



User Experience in Utilizing Virtual Reality and Augmented Reality in Medical Learning and Treatment Processes: A Phenomenological Study and Case Study in Hospitals and Clinics in Indonesia

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ABSTRACT

The field of digital health communication has gained significant attention as technology increasingly plays a role in healthcare interactions. Within this context, the experience of medical practitioners and patients in utilizing digital health platforms, such as telemedicine, remains an underexplored area in health communication research. While existing studies have focused on the adoption of digital tools, little is known about the subjective experiences and the deeper meanings associated with these interactions. This study addresses this gap by adopting a phenomenological approach to explore the lived experiences of medical practitioners and patients in digital health communication. Through in-depth interviews with 25 participants, several key themes were identified, including trust, communication barriers, and perceived benefits of telemedicine. Our findings highlight that medical practitioners and patients face challenges in adapting to telemedicine platforms, such as technological literacy and concerns over data privacy, but also recognize significant improvements in healthcare accessibility and patient engagement. These results offer insights into how digital health platforms can be improved to better meet the needs of users and inform future developments in telemedicine. The implications of these findings suggest that a deeper understanding of user experiences is essential for the continued evolution of digital health systems.



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INTRODUCTION

The integration of emerging technologies in healthcare has transformed various aspects of medical practice, from training to patient care (Breed dkk., 2023). Among these innovations, Virtual Reality (VR) and Augmented Reality (AR) have gained significant attention due to their potential to enhance medical education, improve patient treatment experiences, and optimize healthcare delivery (Aydoğan & Huri, 2021). These technologies allow for immersive, interactive simulations that offer medical professionals and patients a deeper understanding of procedures, rehabilitation processes, and disease management, making them increasingly relevant in both clinical and educational settings.

In the context of medical training, VR and AR are used to simulate complex surgical procedures and diagnostic processes, allowing practitioners to gain hands-on experience without the risk of patient harm (Johnson dkk., 2020). For patients, VR and AR have been explored as therapeutic tools, particularly in pain management, anxiety reduction during medical procedures, and rehabilitation. However, despite their growing adoption, the use of VR and AR in healthcare still faces several challenges, High costs, technical limitations, and user comfort concerns persist as barriers to wider adoption, especially in developing countries like Indonesia, where accessibility

remains limited. These challenges restrict the technologies' reach to advanced healthcare facilities, leaving gaps in their practical application

Previous studies have primarily focused on the technological capabilities of VR and AR in medical settings, with a considerable emphasis on their potential to enhance procedural training and patient outcomes (Kim dkk., 2020). However, limited attention has been given to the subjective experiences of users—both medical practitioners and patients—when interacting with these technologies. This gap highlights the importance of exploring the personal perceptions, challenges, and benefits associated with VR and AR from a phenomenological perspective. By delving into the lived experiences of those who use these technologies, this study aims to provide a deeper understanding of how VR and AR impact medical training and patient care, and to uncover the broader meanings that users attribute to these experiences. The goal is to explore not only the technological effects but also the psychological and emotional responses that may shape their acceptance and effectiveness in real-world applications.

Research into the subjective experiences of individuals interacting with new technologies, such as Virtual Reality (VR) and Augmented Reality (AR) in medical settings, has become an increasingly significant area of study (Lewandowski dkk., 2021). In healthcare, understanding the personal perceptions, challenges, and emotional responses of both practitioners and patients is crucial for assessing the true impact of these technologies on medical practice and patient care. While technological studies have largely focused on performance metrics, the deeper meanings attributed to these technologies by the users themselves remain underexplored. This gap in understanding makes it essential to turn to phenomenology, which offers a methodological framework that prioritizes the lived experience and subjective interpretations of individuals as they interact with these innovations.

Phenomenology, as a research approach, is particularly well-suited for exploring the complexity of human experiences with technology. It allows for a nuanced understanding of how users experience VR and AR in medical settings, revealing insights that go beyond the capabilities of quantitative methods (Schulz dkk., 2023). Quantitative approaches, though effective in measuring usage statistics or effectiveness, often fail to capture the intricate, individual emotional and cognitive responses that influence technology adoption and its practical application. In contrast, phenomenology enables a deeper exploration of users' perceptions of comfort, effectiveness, and emotional impact, providing a fuller picture of the role these technologies play in medical training and patient care.

However, the exploration of such subjective experiences presents its own set of challenges. One major difficulty lies in the inherent subjectivity of the data, which requires careful interpretation to avoid misrepresenting individual experiences. Additionally, the reliance on qualitative methods such as interviews and observations often results in smaller, more context-specific datasets, which can limit the generalizability of findings. Despite these challenges, phenomenological research provides a rich, detailed perspective that is crucial for understanding how VR and AR are truly experienced by users in healthcare, a perspective that is often missing from more traditional, outcome-driven studies.

Although current practical approaches, such as the use of quantitative methods to measure the efficiency of VR and AR technologies in medical contexts, have provided valuable insights, these approaches have limitations in exploring the subjective experiences and deeper meanings experienced by users (Simoncini dkk., 2024). Quantitative research often focuses on measuring tangible outcomes and statistics but fails to capture the complexity of emotional, psychological, and cognitive experiences that influence the adoption and use of these technologies. This results in a limited understanding of how medical practitioners and patients feel, interact with, and evaluate these technologies, while overlooking perceptions that may play a crucial role in the success or failure of their use in medical settings.

As an alternative solution, a phenomenological approach offers a more holistic way to explore this phenomenon. By focusing on lived experiences and the meanings attributed by individuals, phenomenology allows researchers to uncover deeper dimensions of VR and AR usage, particularly in terms of comfort, emotional engagement, and psychological impact—elements that may be overlooked by quantitative research. This method also provides an opportunity to understand how

users interpret and make sense of the technology within a broader context, which will enrich our understanding of the adoption of new technologies in medical practice.

Therefore, while numerous studies have measured the technical outcomes of VR and AR usage, very few have investigated the experiences and meanings perceived by users, especially in highly contextual cultural and social settings such as Indonesia. This study aims to fill this gap by adopting a phenomenological approach, which allows for uncovering the essence of user experiences when interacting with VR and AR technologies in medical environments.

Previous research has touched on various aspects of the use of technologies such as VR and AR in medical contexts, particularly in training and treatment. Several studies have shown that these technologies can enhance medical skills and provide emotional comfort to patients during medical procedures, although the results still vary depending on the user experience. However, most of these studies focus on quantitative outcomes or functional measurements of technology usage, such as skill improvement or medical procedure efficiency, without delving deeper into the subjective experiences of users. Innovation Diffusion Theory, for example, has been used to understand the adoption of new technologies in medical contexts, but few have discussed the personal experiences and meanings attributed by medical practitioners and patients. Therefore, this study focuses on the subjective experiences of users in the context of VR and AR usage in hospitals and clinics in Indonesia.

A phenomenological approach was chosen for this research due to its ability to explore the deeper and more complex meanings of human experience. Phenomenology enables researchers to understand how individuals feel about and attribute meaning to the phenomena they experience—in this case, the use of VR and AR technologies in medical training and patient care. This approach is highly relevant to filling the gap in our understanding of the psychological, emotional, and cognitive impacts of these technologies, which cannot be measured using quantitative methods. Through this approach, the study aims to provide a more holistic insight into the adoption and user experience of VR and AR in medical practice.

The structure of this article includes several sections that will provide a comprehensive overview of the research. After the introduction, the article will outline the context of the phenomenon under study, including the current understanding of medical technology use and the existing knowledge gaps. The phenomenological methodological approach used will be explained, followed by details of the data collection and analysis process. Next, the research findings will be discussed in-depth, with a focus on the meanings expressed by users, concluding with a summary of the main findings and practical implications for the adoption of technology in the medical sector.

RESEARCH METHODS

Study Design

This study adopted a phenomenological approach to explore the subjective experiences of medical practitioners and patients using Virtual Reality (VR) and Augmented Reality (AR) in medical training and treatment (van Gelderen dkk., 2020). Phenomenology was selected as it allows for a deep understanding of lived experiences and the meanings individuals ascribe to these experiences, which is essential for answering the research questions related to the use of emerging medical technologies. The focus of phenomenology on lived experience and meaning-making is particularly relevant in this context, as it provides insights into the personal perceptions, challenges, and benefits associated with VR and AR in healthcare settings.

The study employed a descriptive phenomenological design to capture the detailed and nuanced experiences of participants. This approach is characterized by a focus on the direct, first-person accounts of individuals, allowing the researcher to describe and interpret the essence of the phenomenon under investigation. By using this approach, the study sought to uncover the underlying structures of meaning regarding the adoption of VR and AR technologies, both from the perspective of medical professionals and patients.

Participants

Participants were selected using purposive sampling to ensure that individuals with relevant experiences in the use of VR and AR in medical settings were included. The sample consisted of 20 medical practitioners (10 specialists and 5 nurses) and 5 patients who had direct experience with VR or AR technologies in medical contexts, either for training or therapeutic purposes.

Inclusion criteria for medical practitioners were: (1) at least one year of experience in using VR or AR for medical training or treatment, (2) involvement in a healthcare institution where VR or AR is actively used, and (3) willingness to share their experiences regarding the technology. For patients, the inclusion criteria were: (1) at least one instance of receiving therapy or rehabilitation using VR or AR, (2) ability to articulate their experience during and after using the technology, and (3) consent to participate in the study.

Exclusion criteria for both practitioners and patients were: (1) lack of experience using VR or AR in a medical context, and (2) individuals unable to provide informed consent due to physical or cognitive limitations. Demographically, the medical practitioners had an average age of 42 years, with diverse specialties including surgery, trauma care, and rehabilitation. The patients ranged in age from 25 to 70, with varied backgrounds in terms of health conditions and treatment experiences.

Data Collection

Data were collected through semi-structured interviews and participant observations. Semi-structured interviews were conducted in person, allowing for a flexible yet focused conversation that encouraged participants to reflect on their experiences with VR and AR in medical training and treatment (Aydoğan & Huri, 2021). The interview guide was developed based on the research questions and was designed to explore participants' perceptions, experiences, challenges, and the perceived impact of VR and AR technologies on medical practice and patient care.

The interviews lasted between 30 and 60 minutes, depending on the depth of the participant's responses, and were conducted in a quiet, private setting within the medical institutions or the participants' homes to ensure comfort and confidentiality. All interviews were audio-recorded with participants' consent for transcription and analysis. In addition to interviews, observations were conducted in medical settings where VR and AR technologies were actively being used, allowing the researcher to gain additional insights into the context and practical use of these technologies.

Data Analysis

Data were analyzed using thematic analysis, a technique commonly employed in phenomenological research to identify and interpret themes that capture the essence of participants' experiences. The data analysis process involved several stages, starting with transcribing the interview recordings verbatim. Transcripts were then reviewed multiple times to ensure familiarity with the data.

The next step involved open coding, where initial themes and categories were identified based on participants' descriptions of their experiences. These codes were then grouped into broader themes that reflected the central aspects of the participants' lived experiences with VR and AR technologies. A final thematic map was constructed to illustrate how the themes were interconnected, and the analysis focused on understanding the meanings participants attached to their use of these technologies in medical contexts. Data analysis was assisted by the NVivo software, which facilitated the organization and coding of the qualitative data.

To manage potential biases during thematic analysis, several strategies were implemented. First, an inter-coder reliability process was employed, where two independent researchers coded the same subset of transcripts to ensure consistency and reduce subjective interpretation. Discrepancies between coders were discussed and resolved through consensus. Second, reflexivity was maintained throughout the analysis by keeping a research journal to document any assumptions, preconceptions, or potential influences that might affect the interpretation of the data. Third, participant validation was used, wherein preliminary themes were shared with a subset of participants to confirm that the findings accurately represented their experiences. This iterative feedback process helped to enhance the credibility and trustworthiness of the analysis.

Ethics

The study adhered to ethical guidelines to ensure the protection of participants' rights. Ethical approval was obtained from the relevant institutional review board. All participants provided written informed consent prior to their involvement in the study, and their participation was voluntary. Participants were assured of the confidentiality of their responses and were informed that they could withdraw from the study at any time without consequence. To further protect participants' anonymity, all identifying information was removed from the data, and pseudonyms were used in the final reporting of results. The study complied with international ethical standards for research involving human subjects, as outlined in the Declaration of Helsinki.

RESULTS

Practical Insights on Medical Training and Procedure Simulation Using VR and AR

The integration of Virtual Reality (VR) and Augmented Reality (AR) in medical training was consistently highlighted by practitioners as a transformative tool in enhancing hands-on experience. Many of the interviewed medical professionals, particularly surgeons and specialists, reported that these technologies enabled them to practice complex procedures in a risk-free, controlled environment. A senior surgeon, Dr. H, emphasized, "Using VR for surgery simulations has allowed me to rehearse procedures in ways I couldn't with traditional methods. The ability to visualize the anatomy in 3D gives me more confidence before operating on real patients." This sentiment was echoed by other practitioners who felt that VR and AR not only enhanced technical skills but also offered an immersive way of learning, making complex medical concepts more understandable.

However, despite the general enthusiasm, there were concerns regarding the cost and technical limitations. Dr. K, a physician specializing in trauma care, pointed out that, "While VR is helpful, the high initial cost and the need for specialized equipment often make it inaccessible to smaller clinics. It's still a luxury for larger hospitals." This challenge regarding the accessibility of VR and AR in less-equipped medical facilities was frequently mentioned and became a barrier to widespread adoption.

Patient Experience with VR and AR in Medical Treatment

Patient responses to VR and AR in the context of medical care were varied, with some expressing significant benefits, while others encountered challenges. Patients who had experienced AR as part of their rehabilitation therapy were particularly positive about the technology's ability to engage them in the healing process. One patient, P3, stated, "The AR exercises made the physical therapy more engaging. I could see how my movements improved in real time, which motivated me to keep going." These positive experiences were linked to the interactive and motivating nature of AR applications, which helped patients visualize their progress and better understand the rehabilitation process.

Conversely, some patients expressed discomfort with VR, particularly in relation to the physical effects such as dizziness or vertigo. For example, P5, a middle-aged patient who had undergone a VR-assisted procedure, noted, "At first, it was exciting, but after a few minutes, I started to feel light-headed and disoriented. I had to stop using it." Such discomfort, especially among elderly patients, was a recurring concern. It appeared that while VR provided immersive experiences that could potentially reduce anxiety during medical procedures, its effectiveness was compromised by physical side effects, which some patients found difficult to tolerate.

Perceptions of Comfort and Effectiveness in the Use of VR and AR for Medical Purposes

Both practitioners and patients recognized the potential of VR and AR in improving the quality of medical training and patient care. However, there were varying perceptions regarding the comfort and effectiveness of these technologies in practice. For instance, many practitioners noted the positive impact VR had on their ability to simulate procedures without the risks associated with real-life practice. Dr. L, a clinical educator, shared, "We can create scenarios that are impossible to

replicate in reality, such as rare or life-threatening conditions. VR offers a way to practice these situations without the danger of harm.”

On the other hand, the comfort of using these technologies was a significant concern among patients. While some expressed that the use of VR during medical treatments made them feel more at ease, others had reservations. P2, a patient who underwent a VR-based diagnostic procedure, explained, “I felt like I was in control, which made me less anxious. But I still found it hard to focus after a while.” This feedback suggested that while VR and AR could be effective tools in patient treatment, their utility was heavily dependent on the duration and individual tolerance levels, highlighting the need for tailored approaches.

Technological Barriers and Accessibility Issues in VR and AR Adoption

The practical challenges of implementing VR and AR technologies in the medical field emerged as a significant theme. Both practitioners and patients acknowledged the potential of these technologies but noted the barriers that hindered their broader adoption. Financial constraints were a key issue for many medical professionals, as noted by Dr. M, “The technology itself is expensive, and even when available, not all medical facilities can afford the necessary infrastructure to implement it fully.” Additionally, the need for specialized training to operate VR and AR systems posed a barrier for both medical professionals and healthcare institutions, particularly in smaller clinics.

Patients also expressed frustration regarding the availability of VR and AR technologies. P1, a patient who had used AR for rehabilitation, reflected, “It’s a great tool, but not every clinic offers it. I had to travel to a bigger city to get treatment with this technology.” This highlighted the uneven distribution of advanced medical technologies across different regions of Indonesia, which limited access to innovative care options for many patients, particularly those in rural areas.

The findings from this study provide a nuanced understanding of the experiences of medical practitioners and patients with VR and AR technologies in the context of medical training and patient care. While both groups recognize the potential of these technologies to enhance learning and improve patient outcomes, challenges related to accessibility, cost, and physical comfort remain significant barriers. The adoption of VR and AR in medical practice holds great promise, but its success depends on addressing these barriers, ensuring equitable access, and adapting the technologies to meet the physical and psychological needs of diverse patient populations.

DISCUSSION

This study reveals the subjective experiences of medical practitioners and patients in using VR and AR technologies within the context of medical training and patient care (Garg, 2021). The key findings indicate that while these technologies can enhance practitioners' skills and provide emotional comfort for patients, their experiences are significantly influenced by psychological and contextual factors that cannot be explained solely through quantitative approaches. User experiences, both positive and negative, are closely tied to their perceptions of the technology within their social and professional contexts.

These findings provide deeper answers to the research questions regarding how VR and AR technologies affect the experiences of medical practitioners and patients, as well as how they attribute meaning to the use of these technologies (Ružický dkk., 2022). The study demonstrates that user experiences are not only determined by the functionality of the technology but also by psychological factors such as anxiety, self-confidence, and interpersonal relationships in medical interactions. This leads to the understanding that in order to adopt new technologies in medical practice, it is crucial to consider the emotional and social dimensions of users, rather than just technical efficiency or skill. Therefore, this research makes an important contribution by exploring deeper layers of experience that have previously been underexplored in the existing literature.

Several previous studies have highlighted the importance of VR and AR technologies in medical education and patient care, primarily focusing on skill measurement or technical impact (Wang & Lang, 2018). For example, research by Smith et al. (2021) demonstrated improvements in

medical skills through the use of VR, while studies by Green and Patel (2022) emphasized the benefits of AR in providing patients with a more immersive care experience. However, these studies rarely explore the subjective experiences of users, as found in this study. Our findings reinforce Rogers' Innovation Diffusion Theory, which posits that the adoption of technology depends not only on functional superiority but also on social acceptance and individual perceptions of the technology. Thus, this study enriches the existing literature by emphasizing the importance of personal and emotional experiences in the context of medical technology.

Implications of the Findings

The findings of this study have significant implications both in the context of medical education and patient care. For healthcare policy, the results suggest that decision-makers should prioritize funding and initiatives aimed at reducing the cost and increasing the accessibility of VR and AR technologies, especially in under-resourced healthcare facilities. Subsidizing the acquisition of VR and AR systems or providing grants for training programs could facilitate wider adoption across diverse healthcare settings. Moreover, policies should encourage partnerships between hospitals, technology developers, and academic institutions to ensure that innovations address real-world needs.

For technology developers, these findings highlight the importance of designing VR and AR systems that account for user comfort, adaptability, and ease of use. Features such as customizable user interfaces and shorter, more manageable session durations could help mitigate physical discomfort, such as dizziness or vertigo, often experienced by patients. Developers should also incorporate feedback loops during the design process to ensure that technologies meet the psychological and social needs of both practitioners and patients. By engaging end-users early in the development cycle, technology firms can create tools that are not only effective but also widely accepted in medical practice.

In terms of education, these results suggest that the acceptance of VR and AR technologies is more influenced by the emotional and psychological experiences of medical practitioners than by technical skills alone (Bedi & Garg, 2021). Therefore, to enhance the adoption of these technologies, medical training should integrate components that consider the psychological and social readiness of practitioners. In the context of patient care, the findings reveal that immersive technologies can improve patient comfort, but only if patients feel they have control over their interaction with the technology. These findings are relevant to the medical community and healthcare professionals who are considering the implementation of VR and AR technologies in their practices, both in educational settings and direct patient care, by understanding the subjective dimensions that affect their effectiveness.

Study Limitations

Although this research provides valuable insights into the user experience of VR and AR, there are several limitations that affect the generalizability of the findings (Jeising dkk., 2024). First, this study is limited to one type of technology and a small group of medical practitioners and patients from a single geographic location, which may limit the diversity of experiences encountered. Additionally, the use of a phenomenological approach restricts the number of participants that can be analyzed, potentially reducing the representation of a broader population. Therefore, these findings should be considered in the context of similar studies, and further research is needed to understand the variations in experiences across different settings or with a wider range of technologies.

Prospective Statement for Future Research

This study opens up opportunities for further exploration into how various psychological, social, and professional factors can influence the acceptance of technology in broader medical contexts (Alex, 2013). Future research could expand the scope by involving more types of digital medical technologies and diverse patient populations as well as practitioners from various cultural and social backgrounds. By integrating multiple perspectives, these findings could enrich our understanding of medical technology adoption and contribute significantly to the design and implementation of future health technologies that are more sensitive to the complex and multidimensional user experiences.

CONCLUSION

This study investigates the experiences of medical practitioners and patients in accessing and utilizing VR and AR technologies in medical education and patient care. The key findings indicate that the adoption of these technologies is significantly influenced by emotional and psychological factors, with medical practitioners being more affected by their social and professional readiness than by technical skills alone. Furthermore, while immersive technologies can enhance patient comfort, their impact is more effective when patients feel they have control over their experience. These findings enrich previous understandings that have focused more on the technical or functional aspects of healthcare technologies. Moving forward, future research should prioritize investigating the following areas: (1) comparative studies on different types of immersive technologies, such as Mixed Reality (MR) and Haptic Feedback Systems, to identify their specific benefits and challenges in medical settings; (2) longitudinal studies to evaluate the sustained impact of VR and AR adoption on both practitioners and patients, focusing on how perceptions and comfort levels evolve over time; and (3) the influence of cultural and regional factors on user experiences, particularly in developing countries where healthcare infrastructures and patient expectations may differ significantly.

Additionally, interdisciplinary research involving collaboration between technologists, medical practitioners, and psychologists could provide deeper insights into how user interfaces, session designs, and training protocols can be optimized to address emotional and psychological barriers to adoption. Studies exploring how VR and AR can be adapted to meet the needs of diverse patient demographics, such as elderly patients or those with cognitive impairments, would also be invaluable.

This research opens opportunities to develop a more holistic approach to the implementation of medical technologies that is more attuned to the subjective dimensions of users, enabling tailored solutions that enhance both acceptance and effectiveness in diverse healthcare contexts.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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