to handle such situations. Students can explore various case scenarios, including rare ones that may not be encountered during real-life clinical practice in hospitals. This demonstrates that VR can overcome the limitations present in traditional clinical practice, where students might only be exposed to specific situations and cases. With VR, they can learn and practice handling a wide range of medical conditions, including complex or rare scenarios, thereby expanding their clinical knowledge and skills. This is crucial in shaping students' readiness to face various possible medical situations in the real world, providing them with a more holistic and comprehensive experience during their education.

Figure 2. Face Real Situations

The indicators from the interview interpretations suggest that the use of Virtual Reality (VR) in health education has a significant impact on students' readiness to face real-world situations in hospitals. Students feel more prepared after training with VR because this technology allows them to repeatedly practice medical procedures until they master the

skills without risking patients, which directly boosts their confidence [23]. Moreover, VR has been proven to improve students' accuracy and speed in performing procedures, as recognized by lecturers, affirming the effectiveness of VR compared to conventional practice methods [24]. The simulation environment provided by VR is highly realistic, resembling actual clinical conditions, which accelerates the learning process and offers deep practice [25]. Furthermore, VR provides a broader range of learning experiences, enabling students to practice various case scenarios, including those rarely encountered in traditional clinical practice, thereby expanding their clinical knowledge and skills [26]. All these aspects collectively contribute to enhancing students' clinical competence, better preparing them to handle various medical situations in the real world.

### Comprehensive Development of Non-Technical Skills

In addition to technical skills, VR also plays a role in developing essential non-technical skills, such as communication and decision-making. Through simulations of interactions with virtual patients, students can practice how to communicate effectively, manage emotions, and show empathy. VR can also create scenarios where students must make quick clinical decisions, helping them sharpen their critical thinking skills in high-pressure situations.

Furthermore, the study found that VR is effective in developing non-technical skills such as communication, decision-making, and teamwork. In this discussion, a student said, "I feel more confident communicating with patients after using VR because I can practice various communication scenarios that might occur in the field." This statement reveals that VR can be used as a tool to simulate interactions between medical professionals and patients, which is crucial for honing communication skills in complex medical situations. The interview results show that the use of Virtual Reality (VR) in learning positively impacts students' confidence in communicating with patients. The student felt more prepared and confident after using VR because they could practice various communication scenarios they might face in real life. This indicates that VR provides a realistic and interactive experience, allowing students to explore and prepare for diverse situations without direct risk, thereby enhancing their communication competence before entering the field.

Another lecturer also stated, "The use of VR enables students to think quickly and make accurate decisions in simulated emergency situations. This is very important in developing their critical thinking skills." This finding indicates that VR provides simulations of critical situations where students must respond quickly and accurately, a crucial skill in the healthcare profession. By practicing in a safe and controlled environment, students can develop better decision-making skills. The interview results highlight the important role of VR in honing students' critical thinking skills, particularly in emergency situations. The lecturer noted that VR simulations allow students to practice quick thinking and make the right decisions when facing simulated crises. This experience helps students develop the ability to quickly analyze situations, consider various options, and take the most effective action. Thus, VR becomes an effective tool in shaping critical thinking skills, which are vital for them when facing real-world challenges, especially in the medical context, which requires quick and accurate decisions.

Another student also shared their experience, stating, "In the VR scenario, I had to work with my friends to handle a patient experiencing a heart attack. We had to work as a team, and I learned how important coordination is in emergency situations." This statement reinforces the importance of VR in developing teamwork skills, which are crucial in the medical environment. VR provides simulations that require students to work together, enabling them to understand their roles within a medical team and improve teamwork effectiveness. VR not only helps students improve their communication skills but also emphasizes the importance of teamwork in emergency situations. The student learned that in dealing with critical conditions such as a heart attack, coordination among team members is crucial. This experience allows students to understand team dynamics, develop collaboration skills, and experience firsthand the importance of coordination in ensuring

effective patient care. This underscores the value of VR as a learning tool that provides realistic simulations, helping students prepare to work efficiently in teams in the real world.
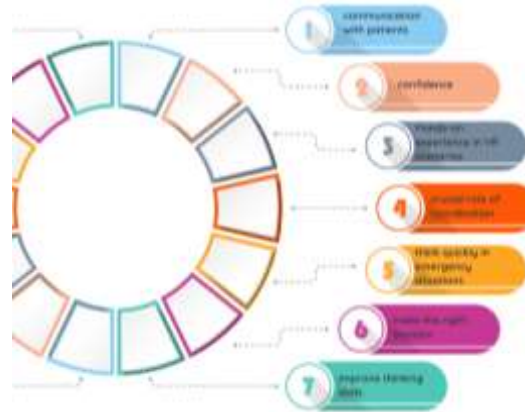
Figure 3. Medical Education

The indicators from the findings above suggest that communication with patients is a vital aspect of the medical profession that requires high confidence from each practitioner [27]. Through direct experience in VR scenarios, students can practice handling various communication situations that may occur in the field, making them feel more prepared and confident when interacting with real patients [28]. This confidence is built because students become accustomed to various communication scenarios, which helps them anticipate and respond more effectively [29]. Additionally, VR emphasizes the importance of teamwork, especially in emergency situations where coordination plays a crucial role in managing medical cases [30]. In VR scenarios, students are trained to think quickly and make accurate decisions, which is the essence of critical thinking skills [31]. This ability not only helps them respond effectively in emergencies but also enhances overall thinking skills, which are essential for quality decision-making in the medical field [32].

Thus, VR in medical education is not just a visual aid but also serves as a comprehensive learning platform for developing various important skills for students. Through VR, students can hone their communication, teamwork, and decision-making skills in critical situations, all within a safe and controlled environment. This better prepares them for real-world challenges, ensuring they are not only technically ready but also mentally and emotionally prepared for the medical profession.

Unlimited Access to Ongoing Training

Virtual Reality (VR) provides exceptional flexibility in training, allowing students to practice anytime and anywhere according to their needs [33][34]. With unlimited access to simulations, students can repeat exercises as much as necessary to strengthen their skills [35]. This enables a deeper and more personalized learning process, where students can focus on areas needing improvement without time or location constraints [36][37]. The study also found that VR offers more flexible and sustainable access to practical skills training. As expressed by one student, "I can practice using VR anytime, even outside of class hours. It helps me learn at my own pace." This statement indicates that VR allows students to set their own study schedules, providing them with greater flexibility compared to conventional training, which is often constrained by schedules and facility availability. The use of VR in learning, where students can access materials and practice anytime according to their needs, emphasizes how VR provides greater autonomy in the learning process, allowing students to deepen their understanding and improve their practical skills in a more flexible timeframe.

Another interviewed lecturer also confirmed, "VR allows us to provide ongoing practice for students, without being limited by space and time. Students can repeat procedures whenever they need, which enhances their competency." This indicates that VR supports a more sustainable learning process, unconstrained by physical or logistical barriers. With the ability to access practice sessions at any time, students can continually refine their skills and ensure they are prepared to face real-world challenges. This interview highlights the significant benefits of using VR in medical education, particularly in providing continuous practice without being limited by space and time. The lecturer noted that with VR, students have the opportunity to repeat procedures and practice whenever needed, without relying on schedules or physical facilities. This allows students to deepen their understanding and strengthen their practical skills independently, according to their individual needs. Consequently, the use of VR not only enhances learning flexibility but also significantly boosts students' competency by providing them with unlimited access to practice and mastery of the material.

Additionally, another student added, "Sometimes I feel there isn't enough time to understand certain procedures in practice sessions. With VR, I can repeat the session as many times as needed until I fully master it." This statement reinforces the importance of the ongoing access provided by VR, which allows students to learn more intensively and thoroughly according to their needs. The interview results show that VR offers an effective solution for students who feel limited by time during traditional practice sessions. The student expressed that in regular class settings, the available time may not be sufficient to fully understand or master certain procedures. However, with VR, they have the freedom to repeat practice sessions as many times as needed until they achieve mastery. This indicates that VR provides an opportunity for deeper and more comprehensive learning, where students can overcome individual difficulties and achieve higher levels of competency without the time pressure typically present in conventional practice sessions.

Figure.4 *Physical Facilities*

Time and place flexibility in learning is one of the primary advantages offered by Virtual Reality (VR) technology in education [38]. With VR, students are no longer constrained by class schedules or the availability of physical facilities. They can access training materials anytime and from anywhere, allowing them to tailor their learning process according to their personal schedules and needs [39]. This flexibility is crucial for supporting more independent and efficient learning, where students can practice and repeat procedures on their own, thereby achieving a deeper understanding of the material being taught [40][41]. With VR, the learning process no longer depends on physical presence in laboratories or classrooms, but can occur in various more comfortable and flexible settings for the students [42]. Independent learning supported by the ability to repeat procedures as needed plays a significant role in enhancing student competence [43]. In traditional practice sessions, available time is often limited, which may leave students feeling that they do not have enough time to fully understand and master the skills being taught [44]. With VR, students have the opportunity to overcome these limitations by repeating procedures until

they feel completely confident [45]. This process not only enhances their understanding but also provides a greater sense of control over their own learning process [46]. Consequently, students can achieve a higher level of competence and be better prepared for real-world challenges. VR offers an effective solution to time constraints in traditional practice sessions, ensuring that each student can learn at their own pace and according to their individual needs, ultimately contributing to better and more equitable learning outcomes [47].

4   Conclusion

This study reveals that the use of Virtual Reality (VR) in health education has a significant positive impact on enhancing students' practical skills. The most important finding of this research is that VR not only improves technical skills, such as accuracy and speed in performing medical procedures, but also develops non-technical skills, such as communication, decision-making, and teamwork. The lessons learned from this study indicate that VR can be an effective and efficient learning tool, offering flexibility and continuous access for practice, and overcoming various physical and logistical limitations in health education.

The scholarly contribution of this research lies in updating the perspective on the use of VR technology in health education, combining both technical and non-technical aspects comprehensively. This study introduces an innovative method in learning, with variables that simultaneously measure technical and non-technical skills. However, the study has limitations, particularly in terms of case scope, research location being confined to a single institution, and participant variability which may not encompass the entire spectrum of age and gender. To gain a more comprehensive view, further research is needed that accommodates various variables, including gender and age, and utilizes broader survey methods. Future research is expected to provide a more accurate policy foundation and targets for the implementation of VR technology in health education.

5   References

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6   Acknowledgment