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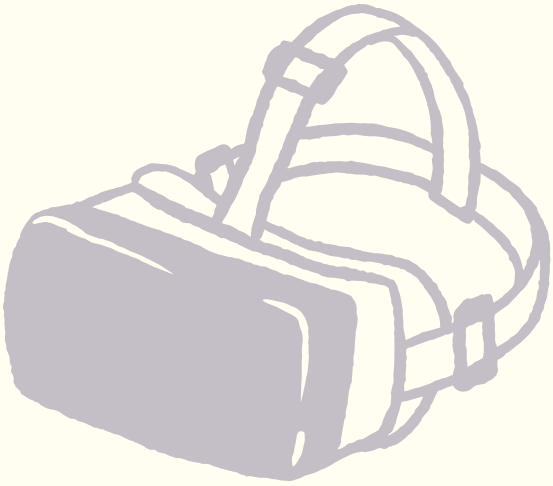

Master's Thesis

Virtual Reality Meets Maternal Care

A Techno-Anthropological Approach to Breastfeeding Preparation and Support

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ABSTRACT

This master's thesis explores the integration of Virtual Reality (VR) technology in breastfeeding preparation and support, focusing on the Danish context. The study addresses the significant challenges new mothers face with breastfeeding, such as latch-on difficulties, pain, and inadequate support, exacerbated by rapid postnatal discharges and a strained healthcare system. Leveraging a techno-anthropological approach with a postphenomenological framework, the research investigates how VR can enhance breastfeeding guidance, offering immersive and interactive experiences that traditional methods lack.

The thesis employs a mixed-methods research design, including a literature review, digital ethnography, surveys, user experience (UX) testing, and expert interviews with an emphasis on qualitative methods, allowing for an in-depth exploration of the phenomenon under study. The findings reveal that VR technology, exemplified by the MidwifeVR platform, provides a highly engaging and immersive learning environment. This environment allows expectant and new parents to practice breastfeeding techniques in a realistic, distraction-free setting, significantly improving their confidence and preparedness.

Key themes identified include the importance of visual perspectives, the role of privacy and autonomy in learning, and the comparison of VR with traditional educational methods. The study also highlights the potential of VR to supplement the role of midwives, offering scalable and consistent support while maintaining the essential human touch in complex cases.

Ethical considerations, such as data privacy, accessibility, and the potential for VR to influence parental autonomy, are critically examined. The thesis concludes with recommendations for integrating VR into public healthcare systems and suggests areas for future research, including developing more interactive and personalized VR experiences.

This research contributes to the field of techno-anthropology by demonstrating how emerging technologies can address real-world challenges in maternal care, ultimately enhancing the support and education provided to new parents. This abstract summarizes the key points of the thesis, including the problem area, research methods, findings, and implications, providing a concise overview for readers.

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1. Introduction

My journey as a midwife in the Danish healthcare system has been a profoundly enriching and reflective experience. Over the years, I have had the privilege of assisting, empowering, preparing, and supporting families through some of their lives most cherished and critical stages. This role has been exciting, challenging, and deeply intimate, often sparking significant reflections about the practices and systems we rely on.

Throughout my career, I have witnessed firsthand the need for improvements and innovations in maternal and newborn care. The existing systems, though functional, often fall short of meeting the complex needs of both families and midwives and also the overall public health recommendations, such as breastfeeding duration. These systems require optimization to provide sustainable solutions that enhance families' experiences during this crucial phase and address the long-term consequences for all involved. The increasing budget cuts, staff layoffs, and resource shortages put additional pressure on midwives, challenging our ability to balance the moral imperative of helping as many as possible with the need to provide the best care to each individual.

My pursuit of further education in Techno-Anthropology stems from a desire not to leave midwifery but to contribute to optimizing healthcare systems related to pregnancy, childbirth, and postpartum care. I aim to contribute to a better systems and solutions that are user-centered and more aligned with the actual needs of families and healthcare providers. Breastfeeding, often perceived as one of the most natural human processes, is crucial for the health of newborns, and in many countries, also their survival. However, the reality of breastfeeding is far more complex. Many mothers encounter significant challenges, which are well-documented in personal accounts and academic literature. Imagine a mother struggling to latch her newborn while receiving conflicting advice from friends, family, healthcare professionals, and societal norms - the frustration and confusion she feels is shared by many parents worldwide. From physical difficulties to emotional and societal pressures, the complexities surrounding breastfeeding are profound and multifaceted (Ajmera & Gonen, 2020).

Describing breastfeeding and other caregiving processes as natural can lead to underestimating the societal value and complexities, subsequently influencing the resources they allocate (Druedahl, 2024). In Denmark, rapid postnatal hospital discharges and a

stressed healthcare system further complicate the situation, often leaving parents feeling underprepared and unsupported. This gap in care has fueled a growing discourse challenging the notion that breastfeeding is inherently straightforward. There is a clear need for innovation and a greater emphasis on the voices of parents and breastfeeding mothers.

From a midwife's perspective, I have frequently observed the instinctive drive in mothers to breastfeed their children despite the availability of alternatives like formula milk. My experience and theoretical knowledge underscore that breastfeeding is a complex process influenced by personal factors, societal norms, cultural discourses, and the recommendations of healthcare professionals (Rossau et al., 2023). Ignoring the need for innovation in breastfeeding education and support risks undermining a critical care area with significant health and societal implications.

Drawing from my experience as a midwife, I have observed firsthand how shifts and constraints in maternity care—driven by societal and economic changes and further exacerbated by global events such as the pandemic—limit physical interactions while accelerating the adoption of digital solutions in healthcare. Recent studies in maternal care reveal growing disparities. Ajmera and Gonen (2020) highlight the mismatch between the demand for trained professionals and their availability, a challenge faced by many countries, including Denmark. The shift from home births to hospital settings, initially promising safer and more pain-free experiences, has resulted in complications such as over-medicalized births and diminished personal care (Relster, 2019). Recent setbacks in public healthcare, particularly in parental preparation services, underscore the need for structural reform (Roed, 2018). These changes have left expectant parents more isolated, especially when discharged early from hospitals, with breastfeeding often becoming the primary challenge in early parenthood.

This thesis draws upon my academic exploration of techno-anthropology during my master's studies, especially my internship at MidwifeVR and my professional experiences as a midwife. MidwifeVR is a pioneering startup developing Virtual Reality (VR)-based solution for breastfeeding preparation and support. VR has the potential to offer practical learning experiences, emotional engagement, and personalized suppo rt, which are crucial for successful breastfeeding practices. By leveraging VR, MidwifeVR aims to revolutionize and enhance how expectant and new parents receive guidance throughout their breastfeeding journey.

This thesis will investigate the potential of VR technology in mitigating breastfeeding challenges and improving prenatal education for expectant parents. My firsthand experiences as a midwife have made me acutely aware of the growing strains on public healthcare systems, motivating me to address these challenges through innovative, user-centered, and sustainable solutions.

1.1. Problem Area

The problem area of this master thesis encompasses two main aspects: breastfeeding challenges and Virtual Reality.

1.1.1. Breastfeeding Challenges

Breastfeeding, often regarded as one of the most natural processes in nurturing a newborn, is surrounded by a complex array of challenges that many new mothers face. Despite being essential for the health and development of infants, breastfeeding is not always straightforward. Mothers frequently encounter difficulties, such as latching problems, pain, and inadequate milk supply. These issues are compounded by conflicting advice from healthcare professionals, family, and societal expectations, leading to confusion and stress for new parents (Rossau et al., 2023).

The perception of breastfeeding as an instinctive and natural process can sometimes overshadow its complexities and the substantial support required. In Denmark, rapid postnatal discharges and a strained healthcare system leave many parents feeling unprepared and unsupported. This lack of adequate breastfeeding support is highlighted by a 2021 survey where nearly 20% of Danish mothers reported not receiving the necessary assistance to initiate breastfeeding successfully (Mødrehjælpen, 2021). Moreover, the high initiation rates of breastfeeding in Denmark, with 97% of mothers starting to breastfeed, drop dramatically to only 14% exclusively breastfeeding at six months, as recommended by the World Health Organization (Rossau et al., 2023). This significant decline is exacerbated by social inequalities, where access to breastfeeding support is disproportionately available to those with more resources.

1.1.2 Virtual Reality in the Context of Breastfeeding

VR is revolutionizing healthcare, including both patient care and the training of healthcare workers. The immersive and interactive features of VR have the ability to bridge the gap in theoretical breastfeeding preparation and practically address some of the most common breastfeeding challenges faced by expectant and new parents through engaging, immersive, and personalized experiences.

VR has the ability to provide an immersive learning experience where users can explore concepts in a highly interactive manner, allowing them to gain a deeper understanding of the techniques and scenarios. This close-up, realistic perspective is particularly valuable in breastfeeding preparation and support, as it presents lifelike scenarios that can enhance learning and confidence (Thanakumar Joseph et al., 2020).

However, integrating VR into the breastfeeding field is not without challenges. Technical and ethical concerns need to be addressed to ensure the effective use of this technology. Ensuring equitable access to VR is crucial to avoid exacerbating existing disparities in breastfeeding support, particularly for those with limited socioeconomic resources or digital access. Additionally, the broader integration of VR into breastfeeding support must consider its impact on healthcare professionals, such as midwives, and ensure that their roles are adapted and managed appropriately to incorporate this new technology effectively.

1.2. Research Question

Main research question:

How can Virtual Reality be utilized to meet the challenges parents typically experience with breastfeeding and enhance breastfeeding preparation and support?

Sub-questions:

1. What are the primary challenges and experiences most commonly shared by parents regarding breastfeeding on Social Media?
2. What factors enhance or hinder the user experience of VR-based breastfeeding preparation and support for expectant and new parents?
3. How can VR-based breastfeeding preparation and support influence the role of the midwife?

By conducting this research, I aim to contribute to a deeper understanding of how emerging technologies like VR can be leveraged to provide more effective, accessible, and user-centered breastfeeding preparation and support. The findings of this study have the potential to inform the development of innovative VR applications that address the real-world challenges new parents face, ultimately leading to improved breastfeeding outcomes.

1.3 Limitations

The scope of this thesis is limited to the Danish context, which may not be globally representative of the diverse cultural, economic, and health perspectives that exist worldwide. While acknowledging the complexity of breastfeeding challenges in Denmark, which are influenced by various factors such as cultural, economic, social status, emotional, physical, and mental health aspects, the study focuses on the experience and perception of expectant and new parents regarding VR as a medium for breastfeeding preparation.

The thesis focuses on understanding the UX and will not focus much on the corporate, economic, or communal goals. It will also limit itself from discussing the inequality implications an integration of VR might have in breastfeeding guidance since this has not been the focus of this research.

Furthermore, due to resource constraints, the thesis did not investigate user experiences and perceptions of technical possibilities such as eye-tracking, electrodermal activity, A/B testing within the VR, electroencephalography, and task trees.

2. Literature review

2.1. Purpose of Literature Search

The main objectives of the literature search were:

1. To gain a comprehensive understanding of the current state of knowledge at the intersection of VR and healthcare.
2. To identify gaps in the research, particularly around the application of VR in maternal care.
3. To position the research as an iterative process, refining the scope to encompass the broader healthcare sector as an entry point to the specific domain of maternal care.

2.2 Search strategy

The search strategy followed a systematic and iterative approach. Each iteration involved creating and refining search strings, primarily using the keywords "Virtual Reality" and "Healthcare." The search strings were continuously evaluated and improved by incorporating different keywords and NOT and OR combinations to optimize the results.
The most commonly used search string across four databases was: "Virtual Reality" AND "Healthcare," which yielded the most relevant results. The search results varied significantly across databases: IEEE Xplore returned 925 results, PubMed 991, ProQuest 92,987, and Scopus 2,285. The research strategy evolved based on the initial search outcomes, with each database requiring tailored refinements to better align with the focus of the master thesis.

Recognizing the need for more specific knowledge related to VR's application in maternal care, the research shifted towards exploring the preferences and information reception of parents, expecting parents, and pregnant individuals. The search incorporated keywords such as "Maternal Care," "Pregnant," "Antenatal Preparation," "Breastfeeding," "Pregnancy App," "Parental Preparation," "Lactation," "Parent*," and "Mother."
Given the enormous volume of search results, a systematic screening approach was employed to streamline the selection process efficiently: Titles of articles were meticulously examined, notably when search results exceeded 250 hits. This initial screening allowed for the elimination of irrelevant studies and the identification of potentially relevant articles. Abstracts of the shortlisted articles were then reviewed, leading to the identification of 28

potentially relevant articles. Upon closer examination, three articles were excluded due to their general focus, concentration on mental health disorders, or irrelevance to maternal care.

The remaining 25 articles were compiled by me as a researcher into a comprehensive document for detailed examination. Each article was thoroughly evaluated for its relevance to the master thesis. This process involved reading each article extensively, summarizing its key findings, and personal reflections on its significance to the research area.

The synthesis of abstracts and conclusions from these articles provided a foundational understanding of VR in maternal care. The selected articles were then categorized, resulting in two main themes: "VR Integration in Healthcare" and "Breastfeeding and Parental Care," ultimately narrowing the focus to nine relevant articles.

This hermeneutic process of refining the research area involved iterative scoping and reflection, contributing to a more nuanced understanding of the field. The approach enhanced the researcher's general knowledge of technology in maternal care and the potential benefits and challenges of VR integration in healthcare, thereby enriching the overall research perspective.

2.2.1. Results of relevant articles found in the literature review

VR integration in healthcare

The integration of VR in healthcare has been recognized for its potential to enhance medical training, therapy, and patient care. Ajmera & Gonen (2020) emphasized VR's role in creating immersive learning experiences, noting the importance of immersion, virtual environment control, and development in crafting effective VR simulations. Rudschies & Schneider (2024) discussed VR's ethical, legal, and social implications, highlighting its benefits for remote and underserved populations but cautioning about privacy, accountability, and equity issues. They stressed the potential for VR to negatively impact patient trust through data mishandling. They noted the need to thoroughly evaluate care quality and safety, especially for vulnerable groups. Legal and social considerations include liability, compliance challenges, and the necessity for healthcare professionals' competence and patients' digital literacy. Ultimately, while VR promises significant improvements in healthcare, its integration requires careful consideration of ethical, legal, and social factors to ensure equitable and safe implementation.

Virtual Reality and Breastfeeding

This section presents a review of the literature on the use of virtual reality (VR) in preparing for breastfeeding, focusing on seven relevant articles. A significant number of these studies involve Kymeng Tang as a co-author. The findings from these articles highlight the potential benefits and challenges of using VR technology to support breastfeeding education.

Gerling et al. (2018) explored the potential of VR interventions in helping mothers understand breastfeeding challenges before birth. Their study underscores the relevance of VR in preparing parents for the breastfeeding journey, emphasizing that immersive experiences can enhance understanding and readiness.

Laws et al. (2023) emphasize the importance of creating visual, accessible, and user-friendly resources. This study addresses the limitations of traditional education methods in conveying breastfeeding challenges and highlights the potential of VR to provide immersive and engaging learning experiences.

Tang, Gerling, and Geurts (2021) discuss the potential of VR technology to engage users, convey knowledge, and prompt reflection in the context of breastfeeding preparation. They stress the need for a VR simulation that adequately represents the bond between the virtual child and the parent, engaging users by fostering relatedness. This paper highlights the complexity of designing VR simulations that accurately reflect the lived breastfeeding experience and the unique challenges and opportunities presented by VR technology in healthcare.

Tang et al. (2022a) continue this discussion, emphasizing the importance of creating VR simulations that capture the complexity of breastfeeding. Their research further addresses the challenges and opportunities of using VR in healthcare, reinforcing the need for realistic and engaging educational tools.

In a separate study, Tang et al. (2022b) critique traditional antenatal education for its failure to fully encompass the firsthand experiences of breastfeeding. They developed a VR simulation to depict the real-life challenges and emotions associated with breastfeeding, showcasing VR's capacity to enhance engagement, foster reflection, and deepen understanding among expectant parents. This study critiques the basic execution of traditional

antenatal methods, which often merely convert existing educational materials into digital formats, and calls for more innovative and experiential approaches to breastfeeding support.

Tang, Gerling, Geurts, et al. (2021) reiterate the importance of designing VR simulations that reflect the lived breastfeeding experience, highlighting the complexity and need for authenticity in these educational tools.

Finally, Tang, Gerling, Vanden Abeele, et al. (2023) discuss the challenges of integrating gamification into VR breastfeeding simulations. They emphasize the need to balance maintaining authenticity and fostering reflection with the engaging elements of gamification.

A relevant finding was that a clinical trial, "Breastfeeding Education Prepared With Virtual Reality Technology" (Turhan & TC Erclyes University, 2024), is currently recruiting participants to study the effect of prenatal breastfeeding education prepared with VR technology on breastfeeding self-efficacy and success. This trial investigates whether breastfeeding preparation with VR technology positively affects breastfeeding self-efficacy and success among primiparous mothers.

Overall, these studies collectively highlight the significant potential of VR technology in enhancing breastfeeding education by providing immersive, realistic, and reflective learning experiences. They also underscore the challenges in designing effective VR simulations, emphasizing the need for innovative approaches that move beyond traditional educational methods.

3. Presenting the field

3.1 Presenting the technology: Virtual Reality

Virtual Reality is a cutting-edge technology that immerses users in artificial three-dimensional worlds, allowing interaction through body movements and controllers, surpassing traditional media capabilities (García et al., 2024). Beyond gaming, VR is used in various fields, including education, medicine, technology learning, history, architecture, and natural sciences. Compared to traditional teaching, VR allows learners to experience studied concepts in a highly immersive context (Joseph et al., 2020). VR effectively bridges theoretical knowledge with practical experiences, making it a powerful tool for education and training (Vindenes & Wasson, 2021). The concept of presence in VR, which influences human performance, is crucial for creating a sense of actually being in the virtual environment (García et al., 2024).

VR applications offer immersive experiences by simulating reality through interactive devices like headsets and gloves, enhancing user engagement and understanding (Lowood, 2024). The burgeoning development of virtual, augmented, and mixed-reality technologies significantly enhances the immersive experience provided by software solutions for end users. This expansion across the immersive extended reality (XR) spectrum introduces fresh challenges for software development teams and processes. In these VR environments, users have the freedom to direct their own visual focus and navigate the space at will, resulting in varied emotional responses (Kopeć et al., 2023, 202).

In healthcare, VR plays a transformative role by offering immersive experiences for therapy, training, and remote healthcare services, which is especially valuable during situations like the COVID-19 pandemic (Rudschies & Schneider, 2024). VR applications in healthcare extend access to medical services, provide therapeutic experiences, and enhance patient engagement through immersive environments and virtual agents. The technology's impact on healthcare delivery is profound, offering controlled and safe experiences that transcend the limitations of traditional healthcare settings (Rudschies & Schneider, 2024).

Moreover, VR has proven to be highly effective in training scenarios, allowing employees to learn up to four times faster compared to traditional methods, fostering

confidence in applying learned skills, and creating strong emotional connections to the content (PricewaterhouseCoopers, 2024).

3.1.1. Digital Immersive Technologies spectrum

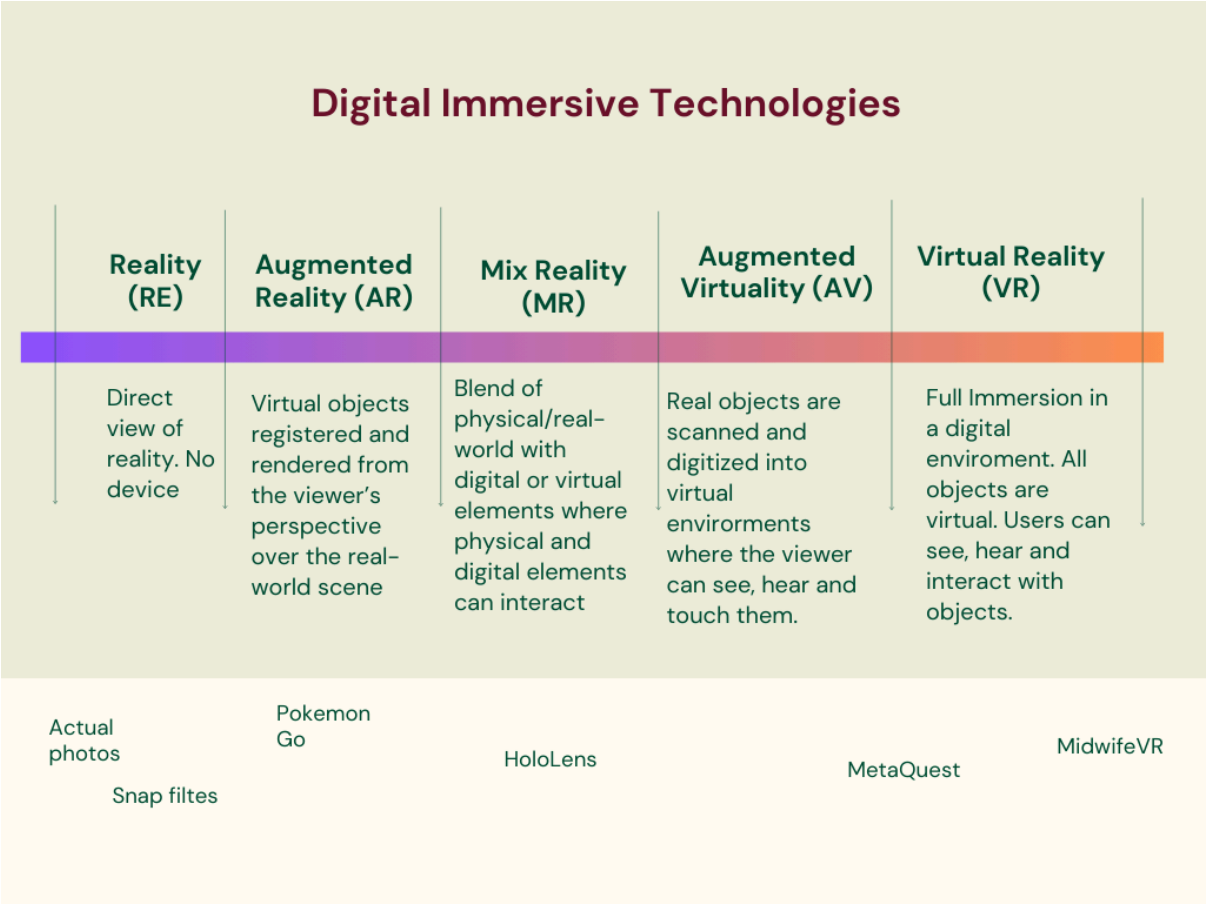


Illustration 1: Digital Immersive Technologies Spectrum

3.1.2. Immersion

Immersion in VR is a measure of a user's involvement with the simulation, creating a stimulating rendering that can be experienced as a VR in any medium. It involves the sensation of being transported to an elaborately simulated place, akin to being submerged in water, where the user feels surrounded by a completely different reality that captures all attention and engages the whole perceptual apparatus in a participatory medium (Johnson-Glenberg, 2018)(Ajmera & Gonen, 2020). Immersion is crucial for creating a sense of presence and enhancing user engagement. It involves learning to interact with the new environment, enabling users to explore and engage with the virtual world actively.

3.1.3. Virtual Environment (VE):

VE allows users to control three-dimensional environments created as simulations of the real world. These persistent online computer-generated environments enable interactions comparable to the real world, facilitating activities like experiential learning, simulation, and collaboration (Ajmera & Gonen, 2020)(García et al., 2024). VE offers opportunities for users to engage with complex scenarios, practice activities, and co-create experiences, enhancing learning and interaction in a dynamic and immersive setting.

3.2. Presenting the field of Breastfeeding Preparation and Support

Breastfeeding preparation and support are crucial components of public health services related to prenatal care. The approach to this support has evolved over time and varies across regions and hospitals in Denmark. Traditionally, breastfeeding preparation has been included in antenatal programs, but recent years have seen significant changes in how it is addressed.

In Denmark, it is standard for hospitals to offer some form of breastfeeding preparation as part of overall antenatal care, although the primary focus often remains on childbirth. Expectant parents have the opportunity to discuss breastfeeding with their midwives. However, the extent of this support can vary greatly depending on the individual midwife, the needs of the woman, and time constraints.

After birth, midwives are responsible for ensuring that breastfeeding is initiated if the parents wish to do so. It is recommended to begin breastfeeding within the first two hours after birth, with the baby placed skin-to-skin with the mother. For the first two to seven days post-birth, parents can request breastfeeding assistance from the hospital, whether they are still hospitalized or have been discharged (See *Illustration 2*).

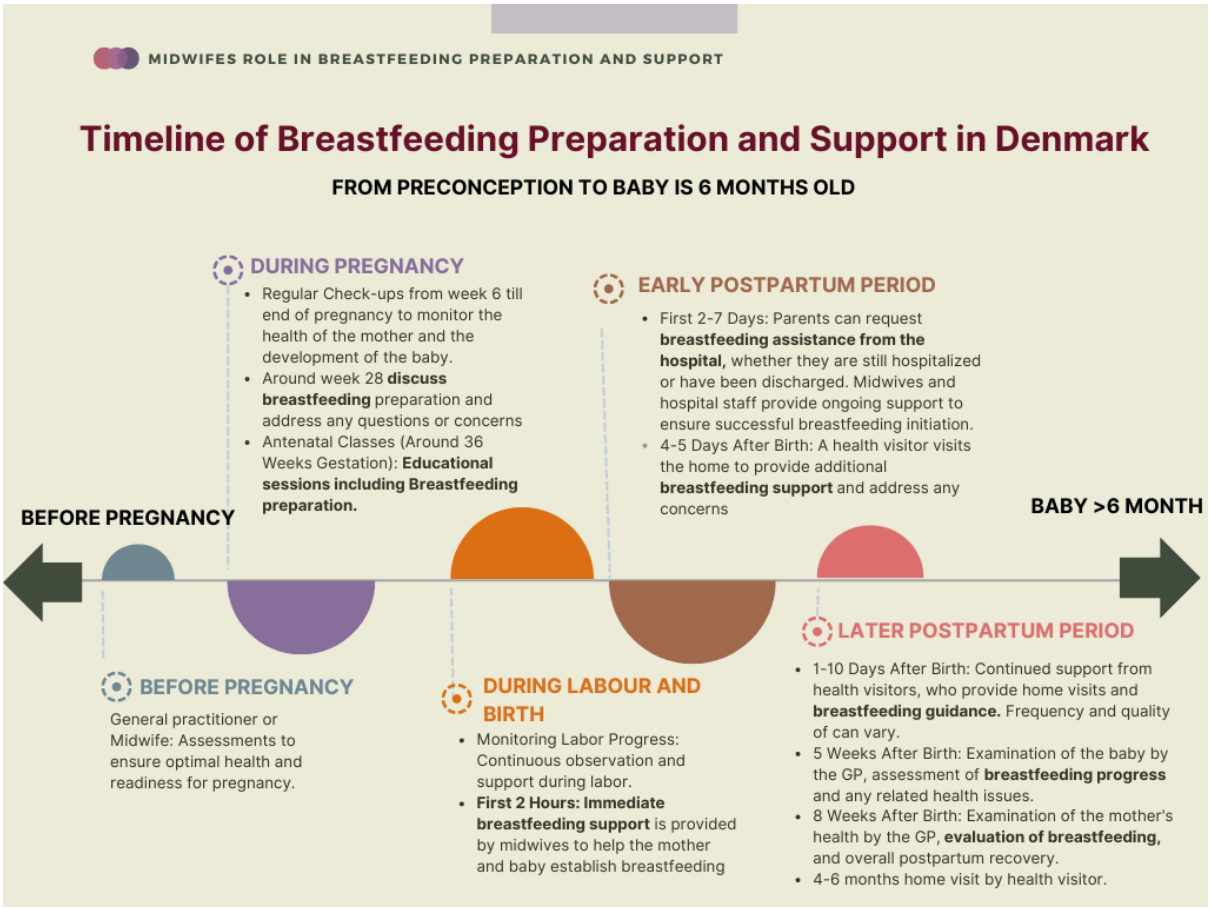


Illustration 2: Timeline of Breastfeeding Preparation and Support in Denmark

Following this initial period, the responsibility for breastfeeding support shifts to healthcare nurses. The level and quality of support can vary significantly due to factors such as time constraints and inconsistencies in breastfeeding guidance among hospital staff. Similarly, in the community setting, the frequency and effectiveness of home visits by healthcare nurses can affect the support families receive in the first weeks postpartum.

The WHO advocates for educational initiatives during pregnancy to potentially extend the duration of exclusive breastfeeding (WHO, 2019, 2024). According to the WHO, optimal breastfeeding practices for children aged 0-23 months could save 820,000 lives annually. While this issue might not be as pressing in Denmark, it underscores the global importance of focusing on breastfeeding and breastfeeding preparation (WHO, 2023). Danish and international health recommendations highlight the importance of exclusive breastfeeding for the first six months to maximize health benefits for both the mother and child. Such benefits for the child include the supply of crucial nutrients and protection against infection and other

diseases like diarrhea and pneumonia, increased intelligence, and potentially overweight and diabetes later in life. And for the mother benefits from long-term health advantages such as decreased risks of protection against breast cancer, possibly also ovarian cancer, type 2 diabetes, and obesity later in life (WHO, 2019)(Rossau et al., 2023).

Despite these benefits, global and national breastfeeding rates are below the recommended levels. The statistics from Mødrehjælpens research (2020) highlight the critical need for breastfeeding preparation. Although most mothers started breastfeeding, only 11.6% were exclusively breastfed at six months. This indicates that many mothers face challenges in maintaining exclusive breastfeeding and that breastfeeding preparation is essential to support them in this endeavor. As breastfeeding rates have declined, various efforts to bolster preparation and support have emerged. Notably, establishing the International Board of Lactation Consultant Examiners (IBLCE) in 1985 and the subsequent certification of lactation consultants globally in providing expert guidance to new mothers have been some of the actions that have been taken to change this (Nilsson & Busck-Rasmussen, 2023).

Breastfeeding preparation in Denmark has transitioned from small group sessions to larger antenatal classes, with many hospitals now offering digital options like webinars and online videos focusing on labor stages, pain relief, postnatal care, and breastfeeding (Hvidovre Hospital, 2023). Region Syddanmark (2022) has introduced user-centered digital antenatal videos featuring expectant and new parents sharing their perspectives on various topics related to antenatal classes. This approach provides a more relatable and authentic experience for viewers by incorporating personal stories and insights from those who have recently gone through pregnancy and childbirth.

Current digital antenatal education methods lack personalization and interactivity, often mimicking traditional lecture formats digitally. Face-to-face interactions remain the most effective, but telephone counseling and telemedicine are increasingly relevant alternatives when in-person contact is impractical (Nilsson & Busck-Rasmussen, 2023).

Expectant and new parents seek breastfeeding information from healthcare professionals, support groups, books, websites, and social media. Ensuring the quality and reliability of online resources remains a challenge (Buultjens et al., 2012). Personal contact with breastfeeding consultants is most times crucial for addressing breastfeeding challenges. Private breastfeeding classes and support services provide additional resources but also contribute to inequality in maternal healthcare, widening the gap between those who can afford private support and those relying on public services.

Denmark needs more effective prenatal education and support to improve breastfeeding practices, as many women prefer personal support during breastfeeding (Nilsson & Busck-Rasmussen, 2023).

3.3. Presenting the case: MidwifeVR

MidwifeVR is a forward-thinking Danish startup focused on revolutionizing breastfeeding support and parental care through immersive VR technology. Established in 2021 at KU Lighthouse in Copenhagen by a group of professionals from the University of Copenhagen and a midwife student, the company aims to tackle the challenges faced by new parents. These challenges became even more pronounced during the COVID-19 pandemic. The company has evolved significantly over the past one to two years. Currently, VR specialist Morten Haulik Kristensen is the sole remaining founder actively working on MidwifeVR. He continues to drive the mission of developing and implementing this innovative product, ensuring that expectant and new parents are empowered and well-prepared for parenthood through the transformative possibilities of VR.

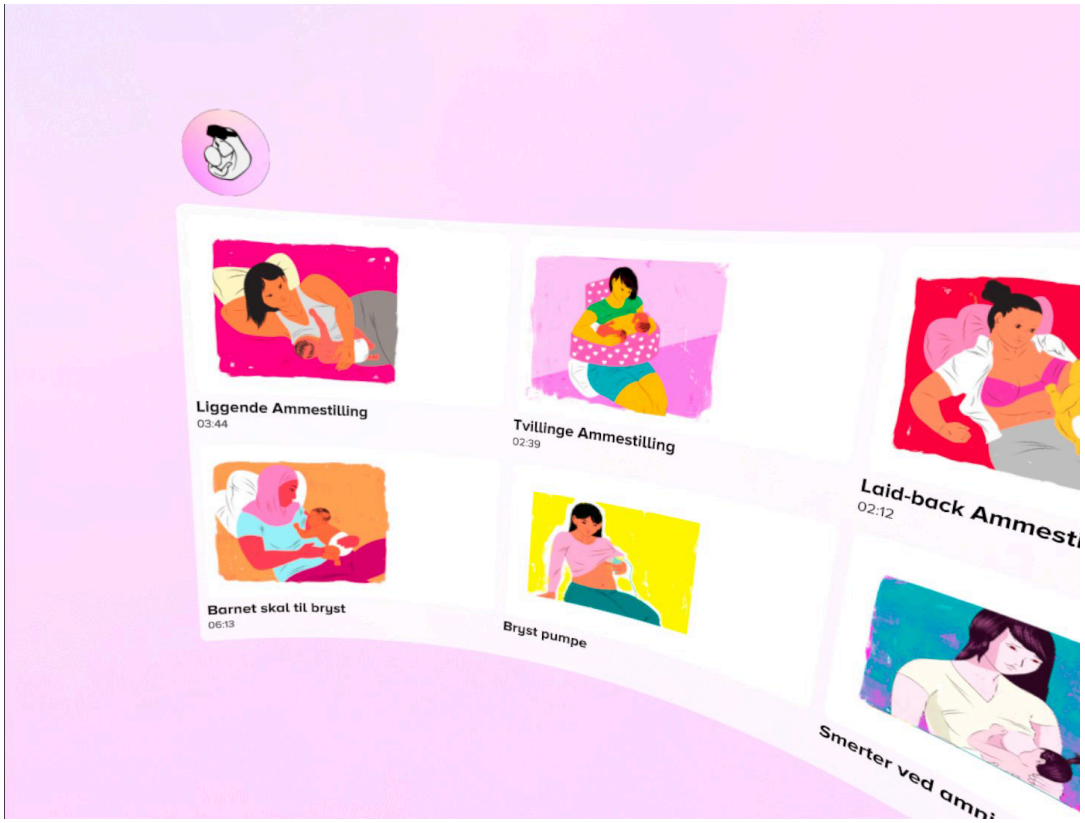
MidwifeVR pioneers the use of VR to provide new parents with practical and engaging breastfeeding preparation and parental care. By offering immersive experiences featuring real midwives, breastfeeding women, and babies, the company aims to create realistic scenarios that enhance learning and support.

Product Details

Illustration 3: MidwifeVR headset and box

'The MidwifeVR Experience'

Users engage with the MidwifeVR product through VR glasses, which present a user interface reminiscent of Netflix. This intuitive menu allows users to select from various VR experiences, each designed to address different aspects of breastfeeding and parental care. The content was significantly developed and refined during the contribution of my internship from September 2023 to January 2024. The development of MidwifeVR has been iterative, with the initial version (referred to as MidwifeVR 1.0) being tested and redesigned during the mentioned internship period. The redesigned version, MidwifeVR 2.0, incorporates feedback and improvements based on user experience testing. The methodological section of this thesis will detail which parts of MidwifeVR 2.0 were included in the UX tests and the rationale behind these choices.



Screenshot 1: User interface MidwifeVR

The product was micro-launched on May 12, 2024, and is available for rent five days a week at a cost of 750 DKK in Copenhagen. The service includes home delivery and pick-up, providing convenience for parents.

Content Offerings

The final product, referred to as MidwifeVR 2.0, includes 12 distinct VR experiences:

1. Baby to breast
2. Laid-back breastfeeding position
3. Side-lying breastfeeding position
4. Classic breastfeeding position
5. Signs of hunger
6. Partner's role
7. Signs of sleep

8. Supplementing - Bottle, etc.
9. Challenges
10. Hand milk expression
11. Exercises with baby
12. Calm

Screenshot 2: Thumbnails MidwifeVR

These experiences are designed to provide comprehensive support and education for new parents, covering a wide range of breastfeeding and parental care topics.

4. Theory

This section outlines the meta-theoretical foundation and theoretical approach of the master thesis. It employs phenomenology as the meta-theory and utilizes Postphenomenology (PP), focusing on technology mediation theory, to investigate the use of VR as a medium for breastfeeding preparation.

4.1 Meta Theory: Phenomenology

Phenomenology seeks to understand the essence of phenomena through the experiences of individuals. It aims to elucidate both the content and the manner of these experiences. Hermeneutic phenomenology, influenced by Martin Heidegger, emphasizes interpretation within the context of lived experience. According to Heidegger, individuals are deeply embedded in their socio-cultural milieu, which shapes their understanding of themselves and the world (Neubauer et al., 2017). This approach acknowledges the interconnectedness of subjective experiences with social, cultural, and political contexts.

Central to hermeneutic phenomenology is the role of interpretation, where researchers engage in understanding experiences through the lens of the lifeworld. This involves recognizing the influence of individuals' backgrounds and contexts on their experiences while also acknowledging their capacity to transcend these circumstances. Researchers in this field embrace their subjectivity, understanding that their perspectives shape data interpretation, thus allowing a richer understanding of human experience (Neubauer et al., 2017, pp. 94-95).

4.2 Theoretical framework: Postphenomenology

Postphenomenology (PP) is rooted in the phenomenological tradition of philosophy and approaches issues from the vantage point of deep descriptions of human experience (Rosenberger & Verbeek, 2015). It emphasizes the mediating role of technology in shaping human experiences, perceptions, and actions. This perspective is particularly relevant to this master's thesis, which explores the lived experiences of expectant and new parents using VR in the context of breastfeeding.

PP provides a framework for examining the intricate interplay between technology and human experiences, shedding light on how VR influences users' perceptions, interactions, and preparations for breastfeeding. By focusing on the mediation of human-technology

relationships, PP offers valuable insights into the ways in which VR can shape the experiences of expectant and new parents as they navigate the challenges and joys of breastfeeding.

In history, there have been an array of developments of phenomenology in the context of technology, spanning from works by Ihde, Selinger, Rosenberger, and Verbeek (Rosenberger & Verbeek, 2015, 9-10), but they all share some fundamental characteristics; firstly, they delve into the nexus between humans and technological artifacts, scrutinizing how technologies actively shape the relationship between individuals and their environment. Rather than viewing technologies as mere tools, these studies recognize them as *dynamic mediators* of human experiences and practices. Secondly, they adopt a unique approach that melds philosophical inquiry with empirical investigation. Instead of imposing abstract theories onto technologies, the Postphenomenological perspective begins its analysis from the vantage point of actual technological phenomena. In essence, it offers a philosophy from technology grounded in real-world observations and engagements (Rosenberger & Verbeek, 2015, 9-10).

4.2.1 Technology Mediation Theory

Technological mediation theory, originating from Don Ihde's postphenomenological insights, views technology as a crucial mediator of human interaction with the world. According to Peter-Paul Verbeek, technologies shape our daily lives by mediating our experiences. We depend on artifacts such as thermometers, photographs, telephones, and television to access information and interact with our surroundings, often perceiving the world through these technological intermediaries (Verbeek, 2005).

According to Don Ihde's (1990) PP, technological mediation provides a framework for understanding the complex bond between humans and technology. Postphenomenology posits that science and technology do not alienate us but mediate and shape our relationship with the world. This perspective reinterprets phenomenology, emphasizing it as a framework for understanding the intricate connections between humans and their environment (Rosenberger & Verbeek, 2015, p. 10).

Technological artifacts influence our perceptions, actions, and experiences, serving not merely as extensions of our capabilities but as conduits that fundamentally alter our engagement with the world. This aspect is crucial to understanding the human-technology relationship, highlighting how technology shapes our presence in the world (Rosenberger & Verbeek, 2015, 12).

PP examines how reality is experienced and perceived through technological mediation. In the context of this thesis, PP enables an exploration of user experiences within virtual spaces and the broader human-world relationship, offering insights into the components that constitute breastfeeding experiences mediated by virtual environments.

4.2.2 Human - Technology - World

In PP, technology assumes a pivotal role in the human-world relationship. The triad of Human-Technology-World encapsulates the interaction between humans, their technologies, and the world they inhabit. Don Ihde emphasizes intentionality, suggesting that our consciousness is directed toward the world predominantly through technological mediation. Technologies such as eyeglasses, televisions, and smartphones shape our perceptions and actions, influencing how we engage with reality (Verbeek, 2008, 13).
Beyond classical phenomenology's aspiration to access "the things themselves," postphenomenology takes a different path. Rather than ignoring technology, it recognizes its role in shaping our reality, with these technological interactions actively influencing our perception and lived experiences of the world.

As a nuanced way of understanding how humans' interactions with technologies shape our existence, actions, and perceptions, Don Ihde proposes a framework that sheds light on these interactions. He identifies four distinct relationships between humans, technology, and the world: Embodiment, Hermeneutic, Alterity, and Background relations (Ihde, 1990).

In this master's thesis research, the interaction between parents and VR can be explored and understood through specific relational perspectives, with some holding greater importance than others. VR can be assessed from various relational frameworks based on factors like its functionality, design, and human interaction.

4.2.2.1 Embodiment relations

Embodiment relations encapsulate the intricate interplay between individuals, technology, and the surrounding environment, fundamentally altering the way users perceive and interact with the world. In embodiment relations, there is transparency, as when we look *through* our eyeglasses or talk *through* the phone (Vindenes & Wasson, 2021, 3). Here, humans take *"technological artifacts into their experiencing, and thereby broaden the area of sensitivity of their bodies to the world*" (Verbeek, 2005, 125).

Ihde's framework of *embodiment relation* underscores the mediating role of technology in shaping human engagement with the world. Ihde schematized the embodiment relations as follows:

(Human-Technology) → World

This notation emphasizes how technology mediates the relationship between humans and the world, influencing both actional and perceptual aspects of experience (Rosenberger & Verbeek, 2015, 14).

A compelling and often-used illustration of embodiment relations is found in the example of eyeglasses. As users wear glasses, their perception of the world is not merely augmented but fundamentally transformed. The glasses become an integral part of the user's perceptual experience, with the wearer embodying the technology itself (Ihde, 1990, 73). At the core of this concept lies the transformative impact of technology on users' experiences, where the device itself becomes integrated into the user's bodily awareness, reshaping their actions and perceptions (Rosenberger & Verbeek, 2015, 14).

Furthermore, Ihde introduces the concept of *transparency* in human-technology relations, referring to the degree to which a device fades into the background of the user's awareness. As users become accustomed to technology, it achieves transparency, seamlessly integrating into their everyday experiences (Rosenberger & Verbeek, 2015, 15-16). However, this transparency is contrasted with a "double desire" inherent in human-technology interactions. On one hand, there is a longing for total transparency, for the technology to seamlessly merge with the user's being. Conversely, there exists a desire for the transformative power that technology offers, highlighting the tension between transparency and technological agency (Ihde, 1990, 75).

4.2.2.2. Hermeneutic relation

Hermeneutic relations, as articulated by Don Ihde, delve into the realm of interpretation and understanding within the context of human-technology interactions. Stemming from the hermeneutic tradition in philosophy, which concerns itself with the interpretation of texts and language, hermeneutic relations focus on the act of perceiving and interpreting technological devices and their readouts (Ihde, 1990). Unlike embodiment relations, where users experience the world *through* the mediation of technology, hermeneutic relations involve a transformed encounter with reality via the direct experience and interpretation of the technology itself. In this framework, the user's interaction is represented as

Human → (Technology-World)

Signifying the mediation of technology between the user and the external world (Rosenberger & Verbeek, 2015). A wristwatch often serves as a simple example of a hermeneutic relation. When a user looks at the watch's face and interprets the hands or digital display, they engage in a hermeneutic interaction, experiencing transformed access to the precise time of day through the interpretation of the technology (Rosenberger & Verbeek, 2015).

The interpretive process in hermeneutic relations goes beyond visual readouts to include any bodily sense. While traditional examples often focus on technologies with visual displays, this is not a defining characteristic. The device's output could involve any physical sensation, necessitating direct perception and active interpretation(Rosenberger & Verbeek, 2015). Verbeek's ultrasound case (Verbeek, 2008) demonstrates the hermeneutic relationship. Ultrasound technology shapes the reality of the phenomena being studied, as it helps to shape the healthcare provider's understanding of the fetus's development and the pregnant person's experience of pregnancy. The technology is not a neutral intermediary but an active mediator that shapes the relationship between the healthcare provider, the pregnant person, and the fetus.

The lens of hermeneutic relations allows researchers to delve into how technologies shape people's understanding of reality and influence interactions with the technological world around us. By recognizing the interpretive role of users in engaging with technology, hermeneutics provides valuable insights into the complex interplay between humans and technology.

4.2.2.3. Alterity relation

Alterity relations, as outlined by Don Ihde (1990), describe the way humans interact with technologies in a manner that mimics interpersonal engagement, blurring the lines between human-to-human and human-to-technology interactions. Schematically represented as:

Human → Technology (World)

Alterity relations describe a mode of interaction where technology is experienced as an "other," an entity with which the user interacts directly within its own system (Ihde, 1990; Vindenes & Wasson, 2021, 3). Examples of such interfaces include automated customer service interactions, GPS devices with audible directions, and voice-activated personal assistant applications, all of which mimic human-like interaction patterns (Rosenberger & Verbeek, 2015).

By acknowledging and exploring the potential for quasi-other interactions within virtual environments, it is possible to uncover novel avenues for creating immersive and emotionally resonant user experiences. This perspective enables the thesis to delve deeper into the intricate interplay between humans and technology in VR contexts, offering insights that can enhance the effectiveness and impact of breastfeeding preparation programs.

4.2.2.4. Background relation:

Background relations, as part of Don Ihde's Human-technology relations, refer to technologies that constitute the user's environmental context, even though the user may not directly interact with them.

Human → (Technology/World).

These technologies shape the experiential surroundings of the user, forming a backdrop to their experiences (Rosenberger & Verbeek, 2015, 19).

Unlike technologies in foreground relations that demand direct attention, those in background relations remain on the periphery of awareness. The lack of attention to background relations is not solely due to technological transparency but rather because these technologies withdraw phenomenologically, existing as a kind of "absence" or being "off to

the side." Despite this withdrawal, they become part of the user's experienced field, blending into the immediate environment (Ihde, 1990, 109). Technologies in background relations play a crucial role in shaping experiences by providing essential functions like protecting from elements or refrigerating food without necessitating direct interaction. They form an integral part of the user's environment, influencing experiences subtly yet significantly (Rosenberger & Verbeek, 2015, 19).

4.2.2.5 Spectrum of Human-Technology-World Relations

Recognizing the diversity of human-technology-world relations and acknowledging that Don Ihde's theories may not fully capture the nuances of emerging technologies, this thesis grounds its analysis in Ihde's foundational theories of human-technology relations. Ihde's framework provides a robust foundation for understanding how technology mediates our interactions with the world. However, to thoroughly analyze and understand the mediating role of VR in user experience and breastfeeding education, a mixed or dual approach inspired by Vindenes and Wasson's (2021) article, *"A Postphenomenological Framework for Studying User Experience of Immersive Virtual Reality,*" will be employed.

In this context, users embody various aspects of VR technology, such as hardware, integrating it into their subjectivity through a transparent embodiment relation. Simultaneously, the objectivity of their experience—including the environment, actors, and social scenarios—is mediated by VR technology, creating an opaque alterity relation where the world serves as the background. This complex human-technology relation established by VR can be conceptualized as user-environment relations, illustrating an embodiment-alterity relation, represented as:

$$\textbf{(Human} - \textbf{Technology)} \rightarrow \textbf{Technology(}-\textbf{World)}$$

This schema delineates a user-environment relation where the user embodies the technology while maintaining an alterity relation with the environment, with the world in the background.

4.2.3. Mutual constitution

The postphenomenological concept of mutual constitution, also known as co-constitution, emphasizes the reciprocal relationship between humans and technologies in shaping each other's subjectivity and objectivity. Verbeek perceptively emphasizes that humans and technologies co-constitute each other. He underscores that the subject and object of mediation are mutually constitutive, shaping each other in a reciprocal dance (Kudina, 2019, 98). Rather than merely bridging subject and object, intentionality emerges as a dynamic source from which both entities spring forth. This emphasis on mediation and mutual constitution sharply distinguishes the postphenomenological approach from classical phenomenology (Rosenberger & Verbeek, 2015, 12). There is no pre-given subject or object; the technological mediation approach allows precise humans and technologies to have an active role in the construction of reality (Verbeek, 2005) (Rosenberger & Verbeek, 2015, 12). This concept is, at its core, based on the idea that humans and technologies are mutually constitutive, meaning they actively participate in the construction of reality.

The concept of what the world "is" and the nature of human subjects are products of the dynamic interaction between individuals and their environment. This interaction results in the concept of *interpreted reality*, where human existence is defined as *situated subjectivity*."(Verbeek 2008, 3). In this symbiotic relationship between humans and reality, a unique objectivity of the world emerges alongside a distinct subjectivity of individuals. This mutual shaping of perspectives underscores how human beings and their surroundings co-constitute each other, leading to the formation of specific worldviews and subjective experiences.

The concept of the Mutual Constitution delves into the intricate interplay between embodiment and presence within virtual environments, shedding light on how these elements contribute to shaping a user's subjectivity in relation to the objective aspects of the environment. This perspective, as seen through the lens of Kudina (2019), emphasizes that this approach does not seek to supplant or dismiss established frameworks for assessing experiences. Instead, it focuses on elucidating the experience by elucidating the ongoing interplay of subjectivity and objectivity that emerges through mediation.

In the realm of PP, the mutual constitution of humans and technologies stands out as a pivotal concept. It underscores the symbiotic relationship between humans and technology, highlighting how they co-constitute each other. This dynamic is especially pertinent when examining the user experience within VR interventions. These interventions are designed to

induce changes in behavior, emotions, and attitudes, thereby influencing how individuals interact with and perceive their surroundings. By recognizing and exploring this mutual constitution, a deeper understanding of the transformative impact of VR interventions on human-world relationships can be gained.

4.2.4. Multistability

Multistability, as conceptualized in PP, refers to the ability of technologies to have multiple stabilities or uses, depending on the context and the user's interpretation. This means that technology cannot be reduced to a particular usage or function, but rather, it can be used in various ways depending on the socio-material context and the user's perspective (De Boer, 2021). This does not mean that VR applications can be so multi-stable that any user-environment relation can be experienced; as Ihde notes, *"Multistability is not the same as neutrality."* (Ihde, 2002, 106). All technologies, regardless of their perceived neutrality, possess inherent directedness. Users' perceptions, behaviors, and resulting values are not fixed attributes but are shaped by the technologies they interact with. Therefore, designing for values must account for the dynamic interplay between users, technology, and values (Kudina, 2019).

While multistability can be intentionally designed into technologies, exemplified often as a smartphone, it is also an inherent property that arises even when the goal is for a technology to serve a specific function. For instance, a VR application created to deliver a particular intervention effect will still exhibit multiple stable patterns in how it is actually used and perceived by different users in varying contexts. Despite these multiple possibilities, there will always be a dominant use associated with technology, typically aligning with its intended purpose and the most common way it is utilized.

In summary, technologies cannot be reduced to or constrained by their designed functions alone. As philosopher Don Ihde notes, technologies "simply can't be reduced to designed functions" (Ihde, 2002, 106). Multistability is a fundamental characteristic of technological artifacts, regardless of whether it is explicitly designed for or not.

4.2.5. Moral responsibility

The mediation approach has profound implications for the ethics of technology. As technologies mediate human actions and lifestyles, they actively participate in shaping ethical

behavior. Ultrasound imaging, drones, and smartphones can serve as mediators of moral decisions and actions, illustrating how technology intertwines with morality (Kudina & Verbeek, 2018). However, this phenomenon of moral mediation should not be mistaken for technologies possessing inherent moral agency.

Postphenomenology does not attribute moral agency to technologies themselves. Instead, it posits that moral agency emerges from the hybrid relationship between humans and the technologies they use (Smits et al., 2019); Verbeek, 2008). Technologies do not possess moral agency on their own; rather, they mediate and shape human moral perceptions, decisions, and actions through their mediating roles.

Contrary to attributing moral agency to technologies, the concept of technological mediation underscores the coexistence and co-shaping of human and technological influences on moral frameworks. Moral agency arises from the interplay between human beings and the technologies they use, creating a hybrid ethical landscape where both human and technological factors contribute to moral outcomes (Kudina & Verbeek, 2018).

By examining the micro-level interactions between humans and early versions of technology, researchers can gain insights into how moral frameworks evolve in response to technological advancements. This approach offers a nuanced understanding of the complex interplay between technology, morality, and ethics in various contexts, including VR-based breastfeeding education.

The use of VR in the context of breastfeeding education presents various moral implications that stem from the intricate interplay between technology, morality, and ethics. Raising ethical considerations of the use of technology to bridge the gap between theoretical knowledge and lived experience, moral questions about the responsibility of technology in shaping parental perceptions and expectations, ethical implications of using technology to promote empathy and sensitivity towards the challenges faced by breastfeeding parents, questions of equity, inclusivity, and access.

5. Methodological approach

5.1. Foundation of the Research Approach

To effectively explore the research question posed in this master's thesis, the methodological approach is centered on a user-centric Participatory Design (PD) perspective. This approach involves expectant and new parents directly in the design and evaluation processes to enhance the development and implementation of VR tools for breastfeeding education. By engaging users as co-designers, the study aims to capture a comprehensive understanding of their experiences and interactions with technology. This participatory method not only facilitates a deeper exploration of the human-technology-world relationship but also ensures that the technological solutions developed are genuinely tailored to the users' educational needs and contexts. Through this methodology, the study seeks to yield insightful and actionable findings that directly inform the enhancement of VR as a tool for breastfeeding education. As defined by Robertson and Simonsen (2012, 2), Participatory Design is

"a process of investigating, understanding, reflecting upon, establishing, developing, and supporting mutual learning between multiple participants in collective 'reflection-in-action.' The participants typically undertake the two principal roles of users and designers where the designers strive to learn the realities of the user's situation while the users strive to articulate their desired aims and learn appropriate technological means to obtain them."

In this study, PD serves as a democratic tool, placing end-users at the heart of the design process to ensure that solutions meet their needs effectively, thereby enhancing outcome relevance and usability. Additionally, the application of ethnography focuses on user experience (UX) within VR-based breastfeeding education, which is crucial for understanding the interactions and perceptions of expectant and new parents towards VR environments. This method captures essential aspects of UX and interaction that are vital for user-centered design. PD, by involving users throughout the design stages, allows them to act as co-designers, providing insights that significantly improve the usability and effectiveness of the final product (Kopeć et al., 2023, 185).

5.2. Research Design

The research design of this master thesis follows a two-phase approach:

5.2.1. Phase 1: Initial User Research and Design Process

During my previous semesters' internship, I familiarized myself with the field and product, conducted user research, and performed UX testing of MidwifeVR with expecting parents and midwives. The goal was to enhance MidwifeVR 1.0 to better meet user needs. I also recruited and collaborated with specialized breastfeeding midwives to gain a deeper understanding of breastfeeding practices. Together, we determined the appropriate content to include in the VR experiences.

Insights from this process informed revisions, culminating in the new version MidwifeVR 2.0, filmed in December 2023 and edited in February 2024.

5.2.2. Phase 2: Master thesis research process

Phase 2 of the research adopted a comprehensive approach that included literature research, digital ethnography, surveys, UX testing, follow-up interviews, and expert consultations. This master thesis aims to investigate the experiences and perceptions of expectant and new parents using VR as a tool for breastfeeding support and preparation. The goal is to provide actionable insights for the design and implementation of VR interventions, such as Midwife VR, to effectively support breastfeeding.

Each method utilized in this study will be elaborately detailed in Section 6.3, where their relevance to the research will also be discussed. The research design process is depicted in *Illustration 3* below, which visually represents both Phase 1 and Phase 2. This foundational layout is instrumental in exploring the research area—specifically, the UX of parents engaging with VR for breastfeeding preparation.

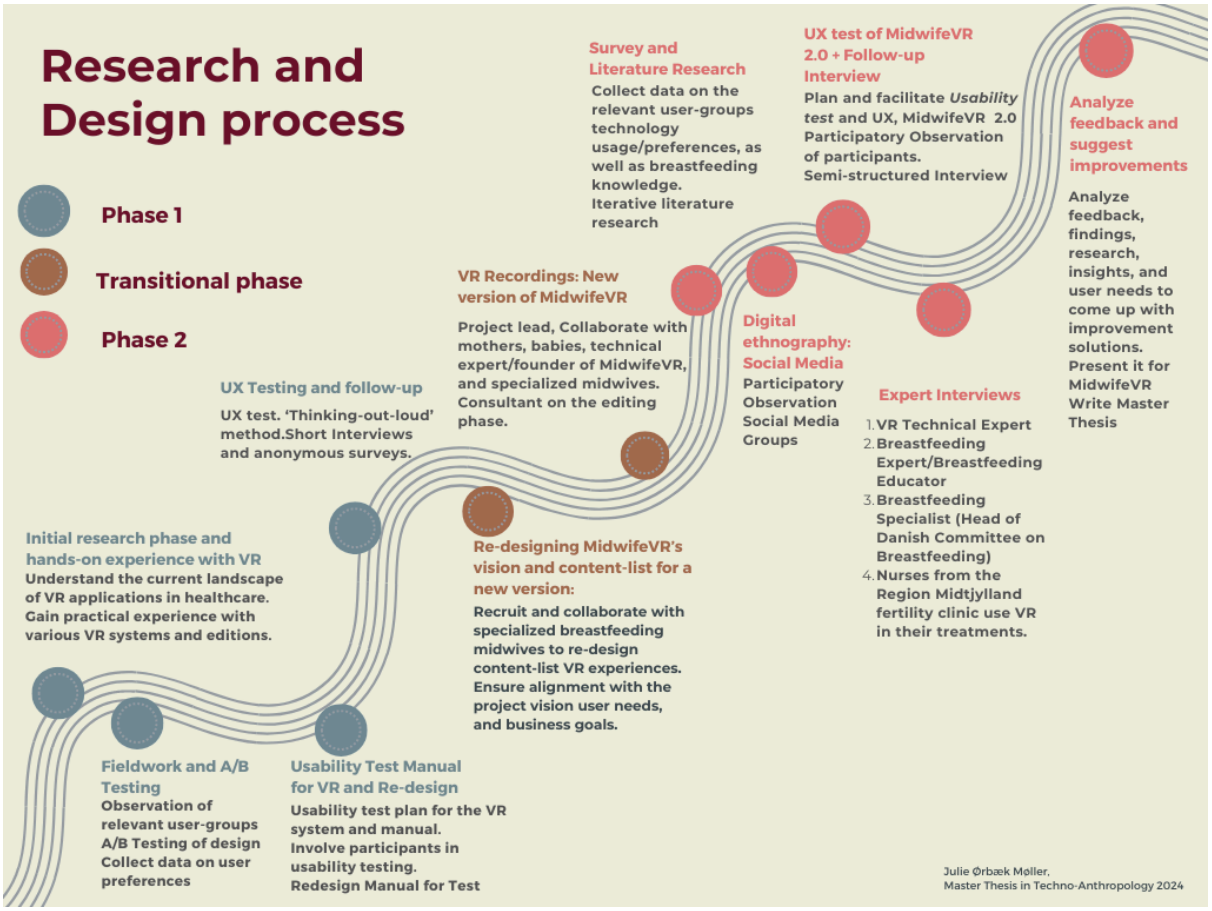


Illustration 4: Research and Design Process

5.3. Methodological choice

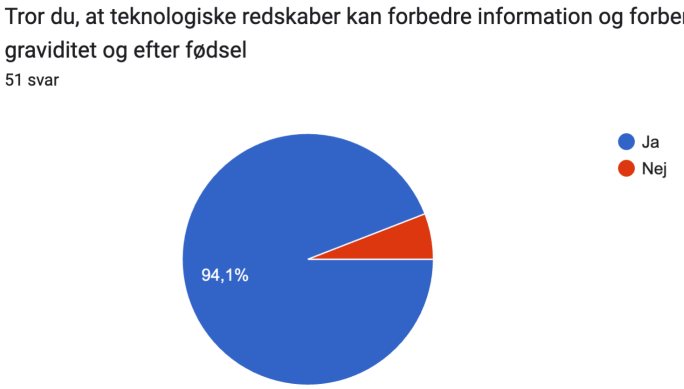
5.3.1. Literature research

(Described in 2.2.)

5.3.2. Survey

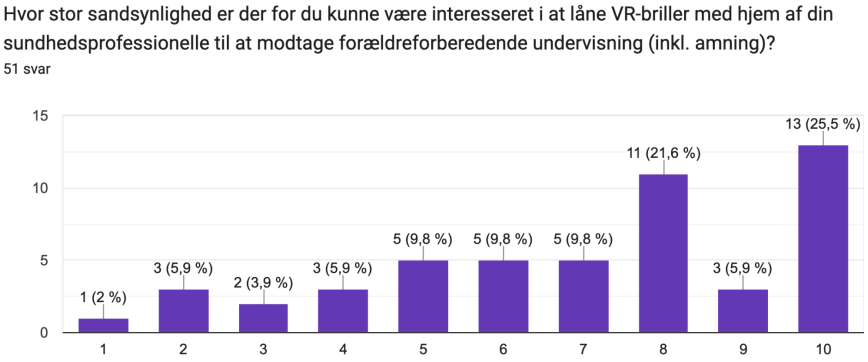
The survey functioned as a preliminary entry into the study, establishing a baseline understanding of user experiences and perceptions regarding technology and breastfeeding challenges. This was undertaken despite my existing knowledge and expertise as a midwife. Due to the personal nature of breastfeeding, the survey was structured to allow for anonymous responses, ensuring that participants could share openly without fear of identification. This design was crucial in fostering honest feedback. To ensure participants' confidentiality and encourage candidness, anonymity was strictly maintained. Participants were recruited through personal social media networks, including LinkedIn and Facebook, and were asked about a range of topics, from practical to emotional aspects of breastfeeding,

and their views on VR technology as a support tool. Although the survey did not yield directly actionable insights for my research questions, it was instrumental in shaping the approach for more detailed methods like UX testing and interviews (DeCarlo, 2018). Here are a few examples that present the survey.:



Screenshot 3: Survey result - Technology Assistance in Pregnancy Journey

Screenshot 4: Survey result - Answers why technology can assist antenatal classes



Screenshot 5: Survey result: Interest in VR for antenatal classes

5.3.3. Digital Ethnography

5.3.3.1. Argumentation and Process of Digital Ethnography

In the study of breastfeeding practices, including the integration of VR technology, digital ethnography stands out as a robust methodology. This approach offers a dynamic framework for examining the ever-changing social dynamics surrounding breastfeeding within digital landscapes. Researchers engaging in digital ethnography must navigate complex social dynamics with agility and reflexivity, as highlighted by Pink et al. (2016). Digital platforms enable individuals to share experiences anonymously, providing researchers with valuable data that is not easily accessible through traditional methods like interviews or surveys, supporting its use in this master thesis.

Embracing digital ethnography allows researchers to delve deeply into the lived experiences, perspectives, and interactions within online communities and digital platforms. By recognizing the multifaceted nature of social experiences, digital ethnographers bridge academic discourse with real-world contexts, enhancing our understanding of digital social dynamics (Pink et al., 2016). Pink et al. (2016) emphasize that digital ethnography offers a dynamic perspective for exploring rapidly evolving social landscapes, which is particularly relevant in the study of breastfeeding challenges.

A participatory observation approach was employed to investigate the experiences and challenges of breastfeeding mothers on various digital platforms. Personal user profiles were used on Facebook, Instagram, YouTube, and TikTok. Given my background as a midwife and personal experience as a mother, I carefully considered the ethical implications of joining private, closed groups. This dual perspective provided me with a deeper

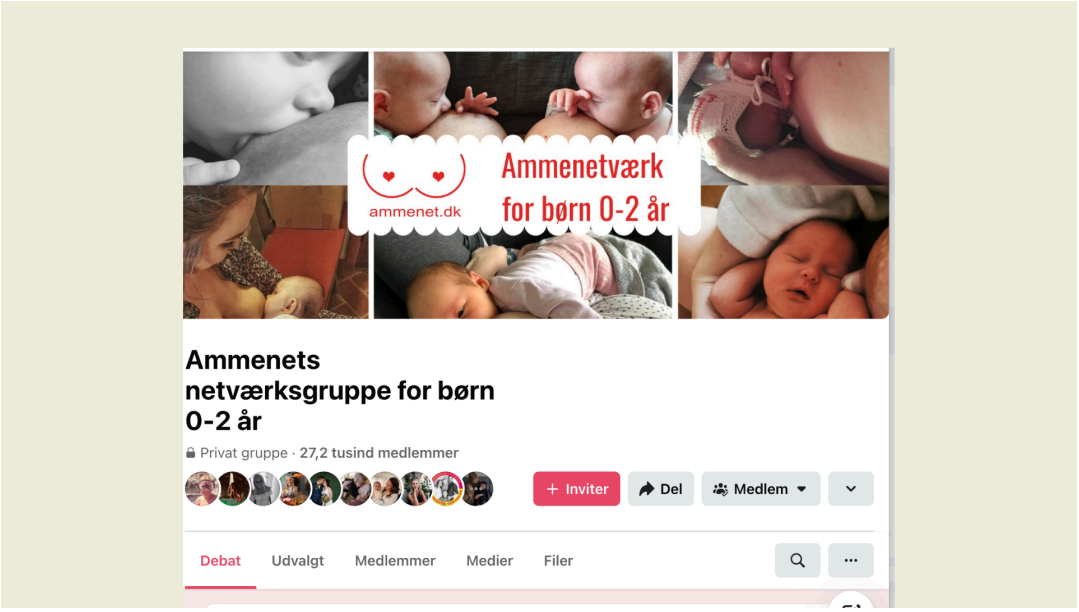
understanding and empathy for the sensitive topics discussed within these groups, enhancing my research approach in these environments.

To investigate specific topics, I searched social media using keywords and hashtags like 'breastfeeding,' 'breastfeeding preparation,' and 'breastfeeding challenges.' I also performed a Google snowball search on "Amning" to understand user perspectives on researching breastfeeding. This digital ethnography revealed a wealth of information across platforms: TikTok and Instagram highlighted personal breastfeeding stories but also some sexualized comments; YouTube featured tips from various influencers, including non-health professionals and midwives.

5.3.4.2. Facebook community: ‘Ammenet netværksgruppe 0-2 år’

The most significant group about breastfeeding challenges was found on the Facebook platform, 'Ammenetværksgruppe børn 0-2 år' (Breastfeeding Network Group 0-2 years). This group, administered by a non-governmental organization specializing in breastfeeding guidance, has a large membership and serves as a forum for mothers to share knowledge, experiences, and challenges. Through participatory observing and analyzing posts and comments, I identified overarching themes and patterns in members' interactions, gaining insights into breastfeeding challenges and diverse perspectives. (Pink et al., 2016).

Active moderation ensured a positive atmosphere by promptly removing inappropriate comments and fostering a safe and supportive environment. The private Facebook group status with strict guidelines on sharing content also safeguarded members' privacy and comfort, maintaining the focus on support and positive exchange. This approach highlights the potential of social media as a tool to support breastfeeding mothers by providing a platform for solidarity and shared learning.



Screenshot 6: Facebook group Breastfeeding Network Group 0-2 years

5.3.4. User Experience and Follow-up Interviews

5.3.4.1. User-Experience Test of VR

The primary objective of conducting UX tests with VR was to understand how this technology is perceived by expectant parents, their partners, and breastfeeding mothers. Specifically, the test aims to:

1. Identify the specific benefits and barriers associated with using VR for breastfeeding education, such as ease of use, emotional engagement, and any misconceptions that could be addressed through further content development.
2. Enhance academic and practical understanding of how immersive technologies can be tailored to meet the educational needs of parents, thereby supporting better preparation for breastfeeding.

The UX test and follow-up interview were carefully planned and facilitated based on the purpose of the thesis research. This included recruitment, choice of participants, facilitation, time and resource planning, ethical considerations, and semi-structured tests and questions. The End-user experience is crucial for a product's success, although it does not guarantee it (Rosenzweig, 2015). A good UX varies from person to person and from product to product. Conducting usability tests, as done with the first group of participants, provided a solid

foundation to ensure the product's functionality. The UX tests involved a diverse group of participants to ensure a comprehensive understanding of the impact of VR content across different user segments.

Participants include:

- Two pregnant individuals: To assess anticipatory reactions and the perceived utility of VR in preparing for breastfeeding.
- Two partners: To understand the support role and gain insights into how VR might enhance their supportive capacities.
- Two mothers were currently breastfeeding: To evaluate the accuracy and helpfulness of the VR content based on their ongoing experiences.
- Eight Additional perspectives from a previous phase (MidwifeVR 1.0), Including three breastfeeding mothers, one partner, one pregnant, and three midwives, to incorporate professional and experiential insights.

Participants were introduced to the MidwifeVR platform for the UX test. This introduction began with a brief tutorial on usability, delivered through a video tutorial or a step-by-step guide provided by me. Due to constraints related to time and resources, participants could not explore all 12 available experiences on the platform. Instead, the developer selected four specific experiences for testing during this phase of the thesis process: Child-to-breast, Classical breastfeeding position, Laid-back breastfeeding position, and Side-lying position.

5.3.4.2. Follow-Up Interviews:

Following the VR immersion, participants engaged in semi-structured interviews to gather qualitative insights, besides participatory observation, about the user's emotional and cognitive experiences and to collect some spoken data from the user.

The interviews were designed to be semi-structured with a blend of open-ended and more direct questions. For instance, participants were asked about their immediate reactions to the VR environment and its content with questions like, "*What was it like to be in the virtual environment while content about breastfeeding was being presented?*" and *"What are your immediate thoughts on using VR as a tool to prepare expectant parents for breastfeeding?."* These questions aimed to delve deeply into participants' experiences, enabling varied responses and enriching the data (O'Reilly, 2004). Follow-up interviews combined open-ended questions' flexibility with targeted guidance, which is crucial for

understanding the nuanced UXs and perceptions of VR in breastfeeding education (O'Reilly, 2004).

To create an environment conducive to honest and reflective responses, I ensured that the interview setting was comfortable and safe. The tone of the interaction was deliberately calm, open, and warm to encourage participants to express their true feelings and opinions without restraint. This informal approach was further emphasized by not rigidly adhering to the interview guide but instead allowing the conversation to flow naturally, which sometimes included sharing personal insights on the subject. The timing of the interviews immediately following the UX test was strategic. It allowed for capturing immediate reactions and thoughts while the experience was still fresh in the participants' minds.

For the transcription, the tool developed by Zetland is called "Good Tape" (Goodtape.com). This facilitated the process and allowed for the complete transcription of all interviews. While "Good Tape" provides an initial draft of the transcription, it is not flawless. For example, the word "Amning" (Breastfeeding) was frequently transcribed as "Armning" (Arms). Therefore, the draft required editing to achieve a usable final result.

5.3.5. Expert Interviews

Expert interviews were employed as a supplementary research method as part of the qualitative research methodology used in this thesis. This decision was guided by the realization that while my primary data provides a solid foundation, the specialized knowledge and perspectives of experts are indispensable for a deeper and more nuanced understanding of the topics. As Döringer (2020) emphasizes, qualitative interviews are crucial for exploring the nuanced views of individuals, thereby enriching the understanding of complex social phenomena. This approach is particularly relevant in the thesis research area, which navigates the intersections between VR technology and Breastfeeding —a field where established empirical data is limited. The Expert Interviews are incorporated to collect knowledge about specific fields of interest (Döringer, 2020). This contributed to some more context-specific expertise within VR and Breastfeeding.

Selection of Experts

Informants for the Expert interview were carefully selected based on their distinctive knowledge and experience in fields directly relevant to the research questions:

1. VR Technical Expert: This expert possesses comprehensive knowledge of VR technology, with a focus on its application in educational and healthcare settings. He is also one of the founders of MidwifeVR. The insights from this expert are crucial in understanding the current capabilities, limitations, and future potential of VR technologies in breastfeeding education.
2. Breastfeeding Expert/Educator: Engaging with a practical, hands-on expert in the field of breastfeeding within a hospital setting provided valuable perspectives on the day-to-day challenges and opportunities in breastfeeding education.
3. Breastfeeding Specialist (Head of the Danish Committee on Breastfeeding): This expert offers a more organizational and theoretical perspective on breastfeeding. Insights about future projects and implementation of breastfeeding guidance offered digitally to expectant and new parents in cooperation with healthcare nurses were the subject of the interview.
4. Two nurses from the Region Midtjylland fertility clinic in Denmark. These nurses are actively involved in a research project that found the value of using VR to alleviate stress and pain for patients undergoing fertility treatments.

The expert interviews were crucial to my thesis, providing context, validating the approach, and enriching interpretations with their insights.

5.4. Data Analysis

In this study, the data gathered from surveys, interviews, digital ethnography, and user-experience testing will undergo a rigorous analysis utilizing both qualitative and quantitative methods. The analysis will employ thematic analysis to discern recurring themes and patterns within the data. Thematic analysis is a systematic approach that facilitates a thorough exploration of the data, revealing underlying meanings and insights. The thesis followed the steps *'Phases of Thematic Analysis'*(Braun & Clarke, 2006): 1. Familiarising yourself with your data, 2. Generating initial codes, 3. Searching for themes, 4. Reviewing themes, 5. Defining and naming themes, 6. Producing the report.

This method aims to provide a comprehensive understanding of the research questions by identifying common threads and connections in the dataset, thereby enabling a more nuanced interpretation of the findings. Thematic analysis is particularly well-suited for user-centered research as it highlights important themes that emerge directly from the data set, thereby

ensuring that the analysis is grounded in the experiences and perspectives of the participants. By structuring the analysis through the themes found in the data, the study can better capture the complexity and diversity of the participants' experiences, leading to a more comprehensive understanding of the research questions.

5.5. Ethical Considerations and reflections of methodological choices

This study integrates ethical considerations throughout, emphasizing respect, integrity, and confidentiality.

- Informed Consent: Participants receive detailed information about the study's goals, methods, and risks before joining. They give informed consent and can withdraw at any time without consequences.
- Confidentiality: Participant confidentiality is protected with strict measures to secure their identities and information. Data is anonymized and securely stored.
- Privacy Concerns: The sensitive nature of the study necessitates utmost privacy, ensuring participants' stories and data are handled with care.
- Transparency and Openness: The study maintains transparency, allowing open communication and addressing ethical issues swiftly, which builds trust and ensures ethical integrity.

The research prioritizes ethical practices and thorough methodology to generate valuable insights while respecting participant rights. It aims to empower parents and enhance breastfeeding success, contributing positively to family and community well-being.

6. Analysis

The analysis is divided into two parts.

- Part 1 explores common breastfeeding challenges in Social Media communities.
- Part 2 focuses on the UX of MidwifeVR for breastfeeding preparation, drawing insights from tests and interviews with parents.

6.1. Part 1 Analysis: Breastfeeding challenges unveiled by Social Media Communities

In an era where digital communication increasingly permeates our daily lives, social media platforms like Facebook groups open new avenues for research into parenting and breastfeeding. The primary object of *Part 1 Analysis* aims to uncover and understand the prevalent breastfeeding challenges encountered by parents by delving into the rich narratives and discussions unfolding in Facebook groups dedicated to breastfeeding. The analysis will identify recurring themes about breastfeeding challenges to serve as a starting point. The second part will explore expectant and new parents' experience and perception of VR as a medium for breastfeeding preparation and support.

6.1.1. Challenges in Breastfeeding:

6.1.1.1. Specific Practical Breastfeeding Challenges

Through analysis of discussions within a social media group, several key challenges emerged, categorized into themes such as *Proper latch-on technique*, *Pain or sore nipples*, *Milk supply regulation*, *Breastfeeding positions guidance*, and *Sleep management*. Furthermore, insights from an expert interview with a breastfeeding specialist, who draws on her daily interactions with parents at a hospital, reveal three primary challenges: *Sore nipples*, *Delayed milk flow*, and *Mastitis*. Despite the variance in terminology, these themes echo those identified in the social media discussions.

Collectively, these findings underscore the multifaceted nature of breastfeeding, which encompasses practical, emotional, physical, and societal challenges. These issues can significantly impact a mother's ability to breastfeed effectively. These themes are integral to the broader understanding and analysis of the breastfeeding challenges faced by mothers and families. This comprehensive perspective is crucial when approaching the topic from a

postphenomenological standpoint. Although this study identifies multiple relevant issues, it prioritizes the two most prevalent challenges discussed within the specific Facebook group (Ammenet, 2024)

1. Proper Latch-on Technique: This theme is vital as it involves the practical skills necessary to ensure the baby is correctly positioned and securely attached to the breast, which is fundamental for effective and comfortable breastfeeding.
2. Pain: This theme covers the physical discomfort and pain that mothers often encounter during breastfeeding. This can include issues like sore nipples and infections, which pose significant barriers to sustained breastfeeding efforts.

6.1.1.2. Latch-on technique

Many women posted within the theme *Prober Latch-on Technique*; this is exemplified here when one group member shared her challenges and worries:

"How do you come to realize that you probably can't breastfeed? My 8-week-old baby has a poor sucking technique, and I doubt whether it's sustainable to breastfeed. He doesn't open his mouth wide, so he just sucks the nipple in and struggles to create a vacuum, and he also chews instead of sucking. However, he is gaining weight as he should and seems to be thriving, but I'm unsure if he's getting the nutrition he needs. It doesn't hurt me, but he sucks/chews unevenly_..." (Anonymous member, Appendix 1)

Here, 21 women participated by commenting and reacting to the post, sharing experiences, advice, and emotional support. Examples as:

"I think I will try some breastfeeding specialists to see if they can help. And then I would say, if it still doesn't work out and you feel that breastfeeding is consuming everything, preventing you from enjoying your little one, then bottle-feeding is a perfectly fine choice. The hardest part is making that decision and coming to peace with it, ...It will be alright (heart emoji)..."(Appendix 1: Comment from Cathrine XX)

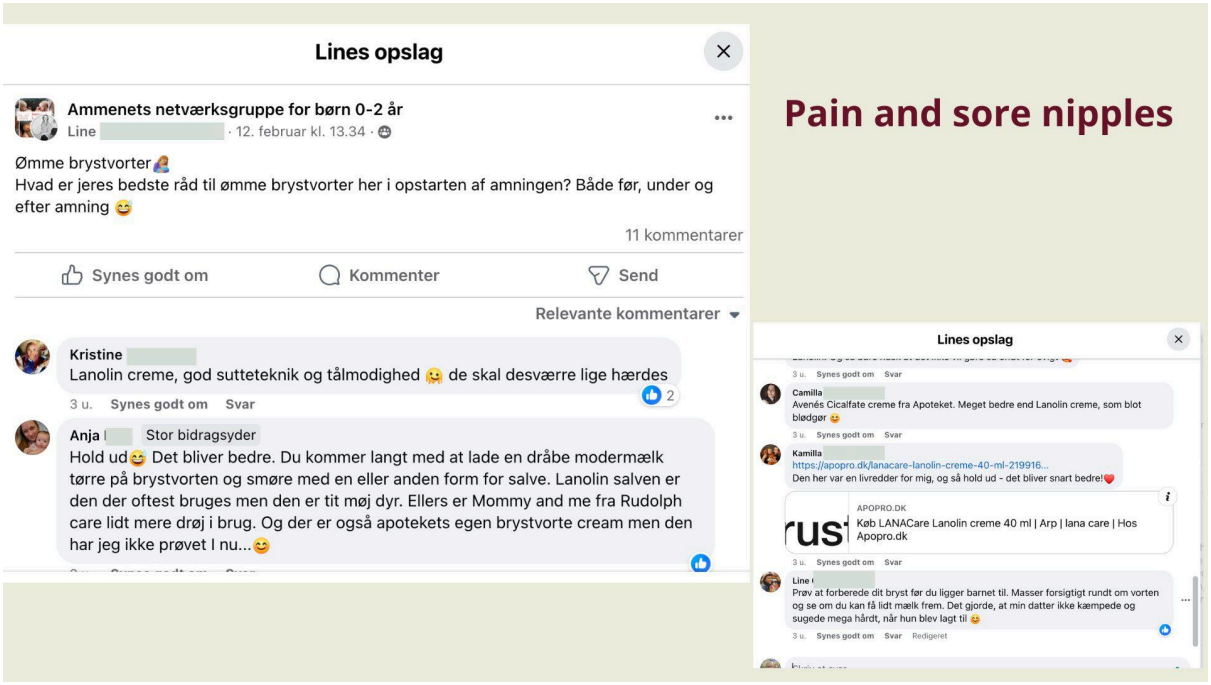
"Breastfeeding can be associated with a lot of emotions and insecurities, so it's no wonder you're doubting yourself... As long as you're monitoring the indicators of well-being (adequate weight gain, wet diapers, bowel movements, good interaction), I think you should take a deep breath, trust your body, and trust your baby. Get a second opinion from your own

doctor and the public health nurse if you need to. Also, get the tongue-tie checked again, it made a big difference for us…" (Comment from Naziye XX).

Additionally, many group members reacted positively with 'likes' and 'hearts,' showing their support and recognizing the common challenge. The empathetic exchange of advice and personal experiences suggests that they have likely faced latch-on issues themselves. This empathy underscores the importance of a supportive environment for breastfeeding mothers, where they can share experiences and seek advice without fear of judgment.

6.1.1.3. Pain during breastfeeding

Pain and sore nipples are one of the most common challenges experienced by mothers, and this was also presented in the data collected. A huge amount of group members shared their experience of discomfort and soreness under breastfeeding, with the aim to seek advice, support, and clarification on what could be considered ‘normal’ in this context. Given the complexity of breastfeeding and its associated challenges, the pain was articulated in various ways, including but not limited to pain, discomfort, soreness, and physical symptoms such as redness, radiation, and nipple damage. A group member, Line (2024, February 12), shared a post: "*Sore nipples. What is your best advice for sore nipples at the beginning of breastfeeding? Both before, during, and after breastfeeding?:)".*



Screenshot 7: Facebook post on Sore nipples

Many group-member commented on the post, giving advice and supportive comments:

"Lanolin cream, good latch technique, and patience :) They just need to toughen up."

"Hang in there :) It will get better. You can go far by letting a drop of breast milk dry on the nipple and smearing it with some sort of salve. Lanolin salve is the one most often used, but it is often very expensive...:)"

"Try to prepare your breast before you lie the baby down. Massage gently around the nipple and see if you can get a little milk out. It made my daughter not fight and suck really hard when she was put to the breast :)."

The responses provided to the post were equally diverse, with users offering a range of suggestions and recommendations to alleviate the pain. These included the use of lanolin cream, applying breast milk as a nipple balm, checking for proper latch technique, ensuring a correct tongue tie, and monitoring for thrush on the breast.

6.1.2. Support and Experience Sharing

Observations within these groups revealed a highly supportive environment where mothers actively sought and offered emotional support and advice. The virtual landscape was rich

with posts from women sharing their personal breastfeeding experiences, contributing to a culture characterized by openness and empathy.

In this supportive environment, individuals freely shared personal stories and effective methods for tackling various breastfeeding difficulties. These interactions often transcend the mere exchange of information, fostering a collaborative effort that significantly contributes to dispelling societal taboos and stigma surrounding breastfeeding.
One member, who chose to remain anonymous, sought assistance and encouragement as she contemplated ending her breastfeeding journey after three months:

"I'm in a situation where, after three months, I'm considering stopping breastfeeding... My son cries and cries during feedings, and he's been checked for any potential issues... I feel like a terrible mother when he screams like that..." (Appendix 1: Anonymous member).

This mother's emotional post reveals her struggle and the impending decision to stop breastfeeding due to her son's distress during feedings. She seeks support and advice from others who may have faced similar challenges or possess valuable insights.
Many women responded with supportive comments, motivation, and advice. For instance, one comment read:

"If he is three months old, a huge appetite emerges that lasts forever. And it lasts for a long time. Hold on! Don't give up. It feels like there isn't any milk, but they keep sucking and sucking to get the production going! It's completely normal! It's a stressful period, but it passes." (Appendix 1: Comment from Naina XX).

From a postphenomenological perspective, this situation exemplifies the concept of *Multistability*, where technology, in this case, social media, can assume multiple meanings and functions based on context. For this mother, the social media group serves as both a source of support and a potential stressor, amplifying her self-doubt. The role of technology is not static; instead, it fluctuates according to her interactions within the group and her emotional state.

Moreover, her experience highlights how technologies like social media can bring issues of visibility and invisibility to the forefront of parenting. While her breastfeeding struggles are exposed within the community, potentially eliciting support, they also expose

her to internal and external judgments about her competence as a mother. This illustrates the double-edged nature of technological engagement in parenting.

A postphenomenological analysis of this mother's experience emphasizes the profound impact that social media can have on the lived experiences of breastfeeding mothers. It not only alters individual perceptions and experiences but also reshapes the collective understanding and discourse around breastfeeding within society, demonstrating how human experiences and technology co-constitute each other in complex and significant ways.

6.1.3. The Mediating Role of Online Communities in Breastfeeding

The analysis of the Facebook community reveals a strong sense of community quality, where mothers can share experiences, seek advice, and provide support to each other, especially in relation to breastfeeding challenges such as pain and proper latching techniques. This human-technology relationship mediates the need for a supportive community among parents, enabling them to share ideas, tips, motivation, and support.

The practical challenges of breastfeeding are mediated through the exchange of knowledge and experiences, allowing mothers to learn from each other, adapt their practices, and navigate the practical aspects of breastfeeding with greater confidence and success: latch-on techniques and pain management were common, with mothers sharing their personal experiences and seeking advice from others in similar situations.

The prevalence of anonymity in the posts is also worth noticing, which highlights the sensitive nature of the topic and the potential for stigma or shame associated with breastfeeding challenges. The online community mediates a space for mothers to share their experiences and seek support without fear of judgment or repercussions. This mediation fosters a sense of community and solidarity among mothers, helping to alleviate the feelings of isolation and shame that can accompany breastfeeding challenges.

Furthermore, the online community mediates a connection between mothers and the broader socio-cultural context. By sharing their experiences and seeking advice, mothers contribute to a collective negotiation of societal norms and expectations around breastfeeding. This mediation can help to challenge and reshape these norms, promoting a more supportive and inclusive environment for breastfeeding mothers outside digital social media groups and within the analog society.

In summary, the online community mediates a complex relationship between human experiences, technology, and the socio-cultural context in the realm of breastfeeding.

Through the sharing of challenges, advice, and emotional support, the community fosters a collective understanding of breastfeeding, facilitates the negotiation of practical and emotional challenges, and contributes to the reshaping of societal norms and expectations around breastfeeding.

6.1.4. Summary

The analysis of social media communities reveals the significant impact they have on addressing common breastfeeding challenges. Through discussions on proper latch-on techniques and managing pain during breastfeeding, these online platforms serve as valuable sources of practical advice and emotional support for mothers. The supportive nature of these communities, characterized by active moderation and a culture of anonymity, creates a safe space for open dialogue and shared experiences. Furthermore, the mediating role of online communities extends beyond individual support to challenging societal norms and fostering a more inclusive environment for breastfeeding. Overall, social media communities emerge as essential platforms that not only help mothers navigate breastfeeding challenges effectively but also contribute to positive socio-cultural changes in breastfeeding perceptions and support.

6.2. Part 2: Analysis of UX of VR Breastfeeding Preparation and Support

Part 2 Analysis aims to uncover the factors that enhance or hinder the UX of VR in breastfeeding guidance. It explores the UX of MidwifeVR through a postphenomenological lens, focusing on individual user perspectives obtained from UX tests and follow-up interviews. The objective is to understand the nuanced interactions between humans and VR technology in the context of breastfeeding preparation and support. By employing a bottom-up, user-centered approach, the analysis identifies and presents key themes derived from the collected data. These themes include: ‘Engagement and Immersion in VR,’ ‘Visual Perspectives,’ ‘Privacy and Autonomy,’ ‘Comparison with Traditional Methods,’ and finally, the analysis will present some suggestions and feedback from the users.

6.2.1. Engagement and Immersion in VR Breastfeeding preparation and support

6.2.1.1. An Embodied Experience of Breastfeeding

The embodiment relation between users and VR technology was found to be particularly significant in the context of breastfeeding education. The fusion of technology and UX was emphasized, as users reported feeling more engaged with the VE *through* the VR headset.

In PP, an embodiment relation can be observed when technology becomes an extension of the body, allowing the user to experience the world *through* it without necessarily being aware of the technology itself (rf. 4.2.2.1). The original version of MidwifeVR 1.0 positioned users as passive observers through a VR headset. Here, one participant expressed it like this:

"It's a balance between not feeling like it's breastfeeding guidance specifically tailored to her ....That you don't end up feeling like this is just something only for those you're observing."
(Appendix 2, UX 8)

Another participant stated:

"Right now, I just see a woman breastfeeding." (Appendix 2, UX 6)

This feedback highlighted users' desire for more active participation in MidwifeVR's simulations, emphasizing the need for an engaging VE that supports direct communication and involvement in breastfeeding preparation. This input was crucial in guiding the redesign of MidwifeVR to its 2.0 version, which features enhanced narrative communication strategies, including the midwife directly addressing the user through the camera, making the experience more interactive and personal. As one user noted,

"So you feel in a way that you're more important, that they're only focusing on you here, so you're very much in focus... In a large classroom, you can hide a bit, whereas here, you're very much in focus. And that's the direct contact."(Appendix 3 UX 13).

The transition of MidwifeVR has significantly enhanced user engagement and immersion, providing an embodied experience where users feel integral to the breastfeeding content. This heightened involvement fosters a sense of direct participation and personal relevance, in contrast to the potential anonymity of a traditional classroom. Inspired by Don Ihde's schematization, the embodiment relation within this thesis research is presented here:

Embodiment relation: **(User - VR glasses) → Virtual Environment**

The VR glasses here become an extension of the user's body, allowing them to experience and perceive the virtual world of breastfeeding through the technology. The user is in an embodiment relation with the VR glasses, which then mediates their experience of the VE, here breastfeeding content.

This presents how VR technology transforms the educational experience, creating a transparent interface that intensifies and personalizes interactions, making users feel deeply connected and central to the learning process. VR technology here profoundly alters the spatial and interpersonal dynamics of learning. The heightened sense of being present within the VR environment significantly bolsters users' perceptual and cognitive engagement with the learning material. VR does more than merely transmit information - it reshapes the user's experiential world. This offers breastfeeding simulations that expand the perspectives of expectant and new parents, equipping them with the essential skills and confidence needed for real-life scenarios.

6.2.1.2. Interaction and Engagement with the Virtual Midwife

The concept of alterity relations, as conceptualized by Don Ihde (1990), refers to interactions with technology where it is perceived as an *other*—a distinct entity that engages users in meaningful ways. The virtual midwife in MidwifeVR simulations acts as a communicator, simulation one-on-one interactions, and mirrors, therefore, an alterity relation.

In VR experiences, users often find themselves profoundly immersed in VEs, blurring the lines between their identities and the technological interface. This immersive quality, even without direct interactive elements, fosters a sense of presence and engagement reminiscent of real-life interpersonal interactions. One participant described the experience as akin to a real-life consultation:

"It felt a bit like being in the presence of a midwife, in reality… I think what was a bit strange was that you didn't know the person you were sitting across from... "(Appendix 3, UX 10).

The participant initially felt the interaction with the virtual midwife was unusual, given the intimacy of the breastfeeding scenario with a stranger. However, she quickly became immersed in the natural and lifelike experience despite not knowing the virtual person she was interacting with. Another participant also emphasized the personalized and focused nature of the interaction:

*"You also feel it somewhat, like when you're at a doctor's office. You feel like you're sitting one-on-one with someone, who's explaining it just to you. Instead of explaining to ten people at the same time" (*Appendix 3, UX 13).

This sentiment is echoed in another statement:

"Yes, and at the same time there's that relationship, which you normally know from, or associate with breastfeeding guidance." (Appendix 3, UX 9)

This immersive and presence-enhancing aspect of VR results in a highly personalized communication experience. This was particularly valued by the participants and enhanced their engagement and involvement in the VE. The concept of alterity is concretized through the virtual midwife in the VE, serving as a distinct entity, an "other," which becomes a central point of interaction influencing the user's subjective experience within the VR application.

The duality of both *embodiment* and *alterity* relations that is observed with the UX and VR technology is also examined in the PP article (Vindenes & Wasson, 2021). They schematized the relations as follows:

Embodiment/Alterity Relations: **(Human-Technology) → Technology (World)**

The user-environment relation: *"a human in an embodiment relation with the technology (i.e. the user) in an alterity relation to the technology (i.e. the environment) while the world is in the background"*(Vindenes & Wasson, 2021). Within the context of this master thesis and the technology MidwifeVR, this is schematized as:

Embodiment/Alterity Relations:
(User-VR-glasses) → Virtual Environment (Breastfeeding)

The users are in an embodiment relation with the VR glasses and in an alterity relation to the VE, where the reality/world of breastfeeding is in the background. This means that the technology not only immerses the users but also interacts with them as a distinct 'other,' and a secondary relation emerges. This alterity relation allows the users to perceive the technology as a separate entity, different from themselves and the VE. Because of the engagement and immersion (ref. 6.2.1.1), to be an embodiment relation, it becomes possible for an alterity relation, with the user's interactions with the virtual midwife, that thereby shapes their perception and understanding of breastfeeding.

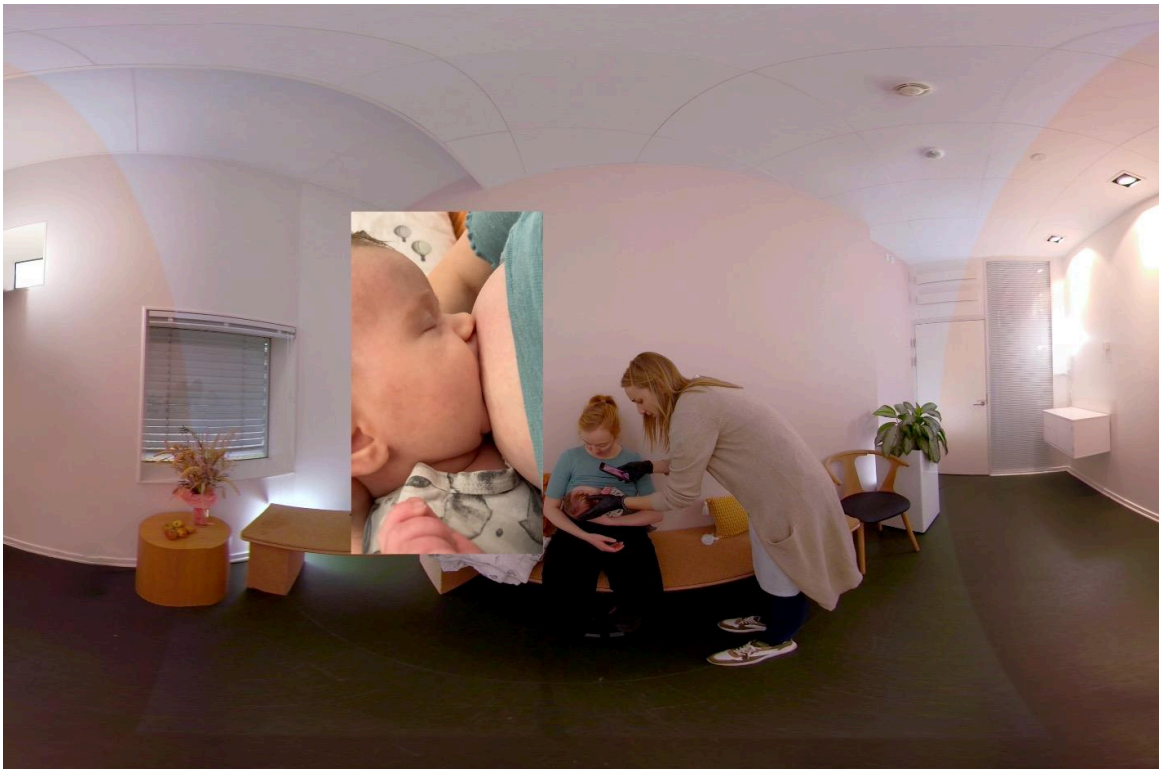
The redesign of MidwifeVR 2.0 illustrates how technology and human experiences mutually shape each other. This demonstrates a key idea - technology is not developed in isolation but is shaped by the people who use it and dynamically continue to shape each other (Kudina, 2019). User feedback played a significant role in influencing changes to the platform, highlighting that technology evolves in response to user needs. This feedback becomes evenmore evidentr through the different human-technology relations as; embodiement- and alterity relations. The platform's evolution, influenced by user feedback, highlights the dynamic interaction between users and technology, where changes are made in response to user needs. This iterative process of feedback and adaptation underscores the mutual influence between users and technology, shaping how individuals perceive concepts like

breastfeeding. MidwifeVR 2.0 serves as a conduit for this interaction, emphasizing the importance of adapting technology to meet educational goals and user preferences, ultimately benefiting both parties.

6.2.2. Visual Perspectives of Breastfeeding

The data collected in this thesis underscores the significant value of visual impact in VR technology. VR technology has been increasingly recognized in the literature as a promising educational tool, offering immersive learning experiences through embodied interactions and a heightened sense of presence (Vats & Joshi, 2023). The redesign of MidwifeVR 2.0 focused on improving user visibility, especially during the baby's latch-on process for breastfeeding, since this is experienced challenging for many mothers (Lindhardt & Sundhed.dk, 2022).

The re-design involved complementing the 360-degree VR recordings with close-up videos that dynamically appear within the virtual room at key moments *(Screenshot 8)*.



Screenshot 8: Close-up screen/Diverse perspectives

This allows expectant and new parents to watch a midwife guide a mother through the process while simultaneously offering close-up visuals of the latch-on technique. This dual

view helps users grasp both the broader context of the breastfeeding position and the specific details of the latch-on method and provides a holistic view of the breastfeeding process. This combination meets diverse learning needs, accommodating users who require a general overview as well as those who benefit from focused, detailed visuals for a deeper understanding. One parent described this duality as:

"One thing is that she shows, but the times when she takes her own phone and films up close. That's quite brilliant… Because it's hard to see what's going on sometimes. But then there were things that made sense " (Appendix 3, UX 11)

This extra visual component contributes to objectifying the act of breastfeeding, breaking it down into a series of steps to be followed, which can be beneficial for learners seeking a more structured approach to learning. The UX further highlights the experiential aspect of the visual impact:

"I felt like I could understand and relate to it... It's nice to see it visually, rather than just reading and all that. Just being guided and seeing... It somehow seems simpler, in a way…Yes, I actually found it quite tangible." (Appendix 3, UX 10)

Another participant describes:

"...When it's something you haven't tried before, it's incredibly hard to learn about it by reading. So you have to see it visually" (Appendix 3, UX 11)

The participant's positive encounter with the dual visual components in VR breastfeeding preparation highlights a significant shift towards immersive and effective learning methods. The visual representations were not only easily understandable but also relatable, underscoring the superiority of visual learning compared to traditional text-based approaches.

The relationship between the users and the immersive 360-degree VR experience and detailed close-up visuals can be understood as a hermeneutic relation. Highlighting how expectant parents interpret and engage with the MidwifeVR technology. Drawing from Don Ihde's concept of hermeneutic relations, this interaction can be represented as:

Users → (VR-system -Breastfeeding)

- Human: The users of MidwifeVR who are expectant and new parents seeking breastfeeding knowledge.
- Technology: The VR system includes an immersive 360-degree environment and close-up visuals.
- World: The realm of breastfeeding concepts and practices.

In this setup, users interact with the VR system to explore and understand breastfeeding. They interpret the information presented through various visual perspectives offered by the immersive VR environment and close-up visuals. This interaction is mediated by the VR system, allowing users to gain insights into breastfeeding from different angles. The presence of a midwife in the VR experience further supports this interpretive process, verbally and visually guiding users through the breastfeeding concepts and practices presented in the virtual world. The understanding and perception of breastfeeding are thus *framed* by the design and content provided by the developer. This hermeneutic relation emphasizes the interpretive nature of user interaction with MidwifeVR, where technology acts as a mediator between the users and the world of breastfeeding, facilitating a more profound understanding through immersive and interactive experiences.

VR uniquely overcomes barriers like privacy and societal norms by offering an intimate and educational view of breastfeeding from multiple angles. This approach enhances understanding of techniques such as the latch-on method. One of the participants mentioned:

"The way she explains as the baby latches on and then continues explaining while making adjustments for proper breastfeeding is really effective for me" (Appendix 3, UX 9).

Another participant described it as:

"I think it was good that it was shown several times, how you could use your hands to press in at the nipple, so the baby could get a better grip with its mouth… Yes, that it was shown visually. That it became clearer ." (Appendix 3, UX 10)

The iterative process of seeing the demonstration multiple times allowed the user to gradually build a more comprehensive understanding of the breastfeeding process, while the visual close-up of the hand-pressing technique provided a more detailed and clear view of the

specific action required for successful latching. The specific inclusion of detailed visuals, especially focusing on the latch-on technique, is not merely a design element but a critical hermeneutic tool. This feature mediates the user's understanding of an essential aspect of breastfeeding, emphasizing the importance of the latch-on technique through technological enhancement.

6.2.3. Privacy and Autonomy

Participants reported a profound sense of privacy and autonomy facilitated by the immersive and insular nature of VR. This mode of learning allowed them to engage with the content on deeply personal terms, undisturbed by the social dynamics often present in traditional educational environments. A participant appreciated the absence of time constraints during a VR session, contrasting it with a structured breastfeeding counseling experience at Rigshospitalet. She felt constrained by time limits during the counseling sessions, which made it challenging to fully grasp breastfeeding techniques that are often best demonstrated. From a midwife's perspective, conveying complex breastfeeding issues without practical demonstration can be difficult, especially when a baby's feeding patterns are unique. The participant valued the VR experience for its ability to allow repeated viewing at one's own pace, unlike the time-restricted consultations at Rigshospitalet:

"Of course, there are these breastfeeding consultants at Rigshospitalet, where you can go in. But there was, I don't know, a bit of a feeling that maybe there was a time constraint. Whereas with that (ref. VR), you could watch it over and over again.....maybe also just the feeling that you don't have to feel rushed. That you have it at home, and you can watch it whenever the baby is sleeping or something." (Appendix 3, UX 9)

The accessibility of VR technology enabled participants to revisit the content at their leisure, allowing for a self-paced educational experience that aligns closely with the individual's temporal and spatial preferences. From a PP perspective, this reveals a transformative relationship between learners and technology that extends beyond mere user-tool interaction, emphasizing how VR technology reshapes the experience of learning about breastfeeding. Here, the technology mediates a valued form of privacy, allowing learning at one's own pace, away from the potential scrutiny of a public setting. This privacy is not just a physical comfort but is also observed in the data collected to have a significant psychological comfort

with sensitive subjects like breastfeeding. Here, one participant described it as an intimate space:

"It is, after all, quite an intimate space, sitting and looking at another breastfeeding woman. This is because, normally, one would turn their back or talk about something else. But you are here forced to look at another woman's breasts in order to understand what is happening, the act of breastfeeding itself. And it might be a bit overwhelming on a large computer screen or mobile device, where you have to sit and watch the same thing with others. But with the VR headset, it becomes a very intimate space, and something very personal" (Appendix 3, UX 9).

The mother perceives breastfeeding as an intensely intimate and private act, a perception that the technology enhances by accentuating the nuanced aspects of breastfeeding. MidwifeVR product here serves as a mediator simulating a breastfeeding scenario from a mother's perspective. This perspective underscores one of the stabilities of the technology, specifically its ability to reinforce the perception of breastfeeding as a private and intimate space.

6.2.2.1. Multistability and MidwifeVR as Educational Medium for Expectant Parents

The concept of multistability, as conceptualized by Don Ihde (2010), is instrumental in understanding the complex roles of technologies like MidwifeVR and highlights that technologies inherently possess structured ambiguities, which allow them to be interpreted and utilized in diverse ways across different contexts. MidwifeVR exemplifies this phenomenon through its diverse intended uses, experiences, and perceptions. The essence of MidwifeVR lies not solely in its designer's initial vision but in its adaptability to different purposes and environments (Ihde, 2010). This adaptability gives rise to a spectrum of possibilities where the same technology can serve multiple functions, resonate differently with individuals, and evolve uniquely within distinct cultural settings. Initially, it was designed to simulate the presence of a midwife for at-home postpartum breastfeeding support, constituting the foundational stability of the technology. However, as the research delved deeper into the varied applications of MidwifeVR through the relations with different users, it became possible to uncover a spectrum of additional utilities that extend far beyond its initial origins. Through UX tests, interviews with various stakeholders, and the iterative processes of the design team, the stabilities of the MidwifeVR continued to evolve.

MidwifeVR's expanded role includes not only postpartum breastfeeding support but also serves as a *Platform for fostering reflections on parenthood*, *An educational tool for midwife students,* and more see Illustration 5.

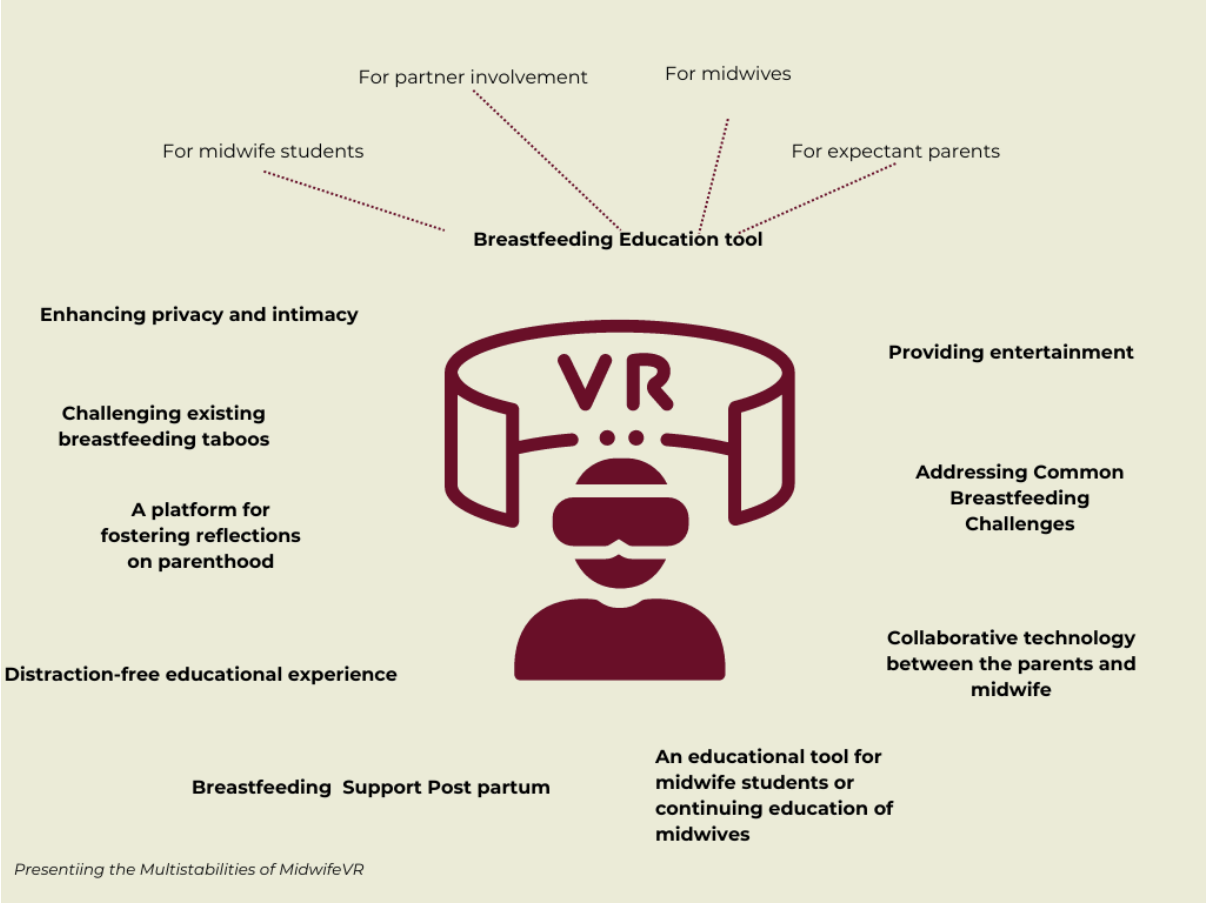


Illustration 5: Multistabilities of MidwifeVR

These expanded functionalities illustrate the concept of multistability, wherein multiple stabilities coexist, each with the potential to be uncovered and further explored by different user groups. Significantly, as Don Ihde articulates, the intentions of technology designers do not necessarily dictate its predominant use (Ihde, 2010, 132). The real-world application of technology such as MidwifeVR evolves through a dynamic interplay between the technology itself and its users. This is further complicated by constraints such as the inability to ask real-time questions, limitations on first-person perspectives, limitations on shared viewing experiences, and the preference for usage in certain physical settings.

By comparing the product with alternative stabilities and contrasting it with the dominant stability – the most prevalent and culturally ingrained usage – a deeper understanding of this technology emerges. This process of comparison reveals nuances that

may otherwise go unnoticed due to the entrenched nature of the technology's common applications (Rosenberger, 2020, 89). The dominant stability observed in the collected data, with the utilization of MidwifeVR, lies in its role as a Breastfeeding Preparation medium for expectant parents. MidwifeVR provides an immersive learning environment that simulates breastfeeding scenarios and offers expectant parents a realistic and nuanced embodied experience of breastfeeding.

In the unfolding narrative of MidwifeVR, Bas de Boer's concept of the *"rich landscape of affordances"*(De Boer, 2021) comes to life, illustrating how the environment actively influences technology use. Rather than a passive backdrop, the environment collaborates with technology to shape its trajectory and significance. The normativity and affordances within MidwifeVR's operating environment are fundamental to understanding the technology's diverse applications and stabilities (De Boer, 2021). The real-world context, shaped by societal norms and expectations about parenting, merges seamlessly with the VE of MidwifeVR. This integration drives the VR's dynamic evolution from a simple at-home postpartum breastfeeding support tool to a comprehensive educational platform for expectant parents, exemplifying the inherent fluidity within the dominant stability of technology. To grasp MidwifeVR's multistabilities, it is crucial to recognize the symbiotic relationship between the technology and its operational environment. The societal landscape, intertwined with norms, cultural practices, and user interactions, dictates the range of roles and stabilities that MidwifeVR can assume. Attitudes towards parenthood, privacy, and intimacy shape user engagement with MidwifeVR, expanding its scope beyond breastfeeding support, and is fueled by broader societal changes, such as the shift to remote educational tools during the pandemic, a paradigm shift in breastfeeding, as well as internal factors like user feedback and technological advancements.

The diverse *stabilities* of MidwifeVR, therefore, are not fixed but are subject to change as users and the environment interact with the technology in various ways, influenced by their evolving needs and preferences. However, there will always be dominant stability, where MidwifeVR has evolved from merely a supplementary tool for at-home postpartum breastfeeding support to a more comprehensive educational resource for expectant parents, illustrating the fluidity of its dominant stability.

6.2.4. Comparison with Traditional Methods

6.2.4.1. Youtube vs VR

Skepticism and preconceptions about the efficacy of VR compared to video platforms were evident among participants and the general public. Here expressed by participants:

“Well, I don't really know what I think in terms of the difference between just video and VR. Because you can easily watch a YouTube video over and over again too." (Appendix 3, UX 12)

"Well, I can't quite decide... whether it's the VR glasses that make the difference compared to just watching videos. I can't quite figure out if it makes any difference... But it does make it a bit more exciting. Because it's not something I've tried before. So, it makes you want to go back in a way. Yes, and at the same time, there's that relationship, which you normally know from or associate with breastfeeding guidance." (Appendix 3, UX 9)

Despite initial doubts, the experience with MidwifeVR altered many users' perceptions. After engaging with the VR content, participants recognized several benefits not available through conventional video formats. These advantages, as detailed in earlier sections of this analysis, were the *immersive* nature of VR, *realistic interaction* with the virtual midwifery and breastfeeding content, a *private* and *intimate learning environment*, enhanced *visual quality,* diverse *visual perspectives,* and enhanced *focus* and *autonomy*. The contrast between initial skepticism and post-UX appreciation of VR underscores the unique value it brings to breastfeeding preparation. The diverse experiences and perceived values of VR as a learning medium underscore the importance of exploring the nuances of human-technology interactions. VR technology has the potential to enhance user engagement and learning outcomes by optimizing educational content about breastfeeding.

6.2.4.2. Realism of Babies and Breast vs. Dolls and Knitted Breast

Many participants revealed their enthusiasm and preference for using real women, babies, and breasts to demonstrate breastfeeding techniques and compared it to methods such as ‘ Dolls and knitted breasts are typically used in conventional classes. One participant described the benefits of this approach:

"I think it's really good, the part about it being a real woman with real breasts and a real child. That it's not an illustration, and that you also see how she handles the child. There are some first-time parents who have never held a real newborn in their arms. So the part about how to actually lay him down in that way, I think is really beneficial." (Appendix 2, UX 3)

"Also because that baby does what you see in reality. If it were an animated baby, one could imagine that it was made to do it perfectly right away. Whereas the woman in the video, she doesn't lift her lip at the beginning, but then they have to go in and adjust it. Yes. So it feels very natural." (Appendix 3, UX 9)

Through user feedback, the VR technology is here observed to *mediate* the UX through realistic breastfeeding scenarios, which users find advantageous for learning about breastfeeding. It does so by providing a simulated environment that can influence and potentially transform the user's perceptions and interactions with the real-world task of breastfeeding. The VR scenarios offer a controlled and repeatable environment, which can be particularly beneficial for learning complex physical tasks like breastfeeding, where the baby's movements and latch-on are variable and can be challenging to manage. In exploring the intersection of VR technology and breastfeeding, it becomes evident that the user's experience is not only mediated by the technology but is also subject to the dynamic evolution of values. This is where Olya Kudina's (a prominent contributor to postphenomenology) concept of *value dynamism* becomes salient (Kudina, 2019, 19). According to Kudina, values are not fixed entities but *"dynamic, open to revision and sensitive to the sociomaterial context"*(Kudina, 2019, 53). The VR breastfeeding scenarios present an intriguing case of this phenomenon. As a user, I find that the VR environment offers a unique space where the challenges of breastfeeding—such as understanding the baby's movements and achieving proper latch-on—are presented in a controlled, repeatable manner. This not only aids in skill acquisition but also subtly influences the values they hold concerning parenthood and caregiving. For instance, repeated practice within the VR space can cultivate patience and empathy, values that are paramount in the real-world task of nurturing an infant. The technology also reinforces the value of competence, such as gaining confidence in handling a newborn—a crucial aspect of self-efficacy in parenting.

6.2.1.2. Focus and distraction-free

The immersive design of VR also mediated an enhanced focus and created a distraction-free environment, which many participants valued. Here, one participant stated it as:

“So, you can't just suddenly start looking at your mobile or something. It might make it more like, now I really have to listen to what is being said" (Appendix 3, UX 13).

Another participant described it as:

"For me, it works extremely well that you are forced to look into some glasses. Because one thing is an auditorium, there I would quickly lose focus. And then I sat thinking about why shouldn't I just get an app or something. But there I would also lose focus because I would be looking at something.. " (Appendix 3, UX 11)

The human-technology relationship is here observed to be a background relationship between the expectant parents and the VR content. The background relation between the parents and the breastfeeding content is mediated by the VR headset features.

Background relation: **Expectant Parents → (VR-Headset/Breastfeeding).**

- Humans (H): The expectant parents are the users who engage with the VR content.
- World (W): The subject matter or content - breastfeeding.
- Technology (T): The VR headset and the MidwifeVR application.

The expectant parents put on the VR headset to learn about breastfeeding, and as they begin the VR experience, the technology is initially noticeable. Gradually, as they become engrossed in the content, the technology fades into the background. The focus of the expectant parents (H) is now almost entirely on the content (W) – the act of breastfeeding. The operational aspects of the VR technology (T) are concretized to the hardware, display, sound, and user interface and evolve to become secondary considerations. The technological features are still crucial as they mediate the experience, but they do not dominate the user’s conscious thought; instead, they support the learning process unobtrusively. The technology (T) recedes into the backdrop of the user’s experience, allowing a seamless and intuitive

interaction with the content (W). This allows the expectant parents (H) to focus on understanding and empathizing with the breastfeeding process without being distracted directly by the technology that enables the experience.

6.2.5. Challenges and Suggestions for Improvements

From the data collected during the UX tests and interviews, several suggestions for improvements emerged.

Support system

Users expressed a need for a support mechanism within the VR preparation platform, highlighting the importance of being able to ask questions and seek personalized guidance. One participant expressed it as

"Because I was thinking, even though I sit here watching this, I am going to have some questions. And she doesn't really answer, does she..?"(Appendix 3, UX 11).

This feedback highlights the complex and individual nature of breastfeeding, emphasizing that a generic approach may not address all users' concerns effectively. It suggests that integrating a feature for users to ask questions and receive customized support could significantly enhance user engagement and provide more targeted assistance. One participant proposed a practical enhancement: a dedicated VR video that addresses common breastfeeding challenges, arguing that *"..Because, then you can say, maybe 80% of my questions is being answered…"*(Appendix 3, UX 11), reducing the need to seek out healthcare institutions for non-critical concerns. However, this participant also recognized that some individuals might still prefer direct interactions with healthcare professionals, indicating that the appeal of VR-based breastfeeding preparation might not be universal. Although this suggested video was not part of the UX test, it is similar and was already recorded and included in the final product, underscoring its perceived value from a user perspective. From a postphenomenological perspective, the lack of a support system within the VE mediates the need for more interactive and personalized solutions to meet the distinct needs of each user. This highlights the fundamentally personal and complex nature of breastfeeding experiences, which often require tailored approaches due to individual

differences, and may be difficult to solve with generic technological solutions compared to face-to-face midwife consultations.

Interactive elements

Suggestions from the participants were made to enhance the design by integrating more *interactive elements* such as drawings, animations, and illustrations. This would help clarify complex concepts and differentiate the VR experience from simply watching a video on platforms like YouTube, where one participant mentioned *"..just go on YouTube and watch a video"(*Appendix 3, UX 14). By leveraging these visual aids effectively, the product could improve user comprehension and engagement, making the learning process more interactive and a better educational experience. Users also recommended the inclusion of text or fact boxes to provide concise summaries of key information. These fact boxes can serve as quick reference points for users, reinforcing important concepts and enhancing the overall learning experience. Here, one participant stated it as:

"...The only thing I was thinking about, and this is obviously about the quality, but that you could use some text alongside it, at the same time, because it can be hard to remember all the things she says, maybe listing them at the end or something." (Appendix 3, UX 14).

From a postphenomenological perspective, the incorporation of interactive elements like animations, graphics, and text in the VR experience plays a crucial role in co-shaping and participatory design. These technological elements within the VE act as mediators that facilitate the understanding of complex concepts, such as learning about breastfeeding. The interactive nature of animations and text boxes not only enhances user engagement but also empowers participants to actively shape their experiences within the virtual space. By allowing users to interact with and manipulate these elements, co-design processes are enriched, enabling a more collaborative and immersive design experience that aligns with the principles of participatory design (Kopeć et al., 2023, 178). This interactive approach fosters a deeper level of engagement and involvement, emphasizing the importance of incorporating such elements to enhance the overall effectiveness and UX in VR environments

6.3 Summary of Part 2 Analysis

Part 2 Analysis highlights the significant potential of immersive technologies, such as MidwifeVR, in enhancing expectant and new parents' preparation for breastfeeding. Key findings emphasize the pivotal role of VR in creating private, distraction-free environments that facilitate focused and engaged learning, a crucial factor in sensitive contexts like breastfeeding preparation. The immersive nature of VR enables the simulation of realistic scenarios, fostering practical skill development and eliciting cognitive and emotional responses that enhance the learning process. The strategic use of visual aids, such as close-up views of breastfeeding techniques, bridges the gap between theoretical knowledge and practical application, providing clear, step-by-step guidance essential for mastering complex tasks.

Enhancing Factors:

- Immersive Technologies: The potential of VR, like MidwifeVR, is to improve breastfeeding preparation.
- Focused Learning Environment: The benefit of private, distraction-free learning settings.
- Realistic Simulations: Practical skill development through realistic scenarios.
- Visual Aids: Effective use of close-up views and step-by-step guidance.

Hindering Factors and Areas for Improvement:

- Interactivity: The a need for more interactive features, such as direct interaction with the virtual environment and support from a virtual midwife, to enrich the learning experience.
- Content Detail: Enhancing animations and detailed text descriptions to improve comprehension and retention.

In conclusion, the UX analysis of VR breastfeeding preparation and support underscores the transformative potential of immersive technologies in revolutionizing the way expectant and new parents acquire knowledge and skills. By creating engaging, focused, and practical learning environments, VR applications like MidwifeVR empower users to navigate the challenges of breastfeeding with confidence and support. Incorporating user feedback and

exploring innovative interactive features will be crucial in optimizing the UX and maximizing the impact of VR in breastfeeding education and support.

7. Reflections on Researcher Role And Design Process

In the realm of academic research, the role of the researcher is pivotal in shaping the methodology, outcomes, and ethical considerations of this master thesis ((Botin & Børsen, 2021, 41). My dual role as a Techno-Anthropologist and Midwife will now be reflected upon.

As a researcher, my involvement in the MidwifeVR re-design process has been a transformative journey, shaping my understanding of the intricacies of academic research and the significance of the researcher's role. This reflective section serves as a critical juncture in my master's thesis, where I will articulate the impact of my evolving and changing role within the design and research phases, drawing from both techno-anthropological competencies and midwife competencies.

My background as a midwife has been an invaluable asset, contributing essential competencies in prenatal and postpartum care. The Danish law for midwives (Cirkulære) and its associated guidelines emphasize the midwife's role in family planning, pregnancy prevention, health promotion, and preparing parents for childbirth and the postpartum period (Indenrigs- Sundhedsministeriet, 2001a, 2001b). Midwives in Denmark are trained to manage normal pregnancies and births autonomously, collaborating with multidisciplinary teams to address complications and ensure holistic care for mothers and newborns.

By integrating my professional background into this research, I have been able to draw on practical experience and knowledge, thereby enhancing the depth and relevance of the study. This integration underscores the importance of midwifery in promoting maternal and child health and highlights the critical role midwives play in the healthcare system.

My role in the design and research phase has evolved significantly, transitioning from an active participant to an observational researcher. Initially, my hands-on approach allowed me to apply ethnographic methods directly, such as participant observation and user interviews. These methods were instrumental in collecting real-time data that informed immediate design changes, enhancing the platform's responsiveness to user needs. My background as a midwife provided a unique perspective that enriched the ethnographic data, ensuring that the insights gathered were deeply rooted in the practical realities of breastfeeding.

However, a significant methodological shift occurred as I transitioned to a more observational role. As a researcher, my focus pivoted towards analyzing the collected data to understand broader patterns and implications. This shift meant that my direct influence on the design process diminished, but it increased my responsibility to interpret and critique the data

more rigorously. This dual focus on participation and observation facilitated a comprehensive understanding of both the immediate and long-term impacts of the design choices made during the initial stages.

Maintaining a balance between participation and observation has critical implications for research integrity and objectivity. As a participant observer, there is a risk of becoming too involved, potentially biasing the observations and outcomes. Conversely, as an observer, one must remain sufficiently engaged to make accurate interpretations without losing the contextual richness provided by being an active participant. This balancing act was crucial in ensuring that the research maintained its rigor while still being practically applicable.

The need to adapt and innovate methodologically was also a significant consequence of my evolving role. During the initial design phase, real-time feedback and rapid iteration were necessary, which required agile and adaptive research methods that could keep pace with the development process. As the project transitioned into a more formal research phase, more structured methods like systematic user testing and controlled observational studies became prominent.

The ethical dimensions of my role also evolved. Initially, as a direct contributor to the design, ethical considerations focused on immediate user impact, such as privacy, consent, and direct feedback handling. As my role shifted toward an observer, ethical considerations expanded to include the interpretation of data, long-term user impact, and broader societal implications. This broader scope required a more nuanced understanding of ethics in research, emphasizing the importance of maintaining ethical standards throughout all phases of the project.

As I reflect on my dual role as both an active participant and researcher in the MidwifeVR project, I recognize how my contributions have significantly influenced the design and research process. This techno-anthropological exploration has highlighted the necessity of flexibility in research methodologies and made clear how the human-technology relationship shapes each other, especially when dealing with the complex intersections of technology, healthcare, and human experience.

My unique blend of techno-anthropological and midwifery expertise has profoundly enriched the research process. It has emphasized the importance of ethical vigilance in designing and implementing technologies aimed at supporting and empowering individuals. This project has revealed that developing effective human-centered technologies, such as the

VR breastfeeding platform, requires a thorough understanding of the relational dynamics between users, technologies, and their contexts.

By actively engaging with these relationships, I have contributed to creating technologies that are not only functional but also empathetic, culturally sensitive, and responsive to user needs. My role has underscored the value of interdisciplinary approaches that integrate diverse perspectives and competencies, fostering a more nuanced understanding of human-technology interactions.

8. Discussion

This discussion will explore the key findings of the thesis and their implications for the integration of VR technology, exemplified by MidwifeVR, into breastfeeding preparation and midwifery practice. The analysis will be divided into three main parts:

1. Discussion of the thesis' key findings, highlighting the potential and limitations of using VR in breastfeeding preparation and support.
2. Examination of the role VR technology can play in redefining the midwife's role, addressing concerns about the impact on traditional caregiving, the ethical considerations, and the potential for VR to enhance midwife competencies.
3. Reflection on the methodological choices made in the thesis, considering their strengths and limitations in exploring the complex interplay between VR, breastfeeding, and midwifery.

The discussion will conclude with a set of recommendations for the effective and ethical integration of VR technology into breastfeeding preparation and support, as well as suggestions for future research directions.

8.1. Discussion of the thesis findings

The analysis of UX with VR and breastfeeding reveals several key themes that contribute to a deeper understanding of human-technology relations in this context. These themes highlight both the potential and limitations of using VR in breastfeeding education and point to areas where the technology can be optimized to create even more effective and meaningful learning experiences for parents.

8.1.1. Challenges of Breastfeeding

As highlighted in Part 1 of the analysis, many women face diverse challenges with breastfeeding. Part 2 of the analysis introduced the perspective that VR simulations offer a unique solution by providing expectant parents with a safe, intimate, and personal space to learn about breastfeeding. VR simulations effectively address practical challenges such as latch-on technique and pain management within this supportive environment. Realistic VR scenarios featuring both close-up and full-perspective views equip expectant parents with invaluable practical insights. These immersive experiences can significantly enhance their

self-confidence and preparedness for real-life breastfeeding. By reducing anxiety and building confidence, VR simulations serve as a powerful tool in helping parents overcome common breastfeeding difficulties.

However, it is crucial to acknowledge that VR cannot fully replicate the complexity and nuances of real-life breastfeeding situations. While VR was presented to simulate scenarios and provide visual and auditory information, it lacked the capacity for empathy, reassurance, and nuanced communication that midwives and breastfeeding counselors can offer. This limitation is particularly pertinent in breastfeeding guidance, where emotional support is as crucial as factual information.

In current public healthcare practices in Denmark, the standard method is found to be in large auditoriums, which can be argued to not give very much possibility for interaction or motivation to personalized questions. The lack of engagement can limit the depth and understanding of breastfeeding techniques among expectant parents. Here, the developments within VR create many possibilities for creating a higher degree of an interactive learning experience that could enhance the prenatal educational landscape.

According to Tang et al. (2022b), as presented in the literature review, traditional antenatal preparation does not fully capture the *lived experience* of breastfeeding, and this is a perspective that many are beginning to acknowledge to have great importance for parents ability and intention to proceed to breastfeed (Tang et al., 2022b). The lived experience of breastfeeding allows for an exploration of the challenges and emotions related to this process. Tang et al. (2022b) also underscore the potential of VR simulation potential, by not only replicating real-world experiences more vividly but also enhancing learner engagement and reflection. VR-based tools like MidwifeVR are pivotal in this regard, allowing for a more personalized and accessible learning experience from the comfort of one's home. This approach can be particularly advantageous in antenatal care, providing a more nuanced and empathetic understanding of breastfeeding. By enabling expectant parents to revisit the content multiple times, VR can help solidify knowledge and confidence in breastfeeding practices.

8.1.2. Support and Experience Sharing

Online communities play a vital role in supporting breastfeeding parents by providing a platform for sharing experiences and knowledge. These virtual spaces foster a supportive environment where mothers can exchange stories, seek advice, and offer emotional support,

empowering them to openly discuss their breastfeeding journeys and combat feelings of isolation.

Combining findings from online breastfeeding communities with MidwifeVR UX testing reveals a growing demand for real-time, personalized support. While social media offers collective advice, MidwifeVR highlights a gap in providing immediate, tailored guidance, suggesting the incorporation of features like real-time Q&A for enhanced UX.

The necessity for personalized features, such as real-time Q&A, underscores the nuanced and individualized nature of breastfeeding, surpassing standardized information delivery as demonstrated by MidwifeVR. Integrating real-time support systems and online communities into the VR platform has the potential to revolutionize parental guidance and support, offering immediate access to tailored advice that can alleviate concerns, boost confidence, and enhance breastfeeding success rates.

While the integration of real-time support and community features into VR holds promise, it also presents challenges. Developers venturing into the VR space for breastfeeding support must carefully navigate issues such as technical feasibility, design complexities, resource allocation for continuous midwife availability, managing real-time communication nuances, ensuring data security, and evaluating the efficacy of visual aids like images or video calls for diagnostic purposes. By addressing these challenges thoughtfully, developers can create a transformative platform that enhances the breastfeeding experience for parents.

8.1.3. Immersive and Visual Learning Environments

A key finding of the thesis analysis is that VR's ability to create distraction-free environments enhances learning outcomes, particularly in the sensitive context of breastfeeding. The immersive learning environments deepen the understanding of breastfeeding techniques and address both the emotional and cognitive aspects of learning. By providing an intimate learning sphere and utilizing visual aids, VR effectively bridges the gap between theory and practice. This clear visual representation of a realistic breastfeeding experience is essential for mastering the often complex task of breastfeeding.

However, it is important to consider the deeper ethical implications of technological mediation, where human-technology interactions shape each other. MidwifeVR is not a neutral tool; it actively influences users' experiences by emphasizing values like responsiveness to the infant’s needs, breastfeeding techniques, and bonding during feeding while potentially downplaying bottle-feeding and maternal well-being. This dynamic

interplay of values, influenced by VR content, forms the core of value dynamism. Users are not merely utilizing VR; they are engaging in a process that shapes their perceptions and behaviors as parents. While VR can enhance understanding of breastfeeding techniques, it may also impact parental autonomy in decision-making. Parents should reflect on how VR education might affect their ability to make informed choices based on personal values rather than being overly influenced by technology. Designers must also consider the ethical implications of how their designs frame and mediate the concept of breastfeeding.

The current third-person perspective of the design has surprised participants, who expected a first-person view. From a PP standpoint, a first-person perspective could enhance the user's embodied experience, potentially augmented by tangible elements like a baby-like probe (Tang, Gerling, and Geurts, 2021).

Screenshot 9: VR headset and baby-like probe

However, this poses technical challenges, such as recording the experience without disrupting the intimate setting of breastfeeding at home. Additionally, a first-person perspective raises ethical concerns about inclusivity. If the virtual scenario does not accurately reflect the user's physical appearance, including ethnicity, breast size, and body type, it may cause disconnection or discomfort. Ensuring that the virtual representation is diverse and customizable to reflect the user's identity could help address these concerns. Technological

developments, such as XR, may help meet these challenges by providing more immersive and customizable experiences.

However, the impact and value of VR can differ significantly based on individual experiences and perceptions of both breastfeeding and VR technology, highlighting the complex interplay between users and technology in educational settings about breastfeeding.

8.1.4. Ethical Considerations

The integration of VR technology into breastfeeding preparation presents a unique opportunity to enhance learning experiences for expectant and new parents. However, it also raises significant ethical considerations that need to be carefully addressed.

The immersive nature of VR can profoundly mediate the parenting experience by providing realistic simulations of breastfeeding, thereby preparing parents more effectively. However, there is a delicate balance to maintain, as over-reliance on VR could potentially undermine the authenticity of the parenting experience. Parents might find themselves guided more by the simulated scenarios than by their instincts or traditional advice from family and healthcare professionals. This mediation by technology could risk diminishing personal autonomy in decision-making about breastfeeding practices.

Engaging with VR for breastfeeding education means that parents are allowing technology to shape their understanding and approach to this intimate aspect of parenting. This raises important ethical questions about the extent to which technology should influence such personal experiences. The influence of VR on these deeply personal aspects must be carefully considered from diverse perspectives to ensure that the benefits of technology do not come at the cost of authentic and meaningful parenting experiences.

The question of autonomy is central to the ethical discussion around VR in breastfeeding education. While VR offers a controlled environment in which to learn, which is undeniably beneficial, it also positions the technology as a mediator between the parent and their experience. This could inadvertently lead to a form of dependency where decisions are heavily influenced by the technology rather than being informed by it. Therefore, VR designers and healthcare providers must ensure that the technology is used as a supplement to, rather than a replacement for, human interaction and traditional learning methods.

The use of VR technology inevitably involves the collection and analysis of user data to enhance and personalize the learning experience. Ethical deployment of VR must ensure stringent measures for data privacy and security. Users should be fully informed about what data is being collected, how it is being used, and who has access to it. Obtaining explicit consent for these data practices is crucial, especially in sensitive areas like breastfeeding, where personal and potentially vulnerable information is involved.

Access to VR technology is another significant ethical concern. There is a risk that the benefits of VR in breastfeeding education might be available only to those who can afford the latest technology, thereby exacerbating existing inequalities in healthcare access. Efforts must be made to ensure that these educational tools are accessible to a wide range of socioeconomic groups to prevent the creation of a "digital divide" in prenatal care.

Designers and developers of VR applications hold a substantial ethical responsibility. They must ensure that their products respect and embody the values and beliefs of the users. This includes designing experiences that are not only informative but also empathetic to the stresses and challenges of new parenting. Technology should aim to empower parents rather than make them feel inadequate without it.

The use of VR as a tool for breastfeeding education offers significant benefits, including enhanced learning experiences and the potential for decreased anxiety among new parents. However, the ethical implications of its application are profound and complex. As VR technology continues to evolve, continuous ethical scrutiny is required to ensure that it serves as a beneficial tool in parenting education, enhancing rather than replacing the human elements of care, empathy, and personal decision-making. Balancing these factors is essential for the ethical integration of VR into sensitive areas of healthcare, like breastfeeding education.

8.2. Discussion and Reflection on the Impact of MidwifeVR on the Midwife Role

The integration of technologies such as MidwifeVR in midwifery, particularly in breastfeeding preparation, presents a compelling opportunity to enhance the quality of care.

However, it also raises important questions about the potential impact on the traditional roles of midwives. A primary concern is that VR technology might overshadow the crucial personal interactions that define midwifery care, which rely heavily on empathetic communication, personalized support, and trust-building.

8.2.1. Role of the Midwife

In our evolving society, the role of the midwife remains a cornerstone of maternal and newborn care. However, we must ask ourselves: Are we truly valuing the expertise and contributions of midwives, or are they underappreciated in the broader healthcare landscape? As technology progresses, a provocative question arises: Could VR potentially supplant the midwife's role in breastfeeding education and support? What are we willing to compromise in the name of technological advancement? Moreover, what are the ethical implications and practical challenges of integrating VR technologies, like MidwifeVR, into midwifery practice? Can these digital tools genuinely enhance midwife competencies, or do they risk undermining the human touch that is so integral to the profession? How will this technological shift redefine the scope of midwives' responsibilities and their essential role in maternal care?

MidwifeVR technology was initially designed to address the challenges posed by the pandemic, which limited midwives' ability to provide in-person support to new parents during the crucial early stages of parenthood, particularly concerning breastfeeding challenges. Originally intended to replace some of the midwives' roles and caregiving tasks, MidwifeVR has since evolved. This evolution has led to its current dominant function as a supplementary tool for breastfeeding preparation for expectant parents.

VR offers practical learning experiences that simulate real-world scenarios, giving mothers a better understanding of breastfeeding techniques. Despite the benefits of VR, the role of midwives remains indispensable, especially when dealing with complex issues that require emotional support and personalized, in-person consultation. This is particularly critical during the postpartum period when breastfeeding is initiated, and individual challenges arise. Midwives provide the nuanced, empathetic care that technology cannot replicate, ensuring comprehensive support for new mothers.

8.2.2. Potential Threats and Ethical Considerations

Despite the numerous benefits of developing VR as a breastfeeding counselor or educator, as mentioned in the thesis analysis, there are potential threats and ethical considerations to address. One significant concern is that some midwives may perceive this technology as encroaching on their traditional roles, potentially diminishing the value of face-to-face interactions that are central to their practice. The intimate and personal nature of breastfeeding support, which often involves a human touch, may be challenging for technology to fully replicate, leading to fears that the essence of caregiving could be lost.

From my perspective, VR technology could profoundly shape the midwife's role by expanding their competencies into digital realms. Midwives could become proficient in using VR as an educational tool, thereby enhancing their ability to provide personalized support in a modern, tech-savvy manner. This technological integration could also elevate the midwife's scope of practice, allowing them to offer innovative services that distinguish their practice. Public healthcare institutions could benefit significantly from VR technology by improving the efficiency and reach of breastfeeding preparation programs. By incorporating VR, these institutions can offer consistent and accessible preparation to a broader audience, potentially reducing the workload on midwives while maintaining high-quality care.

8.2.3. Inclusive Approach in Midwifery

The midwifery profession is currently engaged in debates concerning the nature of normal birth and the scope of midwifery practice. An article in the Midwifery Association's Membership magazine in May 2024 highlighted that while midwives pride themselves on a holistic, woman-centered approach, there is a risk of catering only to a subset of women rather than embracing the full spectrum of women's experiences (Schrøder & De Wolff, 2024). This underscores the necessity for more inclusive discussions within the profession that represent all perspectives. Schrøder & De Wolff (2024) reference Wackerhausen's (2009) work, *"Collaboration, Professional Identity, and Reflection Across Boundaries,"* which argues that symbolic capital within the profession can dictate which values and voices are acknowledged, potentially sidelining those who deviate from dominant norms. Schrøder & De Wolff (2024) discuss the debate among midwives who advocate for women resisting the medicalized model of childbirth but fail to support those opting for medical interventions, such as inductions or cesarean sections.

This discourse and symbolic capital within the midwife profession provide valuable context for the discussion around integrating VR technology into breastfeeding education. Based on the debate and comments received during the research and design phase of the MidwifeVR project, it is clear that normative views and expectations within the midwifery field have the potential to overshadow or limit the individual choices and preferences of mothers when it comes to breastfeeding practices and education.

An inclusive approach ensures midwives respect each woman's autonomy and choices, better supporting the diverse needs and preferences of all women. Midwives must feel comfortable in established practices while also being able to question and reflect on these practices. Achieving this balance is challenging due to intra-professional barriers and obstacles to interprofessional collaboration. These barriers are deeply rooted in the ways professional identity is tacitly acquired and embodied in everyday practice. Reflection, especially second-order reflection, can help overcome these obstacles, enhancing professional adaptability and competence (Wackerhaus, 2009).

8.2.4 Enhancing Midwife Competencies

The introduction of technologies like MidwifeVR in maternal care has the potential to significantly impact the roles and competencies of midwives. This includes enhancing the education of midwifery students, providing ongoing professional training for practicing midwives and shaping the broader understanding of technology's role in both parental and midwifery care. Additionally, expert interviews conducted for this thesis revealed reflections on the use of VR as a supplementary tool for midwives in public healthcare settings.

By providing immersive and interactive training programs, VR can improve the education of midwifery students and support the ongoing professional development of midwives and nurses in breastfeeding care. This was tested with MidwifeVR, which was found to be a valuable learning tool for midwifery students, based on the student's feedback (see 5.2. *Illustration 3* of Research Design). This innovative approach to training ensures that midwives are better equipped with the knowledge and skills necessary to provide high-quality care. It encourages reflection on the midwife's competencies and practices, helping them stay current with the latest health recommendations. By educating midwives in a more streamlined and engaging way, VR technologies such as MidwifeVR have the opportunity to benefit both expectant parents directly and indirectly.

Technologies such as MidwifeVR could be argued not to threaten the midwife role but enhance their repertoire by enabling them to offer a more comprehensive and varied education experience, where VR can serve as a co-learning and collaborative tool between midwives and expectant- and new parents.

Moreover, this technology can lead to better outcomes for mothers and infants by standardizing breastfeeding education, thereby reducing misunderstandings and inconsistent advice from individual healthcare workers—a common critique from parents (Nilsson & Busck-Rasmussen, 2023, 17-18). This also aligns with the midwife's authorization and the midwife's oath of continually adapting to the newest knowledge and recommendations.

This also sheds light on the issue of social inequality in breastfeeding. An expert interview with the Chief Consultant of the Competence Center for Breastfeeding highlighted significant social disparities in breastfeeding success and duration. The project "Breastfeeding – A Good Start Together"(Ammeassistenten, 2024) aims to address these inequalities by improving breastfeeding guidance across Denmark. Key insights from the interview emphasized the importance of varied learning methods to cater to different learning preferences, such as visual learning, auditory learning, and interactive learning. These findings align with the research presented in this thesis, underscoring the value and advantages that VR technology can offer in the breastfeeding preparation and support process for parents. By employing visual, auditory, and interactive methods, VR not only enhances the education of midwives, students, and expectant parents but also addresses broader societal challenges of social inequality in breastfeeding and preparation. Digital platforms such as what is tested in the project “Breastfeeding - Good Start Together” and MidwifeVR can be argued to be a collaborative partner of the midwife, with the aim of bridging the gap between traditional practices and modern needs, more user-centered learning methods, fostering a more inclusive, adaptive and supportive environment.

From my perspective as a midwife, technological advancements like MidwifeVR can indeed complement existing healthcare services during pregnancy and maternity care. I am not concerned about being replaced by technology, as the individual nuances and complexities of pregnancy, childbirth, breastfeeding, and parenting necessitate the traditional competencies of midwifery. While VR can simulate realistic scenarios, it cannot replicate the emotional depth and complexities of face-to-face counseling between midwives and parents.
By collaborating with technology and leveraging the strengths of both midwifery and VR, we can enhance the midwife's role. This partnership can provide expectant and new parents with

more interactive, user-centered, and flexible education, better preparing them for parenthood. Furthermore, it equips midwives with better resources to deliver high-quality care, supporting pregnant women, women in labor, and parents through various stages. My professional experience reinforces the irreplaceable value of traditional midwifery care while also acknowledging the potential benefits of integrating VR technology as a supplementary tool.

In Denmark, the standard care for breastfeeding education begins during midwife consultations around the 28th week of pregnancy. This initial support is vital, but it is often brief and varies in depth due to time constraints and resource limitations. Post-birth, if the mother and baby are hospitalized, midwives and nurses provide the first layer of breastfeeding support. However, the majority of ongoing support is typically delivered by health visitors once the family is discharged from the hospital (Rossau et al., 2023).

One of the key challenges faced by women is the inconsistency in breastfeeding advice and support across different sectors of the healthcare system. This inconsistency can lead to confusion and frustration for new mothers, who might receive conflicting information from different healthcare providers (Rossau et al., 2023). Moreover, recent cutbacks in the maternity sector have further strained these services, reducing the quality and availability of breastfeeding education and support resources. These reductions impact the ability of midwives and other healthcare professionals to provide comprehensive and continuous support to expectant and new parents.

In this context, VR technology could offer a standardized, consistent, and immersive educational tool that enhances the breastfeeding education and support process. VR can simulate real-life scenarios and provide interactive, engaging content that reinforces learning and retention. It can be particularly beneficial in bridging the gap between initial midwife consultations and ongoing postnatal support by offering continuous, accessible education and practice opportunities. Integrating VR does not aim to replace the crucial face-to-face interactions between midwives and parents. Instead, it complements these interactions by providing additional resources that parents can access at their convenience. This approach can help mitigate the impact of cutbacks by offering a consistent level of quality education and support, regardless of the variability in personal interactions.

8.3. Methodological Discussion and Reflection

8.3.1. Comprehensive Understanding of User Experiences

The effort to comprehensively understand UX involved a strategic methodological approach that merits reflection. Initially, the UX tests (Phase 1) utilized the 'Thinking-out-loud' method, which proved its challenges, and transitioned to participant observation paired with follow-up interviews in Phase 2. This shift was intended to enhance immersion and reduce disruptions, aiming to create a home-like environment for parents using the VR product.

Encouraging participants to immerse themselves individually in the VR scenario aimed to simulate real-world use and a disturbance-free environment for more authentic insights. However, this approach presented challenges, including the potential influence of participants' awareness of the researcher's involvement in the VR product's design, as well as observations, which could have biased their feedback. Despite this, some critical perspectives were still offered, indicating a degree of comfort among participants in expressing genuine opinions.

8.3.2. Impact and Significance of VR Experience Selection

The study focused on a subset of four VR experiences related to breastfeeding positions, excluding other themes like 'Pain and Challenges,' 'Partner Involvement,' and 'Calm/Breathing' due to time constraints. This limitation restricted the thematic variety of experiences examined and potentially biased the insights toward specific interactions. While this focused approach aligned with the research objectives, it also limited the breadth of the findings. The full product may have provided a richer understanding of user interactions. Future studies could explore VR use in more naturalistic settings, allowing parents to use VR at home over time, coupled with technological observations like eye-tracking, to yield deeper insights into the real-world application of VR technologies.

8.3.3. Strengths and Limitations of research process

The study faced several limitations, including

- Unstructured user tests and interviews with specialized midwives were not recorded or systematically analyzed, limiting the use of expert feedback.
- The solo researcher framework may have introduced biases and limited analytical perspectives.

- The thesis findings might have benefited from allowing participants to use the VR headset at home, where they could experience it in a more natural and comfortable setting. This approach would likely yield insights that are more representative of the end-user's experience.

Furthermore, increasing the number of participants would enhance the diversity of users, thereby improving the applicability of the results across different demographics.

8.4. Recommendations

- Balancing VR and In-Person Support: Use VR tools as a supplement to traditional methods and face-to-face consultations for comprehensive breastfeeding guidance.
- Empathetic and Empowering Design: Create VR experiences that empower parents and avoid making them feel inadequate without the technology or their choice of breastfeeding.
- Enhancing Interactivity and Content: Integrate real-time Q&A features in VR for immediate, personalized support.
- Participatory Design: Continue to test VR applications with diverse groups of breastfeeding mothers and partners to gather feedback and improve the design.
- Ethical Considerations: Clearly inform users about data collection usage and obtain explicit consent. Implement strict data privacy and security measures and ensure VR technology for breastfeeding education is accessible across different socioeconomic groups.

8.4.2. Future Research Possibilities

Longitudinal and Comparative Studies

- Longitudinal Impact: Assess the long-term effects of VR breastfeeding education on parenting, bonding, and outcomes.
- A/B Testing: Compare the effectiveness, engagement, and satisfaction of VR versus traditional methods.
- Immersion Levels: Evaluate the impact of different VR immersion levels on autonomy and decision-making.

Participant Diversity and Ethics

- Diverse Inclusion: Broaden participant range to enhance applicability to wider populations.
- Ethical Perspectives: Explore parents' views on the ethical implications of VR in intimate parenting aspects.
- Ethical Frameworks: Develop ethical guidelines for VR in parenting education with expert collaboration

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Diverse VR approaches

- First-Person VR: Investigate first-person perspectives for more immersive learning.
- XR: Explore XR for adjustable immersion levels, allowing parental monitoring.
- Multi-User VR: Research value of joint use of VR.

8.5. Summary of Discussion

The thesis discussion highlights the integration of VR technology, through MidwifeVR, into breastfeeding preparation and midwifery practice, focusing on its potential benefits, limitations, and ethical considerations. The key findings reveal that while VR provides immersive and practical simulations that enhance parents' confidence and preparedness for breastfeeding, it cannot fully replicate the emotional support and nuanced communication offered by midwives. The use of VR in breastfeeding preparation aims to create immersive and visual learning environments that bridge the gap between theory and practice, offering distraction-free and intimate settings for mastering breastfeeding techniques. However, as VR continues to advance, it is crucial to proactively address the ethical considerations around its use in the field of breastfeeding through thoughtful recommendations and targeted future research. This indicates that VR should serve as a supplementary tool rather than a replacement for traditional face-to-face interactions.

Ethical considerations are paramount, as VR's immersive nature can shape parenting experiences, potentially leading to over-reliance on technology and reduced personal autonomy in decision-making. Ensuring data privacy, security, and equitable access to VR technology is essential to prevent exacerbating healthcare inequalities.

The discussion also addresses the potential of VR to redefine the midwife's role. While VR can enhance midwife competencies by offering practical learning experiences, the personalized and empathetic care provided by midwives remains crucial. MidwifeVR's role has evolved from a pandemic-related necessity to a valuable supplementary tool in breastfeeding education.

Methodologically, the shift from 'Thinking out loud' to participant observation aimed to enhance immersion and authenticity, though it presented challenges such as potential bias. The focused approach on specific VR experiences limited the breadth of findings, suggesting future studies should explore a wider range of themes and naturalistic use of VR.

Future research should assess the long-term effects of VR breastfeeding education, compare VR with traditional methods, and explore diverse VR approaches to enhance parental support and midwife training.

In conclusion, integrating VR technology like MidwifeVR into breastfeeding preparation and midwifery practice offers significant promise. It can improve parental support while maintaining the irreplaceable value of human care provided by midwives, ensuring a balanced and ethical approach to modern healthcare.

9. Conclusion

From a post-phenomenological perspective, this master's thesis offers a unique exploration of the dual challenges of breastfeeding and the innovative application of VR, specifically through MidwifeVR. It not only identifies significant gaps in current support systems but also proposes technological solutions to address these deficiencies. The thesis underscores the complexity of breastfeeding, which, despite its natural essence, poses substantial challenges for new mothers, exacerbated by inadequate support systems and societal pressures. The situation in Denmark, with high breastfeeding initiation rates followed by a rapid decline within six months, underscores the pressing need for improved support, particularly for marginalized groups with limited resources.

The exploration of social media communities reveals their vital role in addressing common breastfeeding challenges. Mothers frequently share experiences regarding latch-on techniques and pain management, finding practical advice and emotional support through these platforms. These discussions create a safe space for open dialogue and shared experiences, helping mothers navigate breastfeeding challenges more effectively and fostering a more inclusive environment.

The UX of MidwifeVR factors such as focused and private learning environments, realistic simulations, and close-up visual aids were highly valued by the expectant and new parents. However, the analysis highlights the need for more interactive features, including the opportunity for real-time Q/A and support from a midwife, to enhance the learning experience and improve content details such as text descriptions and animations.

The integration of VR into breastfeeding preparation also has profound implications for the role of midwives. While VR, through applications like MidwifeVR, can enhance midwife competencies and offer standardized education, it is crucial to recognize that it cannot fully replace the empathetic and personalized support that midwives provide, especially postpartum. Instead, VR should be seen as a collaborative partner, expanding the scope of midwifery practice and enabling midwives to offer innovative services that improve personalized support in a modern, tech-savvy manner, thereby enhancing the overall breastfeeding experience for new mothers.

VR emerges as a promising tool to bridge gaps in breastfeeding preparation, offering immersive and interactive experiences that provide practical learning opportunities and emotional engagement essential for successful breastfeeding practices. Applications like MidwifeVR enable expectant and new parents to access focused learning environments that facilitate skill development and effectively translate theoretical knowledge into practical application.

In conclusion, the post-phenomenological framework reveals the profound potential of VR in transforming breastfeeding education and support systems. By integrating VR as a co-constitutive element of the lived experience, expectant and new parents gain access to embodied learning opportunities, emotional engagement, and inclusive support networks. This technological advancement allows midwifery practice to evolve, incorporating innovative solutions while upholding the core values of personalized care and empathy. The contributions from a techno-anthropologist are invaluable in this context, as they offer critical insights into the human-technology relationship, ensuring that VR applications are culturally sensitive, ethically sound, and effectively meet the needs of diverse user groups. Navigating this transformative landscape requires a steadfast commitment to ethical considerations and responsible innovation, ensuring that VR technology fully empowers and informs the parenting journey.

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