p–ISSN: 2723 – 6609 e-ISSN: 2745-5254
Vol. 5, No. 12, December 2024 http://jist.publikasiindonesia.id/

Utilization of Immersive Technology in Qualitative Research Design: Virtual Reality (VR) and Augmented Reality (AR) Opportunities

Muhammad Rahmad[1], Willy Arafah[2], Rahmat Ingkadijaya[3], Hera Oktadiana[4]
Institut Pariwisata Trisakti, Indonesia
Email: hmrahmad.id@gmail.com[1*], willy.arafah@gmail.com[2],
rachmatingkadijaya@iptrisakti.ac.id[3], heraoktadiana@iptrisakti.ac.id[4]

*Correspondence

Keywords: virtual reality; augmented reality; qualitative research; research methodology; immersive technology.

ABSTRACT

This study examines the potential use of immersive technology, especially Virtual Reality (VR) and Augmented Reality (AR), in qualitative research design. As technology advances, VR and AR open up new opportunities to improve the quality and depth of data collection and analysis in qualitative research. Through a systematic literature review and case studies, this study explores various applications of immersive technology in the context of qualitative research, including environmental simulations for observation, immersive interviews, and analysis of enriched visual data. The findings suggest that VR and AR can increase participant engagement, expand the reach of data collection, and provide a new perspective in the analysis of social phenomena. However, the study also identifies ethical and methodological challenges that need to be addressed, such as data privacy issues and the validity of results in a virtual environment. The study concludes that the integration of immersive technologies in qualitative research has significant potential to enrich research methodologies while emphasizing the importance of a careful and ethical approach in its implementation. The implications for the development of qualitative research methodologies in the digital era are also discussed.

Introduction

The development of digital technology has revolutionized various aspects of human life, including in the world of scientific research (Al-Ansi, Jaboob, Garad, & Al-Ansi, 2023). One significant advancement is the emergence of Virtual Reality (VR) and Augmented Reality (AR) technologies, which are often referred to as immersive technologies (Beck, 2019). This technology allows users to interact with digitally simulated artificial environments, either by replacing real environments (VR) or by

adding digital elements to the real world (AR) (Rauschnabel, Felix, Hinsch, Shahab, & Alt, 2022).

Although initially this immersive technology was adopted for entertainment purposes, its potential applications in scientific research, particularly in qualitative research, are increasingly being explored. This technology offers an exciting opportunity for researchers to design realistic, controlled, and replicable research environments with high precision while opening up a new dimension in qualitative data collection and analysis.

In the context of qualitative research, VR and AR have the potential to improve the quality and depth of data collection and analysis (Keen, Lomeli-Rodriguez, & Joffe, 2022). For example, VR can be used to create environmental simulations that allow for in-depth observation of participant behavior in a given context. Meanwhile, AR can enrich the interview process by adding relevant visual elements, increasing participant engagement and the richness of the data obtained.

In addition, immersive technology also opens up new opportunities in qualitative data analysis (Cavallo, Dolakia, Havlena, Ocheltree, & Podlaseck, 2019). More interactive and immersive data visualization also helps researchers identify patterns and relationships that may be difficult to see with traditional analysis methods (Korkut & Surer, 2023). This has the potential to expand the reach and depth of understanding of the social phenomena studied.

However, the adoption of immersive technology in qualitative research also presents its challenges. Ethical issues, such as data privacy and participant security in a virtual environment, need to be carefully considered (Prabhakaran, Mahamadu, & Mahdjoubi, 2022). In addition, the validity of research results in the context of a virtual environment is also an important consideration to overcome (Harris, Bird, Smart, Wilson, & Vine, 2020).

This study aims to comprehensively explore the potential use of VR and AR in qualitative research design. Through a systematic literature review and case studies, this research identifies various applications of immersive technology in the context of qualitative research, as well as analyzes emerging challenges and opportunities. Thus, it is hoped that this research can provide valuable insights into the integration of immersive technology in qualitative research methodologies in the digital era while highlighting the importance of an ethical and careful approach to its implementation.

The results of this study are expected to be a source of information and inspiration for qualitative researchers who want to adopt innovative approaches in designing and executing their research, as well as contribute to the development of richer and more relevant qualitative research methodologies in the era of digital technology.

Method

The methodology of this study adopts an exploratory qualitative approach that combines systematic literature review and case study analysis. This approach was chosen

to provide a comprehensive understanding of the utilization of immersive technologies, particularly VR and AR, in qualitative research design.

A systematic literature review was conducted with strict protocols to identify, evaluate, and synthesize research on VR and AR applications in qualitative research. The focus of the review includes environmental simulations for observation, immersive interviews, and analysis of enriched visual data. The inclusion criteria include relevant studies in the last 5 years that explicitly address the use of VR or AR in qualitative research.

Case study analysis complements the literature review, with case selection based on the innovative use of VR or AR in qualitative research, the diversity of study areas, and the availability of detailed information. The analysis was conducted using a thematic approach, focusing on the integration of immersive technologies, their impact on participant engagement and data quality, and ethical and methodological challenges.

Data collection involves careful searching of major academic databases using a combination of relevant keywords. Data from case studies are collected through in-depth analysis of research reports and, where possible, interviews with principal investigators. The data triangulation strategy is applied to increase validity and reliability.

Data analysis uses a thematic analysis approach to identify important patterns in the use of immersive technology. The focus of the analysis includes the application of VR and AR in various aspects of qualitative research, their impact on participant engagement and data quality, and emerging ethical and methodological challenges. This methodology is designed to comprehensively explore the potential and challenges of using VR and AR in qualitative research, as well as identify best practices and areas that require further research. The results of the study are presented in the form of a rich narrative, complemented by data visualization to illustrate the main findings.

Results and Discussion

Applications of VR and AR in Qualitative Research

The results of thematic analysis from systematic literature reviews and case studies reveal a variety of VR and AR applications in qualitative research. These applications demonstrate the significant potential of immersive technologies to enrich qualitative research methodologies in various aspects.

One of the main applications identified is the use of VR for environmental simulation in observation. Some studies have shown that VR allows researchers to create controlled yet realistic scenarios to observe participant behavior. For example, in a case study in the field of social psychology, researchers used VR to simulate social interactions in a variety of cultural contexts, allowing for in-depth observations of the dynamics of cross-cultural communication without the need for physical travel.

Immersive interviews using VR and AR are emerging as another innovative application. Some studies report that interviews in a virtual environment can increase participants' openness, especially when discussing sensitive topics. In a study of traumatic

experiences, the use of VR allowed participants to "revisit" the traumatic site in a safe environment, facilitating a richer and deeper narrative.

AR shows great potential in enriching visual data analysis. Some studies use AR to project additional data onto the physical environment during the analysis process, allowing researchers to explore the relationship between the data and its physical context more intuitively. For example, in urban ethnographic research, AR is used to visualize historical and demographic data in real time as researchers explore urban environments.

The application of VR and AR in participatory research is also emerging as an important theme. Some research projects involve participants in the co-creation of virtual environments that represent experiences and provide a unique perspective on the subjective reality of participants. This approach has proven to be particularly effective in research with marginalized communities or often inaudible voices.

However, the results of the analysis also reveal some challenges in the application of this technology. Accessibility and equality issues arise, considering that not all participants feel comfortable or able to use immersive technology. In addition, some researchers reported difficulties in ensuring the ecological validity of the data collected in a virtual environment.

Nonetheless, the majority of studies show that when carefully implemented, VR and AR can significantly increase the depth and richness of qualitative data. This technology allows for the exploration of participants' experiences and perspectives in ways that are difficult to achieve through traditional methods.

The application of VR and AR in qualitative research shows great potential to expand and deepen research methodologies. From environmental simulations for observation to analysis of enriched visual data, immersive technology opens up a new dimension in the exploration of social phenomena. However, its application requires careful consideration of ethical and methodological implications to ensure that the integrity of the research is maintained.

Improved Participant Engagement and Data Quality

Analysis of systematic literature reviews and case studies shows that the use of immersive technologies, particularly VR and AR, has significant potential to improve participant engagement and data quality in qualitative research. Some of the key aspects identified are:

First, immersive technology creates a more immersive and "real" experience for participants. In a case study of urban ethnography using VR, participants reported a strong feeling of "presence" in a virtual park, resulting in more natural and spontaneous interactions. This leads to more authentic and representative data of the participants' natural behavior. This increased realism allows researchers to observe nuances of social interactions that may be difficult to capture in traditional research settings.

Second, VR and AR offer new ways for participants to express and articulate their experiences. In a phenomenological research case study with AR, participants were able to visualize their emotions and physical sensations using virtual objects. This helps them communicate aspects of the experience that may be difficult to express with just words,

resulting in richer data and nuances. The ability to manipulate and interact with visual representations of their experiences also encourages deeper reflection from participants.

Third, immersive technology allows for the simultaneous collection of multidimensional data. In a case study of emotional response analysis using VR and AR, researchers were able to collect data on participants' subjective emotional responses along with objective physiological data. The integration of these different types of data provides a more holistic understanding of the phenomenon being studied, increasing the depth and complexity of qualitative analysis.

However, improving engagement and data quality also brings challenges. Some participants reported initial anxiety or discomfort in using immersive technology, which could affect their response. It emphasizes the importance of adequate orientation and adaptation periods in research design. In addition, the sophistication of technology can distract from the phenomenon being studied, thus raising questions about the ecological validity of the data collected.

Another important aspect is the potential for bias introduced by the "novelty effect" of immersive technology. Some researchers note that participants' enthusiasm for the new technology may have influenced their response, at least in the early stages of the study. It emphasizes the need for a longitudinal approach or research design that allows participants to become familiar with the technology before major data collection (Byrne, 2021).

Despite the challenges, the majority of studies show that when carefully implemented, VR and AR can significantly improve participant engagement and data quality in qualitative research. This technology opens up possibilities for a deeper and more nuanced exploration of human experience and social phenomena. However, it is important to realize that immersive technology is not a replacement, but rather a complement to traditional qualitative research methods.

The use of VR and AR in qualitative research offers great potential to improve participant engagement and data quality. However, the realization of this potential depends on careful research design, careful ethical considerations, and a deep understanding of how technology can affect research dynamics. With a balanced and reflective approach, immersive technology can be a valuable tool in enriching and deepening qualitative research.

Expanded Data Collection Reach

Analysis from literature reviews and case studies shows that the use of immersive technologies, particularly VR and AR significantly expands the range of data collection in qualitative research. Some of the key aspects of the expansion are identified as follows;

First, VR allows researchers to create and control environments that were previously difficult or impossible to access in traditional research. In urban ethnographic case studies, researchers can simulate various urban park scenarios with a high degree of control over variables such as visitor density, time of day, or even weather conditions. This ability opens up opportunities to explore social interactions in diverse and controlled contexts, expanding the scope of ethnographic research.

Second, AR offers an innovative way to collect rich, contextual data. In a phenomenological study of cancer patient experiences, the use of AR allowed participants to "add" visual and audio elements to their environment while recording their daily experiences. This results in richer and more contextual data, providing deep insights into how participants interpret their experiences in the context of their physical environment.

Third, the combination of VR and AR allows for the collection of complex multisensory data. In the study of emotional responses to art, researchers were able to collect data on participants' eye movements, body gestures, and physiological responses simultaneously as they interacted with virtual artwork. This approach expands our understanding of how different aspects of sensory experience contribute to emotional responses.

Fourth, immersive technology opens up opportunities for more manageable longitudinal research. Some studies show how VR can be used to "revisit" a particular experience or environment over time, allowing for analysis of changes in participants' perceptions or behaviors. It is particularly valuable in research on long-term social development or change.

Fifth, VR and AR expand the possibilities for cross-cultural research without geographical restrictions. Researchers can create virtual environments that represent a variety of cultural contexts, allowing participants to "experience" and interact with other cultures. This opens up new opportunities for comparative study and a deeper cross-cultural understanding.

However, the expansion of the reach of data collection also brings challenges. One of them is the potential for data overload. The ability to collect highly detailed and multidimensional data can result in enormous volumes of data, requiring more sophisticated data management and analysis strategies. In addition, questions arise about how to ensure the ecological validity of data collected in a virtual or augmented environment.

The ethical aspect is also an important concern. The ability to collect highly detailed data on participant behavior and responses raises concerns about privacy and informed consent. Researchers need to develop strict ethical protocols to manage and protect sensitive data collected through immersive technology.

VR and AR significantly expand the reach of data collection in qualitative research, opening up new dimensions in the exploration of human experience and social phenomena. This technology allows researchers to access previously hard-to-reach contexts and data, providing richer insights and nuances. However, harnessing this potential requires a careful and ethical approach, with careful consideration of the validity of the data and the ethical implications of this expanded data collection. With a balanced approach, immersive technology can be a valuable tool in enriching and deepening qualitative research.

Ethical and Methodological Challenges

The use of immersive technologies in qualitative research, while offering many opportunities, also presents a number of significant ethical and methodological

challenges. Analysis of literature reviews and case studies reveals several key areas that require special attention from researchers.

One of the main challenges is the issue of data privacy and security. VR and AR technologies allow for the collection of highly detailed and personalized data about participants, such as eye movements, gestures, and movement patterns. This raises serious concerns about how to protect the identity of participants and ensure that the data collected cannot be misused. These challenges are even more complex given the digital and connected nature of many immersive devices.

Informed consent is another issue that needs to be considered. The complexity of immersive technology and the nature of the experiences it creates can make it difficult for participants to fully understand what they agree on. Researchers faced the challenge of providing participants with enough information about the nature of the experience and the type of data to be collected, without burdening them with excessive technical details.

Ecological validity is also an important concern. While VR and AR can create highly realistic experiences, there remains a question about the extent to which behavior and responses in virtual or augmented environments can be considered representative of real-world behavior. Some case studies suggest that participants may behave slightly differently in a virtual environment, posing a challenge in validating the research findings in a real-world context.

The physiological and psychological side effects of the use of immersive technology also need to be considered. Symptoms such as motion sickness, disorientation, or eye fatigue can affect the well-being of participants and the validity of the data collected. This raises an ethical dilemma about how to balance the benefits of research with the potential risks for participants.

Accessibility and equality are other important issues. Not all potential participants were comfortable or able to use immersive technology, which could lead to sample bias and representation issues in the study. Researchers need to consider how to ensure that the use of immersive technology does not exclude or discriminate against certain groups.

The management and analysis of complex data generated by immersive technology is also a challenge. The volume and complexity of the data collected require the development of new analysis methods and the improvement of researchers' competence in handling multidimensional data.

To address these challenges, several recommendations emerged from the analysis. This includes the development of rigorous and specific ethical protocols for research using immersive technologies, specialized training for researchers, interdisciplinary collaboration, the development of new validation methods, and a phased approach to the implementation of immersive technologies.

While immersive technologies offer great opportunities to enrich qualitative research, their implementation requires careful ethical and methodological considerations. These challenges are not only obstacles, but also opportunities to develop more ethical, innovative, and robust research practices in the digital era. With a careful

and reflective approach, researchers can harness the potential of immersive technology while maintaining the integrity and ethics of qualitative research.

Based on the results of the analysis of systematic literature reviews and case studies, some best practices and recommendations can be formulated for the use of immersive technology in qualitative research design. These recommendations aim to maximize the potential of VR and AR while minimizing the risks and challenges that may arise.

First, the integration of immersive technology must be carried out purposively, not just because of the novelty of the technology. Researchers must conduct a careful needs analysis to ensure that the use of VR or AR really provides added value in answering research questions. This may involve pilot studies to evaluate the effectiveness of the technology in a specific research context before full implementation.

Second, adequate training and familiarization are very important for both researchers and participants. Comprehensive onboarding and training sessions should be provided to ensure all parties are comfortable with the technology being used. This will not only improve the quality of the data collected but also reduce the risk of negative side effects and improve the overall participant experience.

Third, the development and adherence to strict ethical protocols is a must. This should include clear procedures for obtaining truly informed consent, guaranteeing data anonymity and confidentiality, and providing an option for participants to stop the VR and AR experiences at any time. Protocols should also consider the potential long-term psychological impact of intense immersive experiences.

Fourth, to address the issue of ecological validity, it is recommended to adopt a mixed-method approach that combines immersive technology with traditional qualitative research methods. This can involve triangulation of data from a virtual environment with real-world observations or follow-up interviews to validate the findings.

Fifth, data management and security must be a top priority. This includes the use of end-to-end encryption for data storage and transmission, the separation of identification data from primary research data, as well as the establishment of strict data access protocols. Planning for secure deletion of data after a specified retention period should also be considered from the outset.

Sixth, interdisciplinary collaboration is highly encouraged. The research team should ideally consist of qualitative methodologists, technologists, and ethicists who can jointly address the technical, methodological, and ethical aspects of the research. This collaborative approach can help optimize the use of technology while ensuring research integrity.

Seventh, transparency in reporting research results is becoming increasingly important when using immersive technology. Researchers should provide a detailed description of the technology used, its potential impact on data collection and analysis, and the steps taken to address methodological challenges.

Finally, an ongoing evaluation of the impact of the use of immersive technology in qualitative research is essential. This can involve periodic meta-analyses to assess how

VR and AR affect the quality and depth of qualitative research, as well as identify areas that need further adjustment or development.

By implementing these best practices and recommendations, researchers can maximize the potential of immersive technologies in enriching qualitative research methodologies, while minimizing the risks and challenges that may arise. It is important to remember that the field is still evolving, and these guidelines must be constantly updated as technology advances and our understanding of its implications for qualitative research.

Implications for the Development of Qualitative Research Methodologies

The integration of immersive technologies such as VR and AR in qualitative research has significant implications for the development of methodologies. The results of the analysis of this study show that the use of VR and AR not only expands the possibilities of data collection but also has the potential to fundamentally change the way we understand and conduct qualitative research.

One of the main implications is the expansion of the concept of 'field' in qualitative research. With VR, researchers can create and access 'virtual fields' that allow observation and interaction in contexts that were previously difficult or impossible to reach. This opens up new opportunities for cross-cultural, historical, or even futuristic studies, without geographical or temporal restrictions. Consequently, researchers need to develop new theoretical and methodological frameworks to understand and interpret the data collected from these virtual environments.

The use of AR in qualitative research encourages the development of more interactive and contextual data collection methods. The ability to add layers of digital information to the physical environment allows researchers to gather richer data and nuances about how individuals interact with and interpret their environment. This has implications for the need to develop new data analysis techniques that can integrate and interpret visual, audio, and spatial data simultaneously.

Increased participant engagement through the use of immersive technology also has important implications for research ethics and researcher-participant relationships. A more immersive and interactive experience can increase the potential emotional and psychological impact on participants. This demands the development of stricter ethical protocols and a more reflexive approach to managing power dynamics in the research process.

The ability of immersive technology to collect multidimensional data in real time also has implications for the way we understand and apply triangulation in qualitative research. Researchers need to develop new strategies to validate and integrate different types of data collected through VR and AR with traditional methods.

The use of VR and AR also encourages the development of new approaches in the presentation and dissemination of qualitative research results. The ability to create immersive experiences opens up opportunities to present research findings in a more interactive and in-depth way. This can increase audience understanding and engagement with the research results.

The integration of immersive technology in qualitative research has significant implications for the education and training of qualitative researchers. Educational programs need to be updated that include technical competencies in the use of VR and AR, as well as a critical understanding of the theoretical, methodological, and ethical implications of these technologies.

The use of VR and AR in qualitative research not only offers new tools but also drives transformation in the way we understand, conduct, and communicate qualitative research. This paves the way for methodological innovations that have the potential to deepen and enrich our understanding of human experience and social phenomena. However, its realization requires continuous critical reflection and the development of conceptual and practical frameworks that are appropriate to the complexity and opportunities offered by immersive technologies.

Conclusion

This study has comprehensively examined the potential for the use of immersive technology, especially VR and AR, in qualitative research design. Through a systematic literature review and case study analysis, this study reveals that the integration of immersive technology opens up an interesting new dimension in qualitative research methodology.

Key findings suggest that VR and AR have significant potential to improve the quality and depth of data collection and analysis in qualitative research. The technology allows for the creation of a more controlled and realistic research environment, increases participant engagement, and facilitates richer and multidimensional data collection. Specific applications such as environmental simulations for observation, immersive interviews, and enriched visual data analysis show how VR and AR can expand the reach and depth of exploration of social phenomena.

However, the study also identifies several ethical and methodological challenges that need to be addressed. Issues such as data privacy, ecological validity, and potential psychological impacts on participants were of primary concern. The complexity of the technology and the volume of data generated also pose new challenges in data management and analysis. Based on these findings, the study formulated a set of best practices and recommendations for the implementation of immersive technologies in qualitative research. It includes a purposive approach to technology integration, the development of rigorous ethical protocols, comprehensive training for researchers and participants, and interdisciplinary collaboration.

The implications of this study on the development of qualitative research methodologies are very broad. The integration of VR and AR not only offers new tools but also drives transformation in the way we understand and conduct qualitative research. This paves the way for methodological innovations that have the potential to deepen our understanding of human experience and social phenomena.

Although the use of VR and AR in qualitative research is still in its infancy, these technologies have offered promising opportunities to enrich and expand research methodologies. However, its realization requires a careful and ethical approach, with careful consideration of its methodological and ethical implications. With a balanced and reflective approach, immersive technology can be a valuable tool in qualitative research toolkits, allowing for more in-depth and innovative exploration of the complexity of human experiences and social phenomena.

Bibliography

Al-Ansi, Abdullah M., Jaboob, Mohammed, Garad, Askar, & Al-Ansi, Ahmed. (2023). Analyzing augmented reality (AR) and virtual reality (VR) recent development in education. *Social Sciences & Humanities Open*, *8*(1), 100532.

Beck, Dennis. (2019). Augmented and virtual reality in education: Immersive learning research. *Journal of Educational Computing Research*, *57*(7), 1619–1625.

Byrne, Jason A. (2021). Observation for data collection in urban studies and urban analysis. In *Methods in Urban Analysis* (pp. 127–149). Springer.

Cavallo, Marco, Dolakia, Mishal, Havlena, Matous, Ocheltree, Kenneth, & Podlaseck, Mark. (2019). Immersive insights: A hybrid analytics system forcollaborative exploratory data analysis. *Proceedings of the 25th ACM Symposium on Virtual Reality Software and Technology*, 1–12.

Harris, David J., Bird, Jonathan M., Smart, Philip A., Wilson, Mark R., & Vine, Samuel J. (2020). A framework for the testing and validation of simulated environments in experimentation and training. *Frontiers in Psychology*, *11*, 605.

Keen, Sam, Lomeli-Rodriguez, Martha, & Joffe, Helene. (2022). From challenge to opportunity: virtual qualitative research during COVID-19 and beyond. *International Journal of Qualitative Methods*, *21*, 16094069221105076.

Korkut, Elif Hilal, & Surer, Elif. (2023). Visualization in virtual reality: a systematic review. *Virtual Reality*, *27*(2), 1447–1480.

Prabhakaran, Abhinesh, Mahamadu, Abdul Majeed, & Mahdjoubi, Lamine. (2022). Understanding the challenges of immersive technology use in the architecture and construction industry: A systematic review. *Automation in Construction*, *137*, 104228.

Rauschnabel, Philipp A., Felix, Reto, Hinsch, Chris, Shahab, Hamza, & Alt, Florian. (2022). What is XR? Towards a framework for augmented and virtual reality. *Computers in Human Behavior*, *133*, 107289.