Choose-Your-Own-Adventure (CYOA): An empathy digital training tool for healthcare workers in maternity settings

Dissertation prepared in fulfilment of the requirements for the degree of

Master of Science (MSc)

In the Department of Computer Science

University of Cape Town

By

Sharifa Negesa

Supervised by A/Prof. Melissa Densmore

December 2023

PLAGIARISM DECLARATION

1. I know that plagiarism is wrong. Plagiarism is to use another's work and pretend that it is my own.

2. I have used the American Psychological Association (APA) referencing guide for citation and referencing. Each contribution to and quotations in this thesis from the work(s) of other people has been contributed, has been cited, and referenced.

3. This essay/report/project is my own work.

4. I have not allowed and will not allow anyone to copy my work with the intention of passing it off as his or her own work.

5. I acknowledge that copying someone else's assignment or essay, or part of it, is wrong, and declare that this is my own work.

Signed: Signed by Candidate

Sharifa Negesa
NGSSHA002

USE OF RELATED PUBLICATIONS OF OWN WORK

As the author of this thesis, I would like to declare that I have referenced and included in the reference section of my thesis the publication titled "Self-directed digital learning for maternity health workers A Choose-Your-Own-Adventure application for empathic care," which was originally presented as a demo submission at Compass'23 Proceedings of the 6th ACM SIGCAS/SIGCHI Conference on Computing and Sustainable Societies held in Cape Town, South Africa in 2023. The publication, authored by Sharifa Negesa and Melissa Densmore, can be found at the following link: https://dl.acm.org/doi/10.1145/3588001.3609375.

I would like to further declare that I used ChatGPT to support background research and editing of the dissertation. For example, in some cases I used ChatGPT to suggest possible edits to overly wordy sections, or to check grammar. I further declare that all original ideas, arguments, and conclusions presented in my thesis are my own, and any contributions from ChatGPT have been used responsibly and ethically in the spirit of academic integrity.

I have diligently cited all external sources and adhered to the ethical standards and guidelines set by my academic institution.

ABSTRACT

The study aimed to explore the potential of adapting the Secret History (SH) workshop method to an independent digital learning tool using the Choose-Your-Own-Adventure (CYOA) framework to enhance empathy skills and support continuous healthcare worker education among healthcare workers in maternity settings. In the context of SH training, healthcare professionals are encouraged to participate in roleplay activities while simulating scenarios involving patients, observing their own reactions and responses in each role. This enables them to gain insights into both the patients' backgrounds and the assumed roles of healthcare workers. While this training has enhanced the empathic abilities of healthcare workers, there are challenges in expanding the reach of this intervention.

The implementation of the SH workshop presents cost implications in terms of the logistics required to implement in-person workshops. This study makes a meaningful contribution to the field of healthcare training and has important implications for the development and implementation of digital storytelling technologies in healthcare. The research provides a valuable resource for healthcare workers looking to improve their empathy skills in the healthcare industry, particularly in maternity settings. The CYOA tool developed in this study consists of a mobile application that presents users with a series of interactive narratives that simulate real-life scenarios in maternity settings. Our mobile application (SHiMA) has the potential to either enhance or introduce SH concepts on a larger scale for healthcare workers.

The study employed a mixed-methods approach, incorporating two interviews, four co-design workshops, and two focus group discussions. The participants included expert informants associated with the Perinatal Mental Health Project (PMHP), Bhabhisana Baby Project (BBP), and midwives from Al-Nisa Maternity Home. The narratives have been collaboratively developed with this group of participants utilizing a CYOA framework to gradually reveal the characters' stories similar to the original SH workshop method. The data collected from these methods was analysed using thematic analysis to identify recurring themes and patterns on the adaptation of the SH workshop method to a digital training tool. The study identified key design considerations for the development of the CYOA tool, including the need for engaging and interactive narratives, the significance of customizing the tool to meet the distinct requirements of healthcare workers, and the need for ongoing evaluation and feedback.

ACKNOWLEDGEMENT

First, I would like to express my gratitude to the Almighty Allah for granting me the strength and perseverance to complete this study. Without His blessings, this achievement would not have been possible. I extend my sincere gratitude to the Mastercard Foundation Scholars Program at the University of Cape Town for the generous scholarship, enabling me to pursue and complete my Master of Science degree in Computer Science. Their unwavering support has been a pivotal force in realising my academic and professional aspirations.

My heartfelt thanks go to Assoc. Prof. Melissa Densmore, my supervisor, for her guidance, mentorship, support, and encouragement throughout the entire research process. Her expertise and insights have played a crucial role in shaping the content and direction of this thesis. I am especially thankful for the career guidance she provided, affording me opportunities such as travel and conference presentations, which have enriched my academic experience and broadened my perspectives. Assoc. Prof. Densmore's commitment to my professional development has been invaluable, significantly contributing to the depth and breadth of this research.

I would also like to express my gratitude to Prof. Simone Honikman of the Perinatal Mental Health Project (PMHP) for her invaluable support and collaboration throughout this research. Her commitment to enhancing maternal mental health outcomes is truly commendable, and I appreciate her for generously sharing her expertise and insights with me.

To my family, especially my mother -Asina Muduwa, my husband – Nassifu Ssemwanga, my brothers - Abdallah Hassan, Ryan Edirisa, and Hassan Nasaba, I am deeply grateful for their unwavering support and encouragement. My colleagues at Global Give Back Circle especially Asmahan Pogal, am grateful. Their love has been a constant inspiration, fuelling my determination to complete this research project. I want to express my appreciation to my friends Jaydon Farao, Toshka Coleman, Ndinaleo Itumba, Leina Meoli, Farzana Toma, and Khaya Sambo, in the Computer Science department for their steadfast support and encouragement during this challenging journey. Their friendship has been a source of motivation and strength.

Special thanks are extended to the expert informants from the Perinatal Mental Health Project and Bhabhisana Baby Project, as well as the midwives at the Al-Nisa Maternity Home, for their invaluable contributions. Their participation in co-design workshops and focus group discussions significantly influenced the development of the CYOA tool, making it a more robust and impactful resource. Collaborating with healthcare professionals has been a privilege, and I appreciate their dedication and insights that have not only shaped this dissertation but have also contributed to the development of the CYOA tool.

To everyone who played a role, whether large or small, in this research project, thank you. Your collective support, encouragement, and contributions have been instrumental in bringing this thesis to fruition. This work stands as a testament to the collaborative efforts of many, and it is my hope that it contributes meaningfully to the field of healthcare by supporting the healthcare workers in developing empathy skills.

DEDICATION

I dedicate this dissertation to all the healthcare workers who work tirelessly to improve the lives of their patients. Your dedication and commitment to your profession are truly inspiring, and I hope that this CYOA tool will help you to enhance your empathy and communication skills.

I would also like to express my gratitude to the Perinatal Mental Health Project (PMHP) for their invaluable support and collaboration throughout this research. Your dedication to improving maternal mental health outcomes is truly inspiring.

This work is also dedicated to my mother, an unwavering source of inspiration and support throughout my academic journey. Her unwavering love and encouragement have been instrumental in shaping the person I am today.

I would also like to dedicate this dissertation to my husband, Nassifu Ssemwanga who is a nurse professional and has been my partner in this journey. His dedication to his profession and his unwavering support, love, and understanding have been a constant source of motivation for me.

Finally, I would like to dedicate this thesis to the Mastercard Foundation Scholars Program, which has provided me with the opportunity to pursue my academic and professional goals. Your investment in my education and development has been life-changing. Without their support, this dissertation would not have been possible. Thank you to everyone who has contributed to this research project. Your support, encouragement, and motivation have been invaluable in making this dissertation a reality.

TABLE OF CONTENTS

LIST OF ACRONYMS

Abbreviation	Definition
AR	Augmented Reality
ASHA	Accredited Social Health Activist
BBP	Bhabhisana Baby Project
CHW	community healthcare worker
COVID	Coronavirus Disease
CSS	Cascading Style Sheets.
ECHO	Extension for Community Healthcare Outcomes
ESMOE	Essential Steps in Managing Obstetric Emergencies
ICT4D	Information and communications technology for development
MW	Midwife
NPC	Non-Player Character
ODK	Open Data Kit
URL	Uniform Resource Locator
AI	Artificial Intelligence
AR	Augmented Reality
GREC	Graph-based multi-hop Reasoning on Emotional Causality
HCI	Human Computer Interaction
HTML	Hyper Text Markup Language
LMIC	Low- and Middle-Income Countries
OS	Operating System
PHC	Primary Health Care
PMHP	Perinatal Mental Health Project
RMC	Respectful Maternity Care
SH	Secret History
SHiMA	Secret History Mobile Application
SMS	Short Message Service
UCT	University of Cape Town
UNICEF	United Nations International Children's Emergency Fund
VR	Virtual Reality
WHO	World Health Organization
XML	eXtensible Markup Language

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

CHAPTER 1: INTRODUCTION

1.1. Introduction

Obstetric violence, characterized by the disrespect and mistreatment of women during childbirth, is a significant issue in healthcare systems worldwide, particularly in low- and middle-income countries (Bohren et al., 2015; Jewkes & Penn-Kekana, 2015). This mistreatment takes various forms, including physical abuse, verbal humiliation, neglect, and even denial of care, all of which can have long-term psychological and emotional consequences for affected women (Freedman et al., 2014). This deeply rooted issue not only erodes trust between patients and healthcare providers but also exacerbates trauma during what is often a vulnerable and critical moment in a woman's life. Addressing this issue requires not only a change in protocols but also a fundamental shift in how healthcare providers understand and relate to the emotional and psychological needs of patients. In response to this, the Secret History (SH) workshop method was developed to foster empathy and self-reflection among healthcare providers. The SH method immerses healthcare workers in realistic role-play scenarios, where they assume both the roles of patients and healthcare providers, gradually uncovering the "secret histories" of the patients (Knapp et al., 2018). This method enables participants to reflect on their actions and the impact of their decisions, fostering a deeper understanding of patients' experiences (Cho & Kim, 2024).

While in-person SH workshops have been effective in improving empathy skills, there are challenges associated with implementing such training on a wide scale. These workshops are resource-intensive, requiring trained facilitators, time away from clinical duties, and logistical arrangements, which can be especially difficult in under-resourced settings. To address these limitations and expand the reach of empathy training, this study explores the development of a mobile application; SHiMA (Secret History Mobile Application)[1] which adapts the SH workshop method into a digital format using the Choose-Your-Own-Adventure (CYOA) framework. The motivation behind SHiMA's development lies in its potential to bridge the gap in empathy training by overcoming the resource limitations of in-person workshops. It provides healthcare workers with a self-directed learning tool that mimics real-life scenarios, allowing them to interact with branching narratives based on healthcare worker and client needs. Just as healthcare workers in the SH workshops are encouraged to reflect on their decisions and the hidden contexts of their patients, SHiMA enables users to experience these scenarios digitally, guiding them through a series of choices that mirror real-life maternity care situations.

Additionally, the researcher explores ontology and knowledge representation techniques to accurately depict the training stories and histories within the mobile app. These techniques are essential for structuring the content and ensuring that the narratives are both meaningful and informative. Ontologies provide a framework for organizing the narrative elements, while knowledge representation techniques facilitate the precise depiction of patient histories and

[1] SHiMA is an application that enables health workers to explore different stories as well as access resources focused on empathic skills. It allows health workers to reflect on each choice of action they make in the story as the choices impact them as well as their patients who seek health services needs

scenarios. The development of SHiMA follows a co-design process, involving collaboration with healthcare professionals and domain experts. This approach ensures that the app is user-centered, practical, and relevant to the needs of its target audience. The insights gained from this collaborative effort are integral to refining the app's content and functionality.

1.2. Background

Disrespect and abuse within maternity settings persist as prevalent issues in Primary Health Care (PHC) across South Africa and other Low and Middle-Income Countries (LMICs) (Honikman et al., 2020). Women grappling with mental health challenges face heightened susceptibility to encountering disrespectful and abusive maternity care. The repercussions of such mistreatment can manifest as trauma, depression, and anxiety (Honikman et al., 2020). "Healthcare workers have the opportunity to exacerbate or alleviate distress experienced by women in the perinatal period" (Jin et al., 2022). Healthcare workers, "particularly midwives and obstetricians, can be empowered to play a crucial role in offering psychological support to women during the childbirth process" (Kapadia et al., 2019). Providing such care necessitates healthcare workers to possess abilities such as empathy, which includes self-reflection to comprehend and interact effectively with their patients. It constitutes a vital aspect of healthcare that "boosts communication, enhances patient satisfaction, and positively influences healthcare outcomes by enabling healthcare workers to better address the mental health needs of their patients" (Kapadia et al., 2019). Empathy in maternal care is defined as "the ability to understand the personal experiences of the patient without over-identifying with them and it constitutes an important communication skill for a health professional" (Moudatsou et al., 2020). However, to support the development of empathic skills development, there is a need to teach empathy as a subject of lifelong and continuous education in helping professions (Moudatsou et al., 2020). Additionally, continuous healthcare worker education and training are one of the many ways that could influence healthcare outcomes in maternity settings (Mirzania et al., 2023; Munabi-Babigumira et al., 2019).

In South Africa and many other low- and middle-income countries, the integration of mental health services into routine PHC through a task-shifting approach could be used to reduce the gaps in treatment coverage. To make this approach an effective one, the Perinatal Mental Health Project (PMHP) developed the secret history method which is a training tool for healthcare providers working within maternity settings (Honikman et al., 2020). The Secret History (SH) workshop method, created by health professionals, serves as a training tool that allows healthcare workers to contemplate the significance of empathy in their profession. "The training approach helps participants to re-enact scenarios from the perspective of both the healthcare worker and the client, using role play"; followed by a facilitated reflection on emotions, needs, and specific empathic skills such as building rapport, communication, reflecting feelings, affirming, getting feedback and knowledge sharing (Honikman et al., 2020). Typical learning methods in the health sector involve the use of interactive approaches like workshops that leverage the use of tools such as videos supported by quizzes with an instructor explaining the concepts (El-Rashidy et al., 2021). However, these are associated with constraints that do not enable participant engagement since the participant passively watches the content. For example, with the unforeseen challenges posed by the COVID-19 pandemic which impacted most of the healthcare services, healthcare worker trainings were difficult to conduct because

of the emergency which required limited physical interactions and the need to ensure social distancing (Chemali et al., 2022).

Health worker training has been sought as one of the ways that could be used to empower healthcare workers and support them with empathic skills development. Limitations of in-person training such as limited resources in the form of logistics could be a hindrance to participant engagement and would therefore require supplementing the in-person training approaches with interactive digital tool narratives such as CYOA to enhance skills transfer amongst healthcare workers. Interactive narrative stories such as JUNGLE stories defined as those "utilizing multiple video formats and accommodating branching outcomes" (Kapadia et al., 2019) and narrative puzzles could be a good example of a CYOA framework since they provide for exploration and creative thinking and accommodate the branching of story narrative outcomes as participants take part in the stories and games (Fatimah, 2018; Honikman et al., 2020). CYOA is a storytelling format that allows users to navigate through a narrative by making decisions at key points, thereby influencing the direction and outcome of the story. It offers autonomy and encourages active participant involvement by allowing them to progress through a story at their own pace and make their own choices during the storytelling phase. This contrasts with passive engagement in training content, promoting a more interactive and engaging experience.

The SH workshop method and interactive branching stories share a common foundation in their use of narrative to engage participants and explore complex scenarios. SH stories immerse participants in realistic situations where they play out roles in maternity scenarios, gradually revealing the "secret histories" of patients. This process encourages deep reflection on the impact of healthcare decisions and the underlying factors influencing patient care. Similarly, interactive branching stories, such as those in CYOA narratives, offer a dynamic structure where the storyline evolves based on the choices made by the participants. This parallel allows for the seamless integration of SH stories into an interactive digital format, where users can experience the impact of their decisions in real-time. By merging these concepts, the adapted SH method within a mobile application not only replicates the reflective nature of traditional workshops but also provides a training tool that can be used to supplement in-person workshops. This digital adaptation enhances the learning experience by offering a safe space for exploration and decision-making, ultimately fostering empathy and better understanding in healthcare settings.

1.3. Problem Statement and Research Objective

Healthcare training workshops have been a well-established structure used for medical training for decades. Most of the training approaches in the medical field require in-person interactions to support healthcare worker education. Similarly, other training approaches in healthcare, such as the SH workshop method work by enabling healthcare workers to meet in-person and play out different scenarios (roleplay) as they reflect on the role of empathy in their work. However, with the rapid growth of digital health methods, researchers, and health educators have had to explore innovative ways to respond to the need for self-driven learning. In this study, the researcher focused on the adaptation of the SH workshop method into an independent digital learning platform, using a CYOA framework. The researcher presents the Secret History Mobile Application (SHiMA), developed based on the principles of role-play and the application of empathic skills (Honikman et al., 2020) to enhance the existing SH training workshops. SHiMA works towards exploring how the CYOA framework can support healthcare worker education. CYOA allows the user to make multitudes of choices in the story. The healthcare professional's decisions within the narrative can foster emotional connections

with the characters, amplifying the impact of their choices (Knapp et al., 2018). CYOA gives its participants benefits such as self-efficacy, continuous learning, and engagement derived from the choices made in the narrative.

1.3.1. Research Objective

The main aim of the study was to develop a digital platform that supports the representation of the secret history method using Choose-Your-Own-Adventure to facilitate healthcare worker training.

1) To explore how a secret history workshop approach can be adapted into Choose-Your-Own-Adventure.
2) To explore the extent to which story content represented in secret history-based training can be digitized.
3) To develop a Choose-Your-Own-Adventure platform that might allow healthcare worker trainers to leverage digital media to support training.

1.4. Research questions and objectives

This research study focused on understanding how expert informants represent storylines in secret history and the development of a mobile application that uses the Choose-Your-Own-Adventure framework to support continuous learning amongst healthcare workers. The study followed a qualitative approach and sought to answer the following questions.

1.4.1. Research Questions
1.4.1.1. Main research question

What are the adaptations that can be made to the secret history workshop method to support digital training using CYOA?

Secret history narratives represent workshops that use roleplay alongside narratives that are revealed as the story develops. Adapting them to a CYOA format will require shifting the roleplay into a series of alternate story arcs. However, the key adaptation will be to account for the role of the facilitator in an in-person workshop; finding a way to help the CYOA emulate some of that role by responding to answers and offering more information based on adventure choices. Answering this question means explaining how the CYOA can mimic the facilitator's interactive role to create an engaging and dynamic storytelling experience for the healthcare worker, where their choices influence the unfolding of the secret history narrative.

1.4.1.2. Sub-research questions

1. What are the design considerations for adapting secret history narratives to a CYOA format?

The design considerations for adapting Secret History to CYOA involve crafting sequential choices for the stories, balancing creativity, and accuracy of activities in a maternity environment, ensuring a narrative flow, and creating multiple possible endings (Jenkins, 2004). This is to encourage self-reflection while engaging the participants with immersive elements. These considerations aim to create an interactive and engaging experience for learning empathic skills while exploring the story revealed by both the healthcare worker and the patient

through various choices and pathways (Bird et al., 2021). To achieve this, a flowchart to represent the stories and learning objectives will be developed and this will inform the replication of the same ideas on a mobile application.

2. What are the design and functionality requirements for the use of CYOA to support the secret history workshop method?

CYOA supports branching narratives that reveal the secret histories of both the healthcare worker and the patient based on user choices while maintaining learning and engaging storytelling. The method has been designed to allow for multiple endings that disclose various aspects of the secret history, and it will be user-friendly, encouraging replayability to explore different paths and uncover the full narrative. Testing and feedback collection with healthcare workers will be part of the process to refine and improve the structure of the secret history CYOA flow.

1.4.2. Research Objective

The main aim of the study was to develop a digital platform that supports the representation of the secret history method using Choose-Your-Own-Adventure to facilitate healthcare worker training.

1) To explore how a secret history workshop approach can be adapted into Choose-Your-Own-Adventure.
2) To explore the extent to which story content represented in secret history-based training can be digitized.
3) To develop a Choose-Your-Own-Adventure platform that might allow healthcare worker trainers to leverage digital media to support training.

1.5. Significance of the study

The results from the study will assist in determining if self-digital learning tools can be used to make healthcare workers in maternity settings more aware of their attitudes and how these affect their clients when they seek healthcare services. The results will also assist in supporting continuous healthcare worker education. This study aims to offer additional insights into the factors that should be considered when developing interactive digital tools for fostering empathy, especially within the CYOA context.

1.6. Summary of Chapter

This chapter introduces the research project on the adaptation of CYOA to develop an empathy digital training tool for healthcare workers in maternity settings. The chapter provides an overview of the project and its purpose. It delves into the background of the project which includes the importance and need for empathy skills amongst healthcare workers especially in maternity settings. The researcher presents a problem statement that highlights the challenges faced by healthcare workers in developing empathic skills. The context of the SH workshop method is also discussed, which is a digital storytelling tool that has been used in healthcare settings to improve communication and empathy. The overall project scope is then presented, which includes the development of a CYOA tool that can be used to train healthcare workers in empathy and communication skills. The research questions and objectives are also outlined, which include exploring the potential of CYOA to enhance empathy and communication skills

among healthcare workers. The significance of the study is then discussed, which highlights the importance of empathy and communication skills in healthcare settings and the potential of CYOA to address these challenges. Finally, the structure of the thesis is presented, which includes an overview of the chapters and their contents.

1.7. Structure of the thesis

The remainder of this thesis is organised as follows:

- Chapter 2: Literature review which provides an overview of the existing literature on the history of health worker training, digital media technologies for improving health, interactive narratives in healthcare, digital storytelling in healthcare, and persuasive health methods in healthcare as a way of improving healthcare outcomes.
- Chapter 3: Methodology presents the research methods that have been used in this study. The chapter first introduces the study design, study setting, target population, sampling strategy used, participant demographics, data collection procedures, data management, analysis, dissemination of study findings, study rigor and aim of the study then details the ethical considerations for the study.
- Chapter 4: Research findings discuss the findings related to story elements, CYOA storyboard design as well as the development of the mobile app by drawing on existing literature. The chapter entails the results obtained during the codesign workshops, focus group discussions, and interviews.
- Chapter 5: This chapter presents the iterative codesign process used in the development of SHiMA and the final story structure used in the design and development of the mobile application.
- Chapter 6: Research discussions and analysis presents the results drawn from the study on the use of the CYOA self-digital learning tool, factors that could affect its reliability, usage, and the effects of using a digital tool to help healthcare workers learn more empathic skills in their line of duty.
- Conclusion: The conclusion provides a summary of the key findings from the study as well as the limitations of the study and suggestions for future work.

CHAPTER 2: LITERATURE REVIEW

2.1. Literature review

The objective of this chapter is to examine the existing literature related to the secret history method of training, the history of healthcare worker training, digital health technologies, interactive narratives, digital storytelling in healthcare, and persuasive technologies in health.

2.2. History of healthcare worker training

The training of health workers has a history that dates back to the 1930s when Community Health Workers (CHWs) first emerged in China. Between the 1970s and 1980s, government CHW programs proliferated leading to the growth of CHW programs in many low-income countries (Perry, 2013; Perry et al., 2014). In South Africa, the CHW programs were established between the 1970s and 1994, however many of these programs collapsed in 1994 when the government embraced primary healthcare (PHC) (van Ginneken et al., 2010). Other reasons why some of these programs were unsuccessful include limited access to resources, training, and supervision of CHWs as well as the integration of CHW programs into the existing healthcare systems. Nevertheless, in recent years, new successful programs have emerged, leading to renewed interest and growth in CHW programs globally (Perry, 2013).

As a way of supporting CHW training, innovative approaches such as the Extension for Community Healthcare Outcomes (ECHO) model have been used to keep CHWs in their communities using distance learning for ongoing training and support (Komaromy et al., 2018). Likewise, other strategies such as the use of videos amongst Accredited Social Health Activists (ASHAs) have also been used to support healthcare service delivery in India (Ramachandran et al., 2010). Recent innovations provide room for reinforcing knowledge and skills over time. For instance, the ECHO model described above incorporates the principles of adult education theory including active participant engagement rather than passive learning (Komaromy et al., 2018). Similarly, through the SH workshop method, participants are active participants during roleplay activities which encourage them to reflect on themselves as their secret histories are being unveiled.

2.3. Digital media technologies for healthcare worker training

Within the healthcare domain, technology such as telemedicine and smart health applications have alleviated the unprecedented outcomes of the pandemic (Mbunge et al., 2022) and significantly transformed the dynamics of human interactions, and the approach healthcare workers adopt in patient care. Technological advances such as Artificial intelligence (AI) have been applied to the gaming field through the use of computational models to evoke empathic emotions in interactive systems partners (Yalcin & DiPaola, 2018), and "knowledge representation techniques such as emotional behaviour trees to impact multiplayer online battle arena environments for Non-Player Characters (NPCs)" (Waltham & Moodley, 2016), in education through the use of scripting knowledge representation to facilitate the teaching of history in elementary school (Fatimah, 2018). Virtual Reality (VR) and Augmented Reality (AR) technologies have been commonly applied in fields such as education, gaming, and medical fields

to facilitate medical education and training (Hsieh & Lee, 2018). The utilization of knowledge representation techniques and computational models employed by these technologies could support the development of systems aimed at promoting behavioural change amongst interactive agents. Knowledge representation techniques such as emotional behaviour trees (Waltham & Moodley, 2016) and computation models around empathy are being used to influence the behaviour of the agents.

Digital health solutions are increasingly being used to facilitate training of the health workers. Digital strategies majorly rely on mobile phone devices and other wireless technologies as a primary tool for training or tools that supplement face-to-face interactions (Schoeman, 2019). Digital health tools present a valuable opportunity to enhance engagement and accessibility of health services (Alqahtani & Orji, 2020). With the advent of advanced technologies, digital wearables like mobile phones, smartwatches, and iPads have transcended mere communication and are being employed in the field of healthcare to influence behavioral changes (Wilson et al., 2019).

Mobile phone-based interventions have been employed to support community health workers, as seen in India. In this context, videos have empowered Accredited Social Health Activists (ASHAs) to enhance their self-efficacy. These videos assist ASHAs in identifying underlying problems, devising solutions, and bridging communication gaps, particularly when healthcare workers find it challenging to explain certain principles to the audience (Kumar et al., 2015; Negesa & Densmore, 2023; D. Ramachandran et al., 2010). The utilization of digital media is a substantial contributor to enhancing healthcare in developing countries. This involves integrating videos into nursing development activities, resulting in a positive impact on health decision-making, behavior change promotion, and increased responsiveness within communities where stigma and medication refusal are prevalent. Additionally, presenting health education content in video format serves the purpose of reaching patients with literacy challenges, extending the scope of healthcare initiatives (Molapo et al., 2017; Negesa & Densmore, 2023; D. Ramachandran et al., 2010). Despite an increase in the use of smartphone devices with vast functionalities such as large screen size, greater memory, and support for larger caseload compared to feature phones (Schwartz et al., 2014), various foundational elements, including learning theories and usability engineering, contribute to the understanding and development of digital wearables and their applications (Kharrazi et al., 2009) constrain the development of these videos. These factors contribute to challenges in deploying digital wearables, given the substantial costs associated with technological devices such as smartphones. Issues like liability, device security, usage expenses, and the limited battery life of smartphones further compound the deployment challenges (Schwartz et al., 2014).

2.4. Interactive narratives in health care

Numerous digital media technologies, such as games and videos, use the CYOA framework to provide interactive narratives. “Interactive narratives are defined as stories in which the user can control the sequence of events and the outcome of the story” (Bran & Vaidis, 2019). As participants navigate through the narratives, they have the power to shape the destinies of the characters involved. “Examples of such interactive narratives include games like Tumaini, created for adolescents in Kenya, SwaziYollo tailored for HIV-negative youths in Swaziland, and PlayForward” (Winskell et al., 2019). These programs were specifically crafted to

empower teenagers by equipping them with the knowledge, expertise, and motivation essential for minimizing sexual risks and addressing the challenges associated with HIV.

Interactive narratives engage participants in the content, serving as the perfect medium for users to experience pleasure and immerse themselves in human behavior, and intrinsically motivate users (Koivisto & Hamari, 2019). These narratives facilitate the acquisition of information, and skills by delivering unique learning experiences, and incorporating various behavioral interventions that provide users with supportive engagement, fostering the development of confidence and practical experience related to the concepts under development (Molapo et al., 2016b).

The utilization of digital media for educating patients about diverse health conditions, including autism spectrum disorder and diabetes, is on the rise due to its effectiveness in motivating participants and influencing positive lifestyle changes (Boulos et al., 2015). “Behavior change is essential for improving the delivery of healthcare that is tailored to the patient. It achieves this by influencing decision-making in daily activities and complementing visible and communicated efforts” (Angeli & Campbell, 2017).

A combination of interactive narratives and CYOA “enhances user engagement and enriches emotional involvement, and the narrative experience in terms of transportation, identification, and realism” (Oh et al., 2020). While “transportation refers to the sensation of being engaged and immersed in the story, identification pertains to the concept of being in the story’s characters’ shoes” (Bran & Vaidis, 2019). “Interactivity fosters the cultural adaptation of the healthcare provider by using recent problematic situations from the healthcare provider’s own experiences as case narratives rather than pre-prepared ones” (Kharrazi et al., 2009). Furthermore, it moulds users' behaviors by necessitating critical thinking about their actions at each juncture, prompting them to empathize with their patients before making decisions. As such, Interactive novels offer immersive and enjoyable activities that positively impact human behavior and decision-making (Bran & Vaidis, 2019).

2.5. Digital storytelling in healthcare

Narrative storytelling acknowledges the centrality of learning and facilitates a collective learning experience by providing a shared framework for individuals to learn from each other (Christiansen, 2011). In healthcare, digital storytelling provides an immersive and interactive digital experience through the utilization of first-person narratives, standalone stories, and multimedia elements. Beyond enhancing patient satisfaction in maternity care settings, it can also contribute to quality and safety improvement initiatives (Morrise & Stevens, 2013).

Often characterised as a distinctive human experience, digital storytelling aggregates and fosters positive development, and enhances interpersonal relationships and self-knowledge through engaging and motivating participants (Ribeiro, 2015). Digital storytelling helps to reduce text dependencies and increases audience engagement in communities with low literacy rates (Kumar & Anderson, 2015). In health care, it empowers healthcare workers to actively engage in the design of the narratives ensuring that their needs are addressed (Mburu et al., 2018). Allowing health care providers to participate in role-play activities in a maternity care setting exposes them to patient experience fostering the development of individualised and compassionate practice (Moreau et al., 2018). “These activities can be used to evoke new ideas,

communicate a concept, train a specific behaviour, and build user empathy" (Molapo et al., 2016a).

2.6. The Secret History method and Theatre of the Oppressed

The Perinatal Mental Health Project (PMHP) of the University of Cape Town developed the Secret History method in 2004. This was a response "to the realization that public service staff engaging with mothers could add to or alleviate levels of distress experienced by vulnerable women" (Honikman et al., 2020). The method has been refined and used this training approach in a wide variety of settings in South Africa and with a range of healthcare worker cadres involved with mothers and children. The training has undergone both qualitative internal and external evaluation. The training aims to improve the empathic engagement skills of health workers working with mothers vulnerable to psychological distress.

The interactive training method enables real-life responses toward 'the other'/the patient. Identifying with 'the other' is a critical element of the training and allows for the dissolution of cognitions leading to blame, disapproval, and abuse of clients. A process of polarization and reintegration allows participants to engage with a wider context of maternal care, one which encourages empathy for the 'other' and validates sympathy for the 'self.' Participants are then able to develop their solutions to address difficulties in the workplace, and interpersonal challenges with colleagues and clients, and to be more aware, responsive, and supportive of the needs of patients, and each other (Honikman et al., 2020).

The training approach utilizes Augusto Boal's Theatre of the Oppressed as opposed to conventional training methods to enable midwives to become "more aware of their thoughts, experiences, and feelings, as well as the feelings of their patients" (Honikman et al., 2020; Knapp et al., 2018) and also foster an environment where the healthcare workers can scrutinize and envision instances of care in health facilities. "Boal's theatre of the oppressed drew on improvisation and audience participation to examine social problems, express reflections, and demonstrate different behaviours that promote change" (Proctor et al., 2008). Boal's Theatre of the Oppressed drew on improvisation and audience participation to examine social problems, express reflections, and demonstrate different behaviours that promote change (Proctor et al., 2008). Following Boal's principles, the audience can intervene, switch places with the actors, and improvise their actions by instructing them on how to change. Storytelling acknowledges a central aspect of learning and facilitates a shared framework for individuals to learn from each other (Christiansen, 2011).

The method involves participants engaging in role-play activities from both the healthcare workers and the patient's perspectives. Engaging in role-play activities enables healthcare professionals to gain a deeper understanding of themselves, practice mindfulness towards others, and become aware of their personal experiences and circumstances when interacting with clients (Honikman et al., 2020; Knapp et al., 2018). During this method, half of the participants take on the role of the nurse or healthcare worker, while the other half assume the role of the client or patient, following them through a journey from pregnancy to the postnatal period. Drawing from realistic life stories within the local context, the personal narrative of each role unfolds gradually. At each stage, participants are guided to recognize their emotions and needs, with two separate columns on a whiteboard representing these aspects for each role. Simultaneously, facilitators encourage interaction between the two roles. The second part of the session involves a debriefing where staff can align their feelings with the needs of the "other" or patient. This process informs the development of new strategies for providing

empathic care to patients and self-care for healthcare workers. The training encompasses chances for participants to contemplate the emotions and needs of both characters involved. It also focuses on acquiring and honing empathic skills such as active listening, affirming, and sharing knowledge, among other essential abilities. The SH training additionally supports strategies aimed at fostering self-care among healthcare workers (Honikman et al., 2020).

2.7. Persuasive health approaches for enhancing health care.

"Persuasive technologies are technologies that change human behaviour in an intended way without using deception" (Orji, Vassileva, et al., 2013). As per a review of persuasive technologies, recent research indicates that "these technologies can effectively influence participants through persuasive stimuli, utilizing computers to induce human behavior" (Katule et al., 2016; Orji, Vassileva, et al., 2013). To aid in crafting effective interventions for the health sector, various behavioral theories from social sciences and psychology are applied. (Orji, Vassileva, et al., 2013). These behavioural change models include "the health belief model, health action process framework, social cognitive theory, and trans-theoretical model, which influence outcome expectations and self-efficacy among maternity care providers" (Wilson et al., 2019). Stakeholders across the healthcare industry utilize persuasive technologies to drive change and influence interventions related to detecting early illness symptoms and maintaining general well-being (McLean, 2020; Orji, Mandryk, et al., 2013). These technologies are affordable and flexible, providing real-time strategies and personalized content. (Wilson et al., 2019). Certain demographic groups, particularly inexperienced users, may encounter limitations in utilizing specific technologies. These limitations stem from the current design of mobile phone applications, where interactions are tailored to the preferences of the developers, rather than the users. However, these challenges can be addressed by implementing the concept of user-controlled tailoring, which allows users to customize the technology to better suit their competencies and needs (Katule et al., 2016; Orji et al., 2017).

Additionally, the design of such technologies should empower users to establish their own goals and methods for achieving them. One persuasive health technology employed in maternity settings is "interactive videos, providing tailored behavioral interventions"(McLean, 2020). This compelling solution utilizes smartphone technology to achieve both project and clinical objectives. The creation of this persuasive health technology tool is dependent on employing appropriate software and adhering to a specific workflow in the software development process, which includes the careful selection of functionalities. However, the challenge lies in choosing appropriate functionalities that ensure the effectiveness of the mhealth tool, as this is not always straightforward. Unlike traditional linear video approaches, interactive videos utilize various digital media interfaces such as motion platforms, enabling participants to control and engage with the video through their actions. The incorporation of mechanisms like slow technology in interactive videos encourages reflection on participants' behaviors as they interact with the video. According to Orji et al. (2013), "Technology should be slow to encourage reflection on actions and decisions and be slow about the consequences of those actions" (Orji, Vassileva, et al., 2013). Incorporating slow technologies into interactive narratives enriches the learning and reflection experience, particularly in maternal care settings where participants independently make decisions before implementing any actions.

2.8. Interactive Narrative Frameworks

Interactive narratives are important in creating engaging and immersive learning experiences, particularly in digital training tools. Various frameworks for interactive narratives exist, each

with unique strengths and applications. This section compares the Choose-Your-Own-Adventure (CYOA) framework with other frameworks such as linear narratives, and branching scenarios, to evaluate their effectiveness and alignment with the Secret History (SH) method used in this study.

The Choose-Your-Own-Adventure (CYOA) framework allows users to make decisions at various points in the narrative, leading to different story paths and outcomes. This interactivity engages users actively, fostering a sense of agency and personal investment in the story. The CYOA format's branching structure aligns well with the SH method's emphasis on exploring multiple perspectives and scenarios in healthcare settings. This adaptability makes it suitable for training healthcare workers in empathy by simulating real-life situations and decision-making processes. Linear narratives, on the other hand, follow a single, unalterable path from beginning to end. While this approach can be useful for conveying specific information or telling a straightforward story, it lacks interactivity and user engagement. The fixed nature of linear narratives does not support the exploration of different perspectives or outcomes, making it less effective for training purposes that require user interaction and decision-making.

Branching scenarios, similar to CYOA, allow users to make decisions that affect the narrative's direction. However, branching scenarios often focus on specific decision points without the extensive narrative depth of CYOA. They are effective for short training modules or specific skills development but may not provide the comprehensive, immersive experience needed for empathy training in healthcare settings (Aldrich, 2005). By integrating branching scenarios within the CYOA framework, users can experience a more detailed and dynamic narrative, enhancing the overall training experience. Role-playing elements can also be integrated within the CYOA framework to enhance interactivity and engagement. Role-playing allows users to immerse themselves in characters and scenarios, enhancing the depth of the narrative and the realism of the decisions they must make. This method can significantly improve empathy training, as users can experience situations from different viewpoints, furthering their understanding and empathy (Tekinbas & Zimmerman, 2003).

2.9. Ontology and Knowledge Representation in Interactive Storytelling

Interactive storytelling ontologies represent a pivotal advancement in educational and training methodologies, offering structured frameworks to model narrative dynamics and user interactions. These ontologies serve as formal models that define the components and relationships within a story, facilitating immersive and personalized learning experiences. However, the approach faces significant challenges, particularly in the realm of knowledge representation, which impacts its application and effectiveness in diverse educational contexts. While interactive storytelling ontologies, such as the Choose-Your-Own-Adventure (CYOA) framework, excel in providing dynamic and engaging narratives, their effectiveness in representing complex knowledge domains remains limited. Traditional ontologies often struggle to capture and integrate nuanced contextual information and domain-specific intricacies essential for comprehensive learning experiences (Nakasone & Ishizuka, 2006; Smed et al., 2019). The CYOA ontology partitions narratives into discrete story nodes, each encapsulating textual details, character interactions, and branching choices. These nodes are interconnected through decision points, enabling nonlinear progression and multiple story paths. This structure not only enhances user engagement but also supports the exploration of

diverse narrative arcs, thereby enriching learning experiences in healthcare training contexts (Kononowicz et al., 2019).

In contrast to AI-driven ontologies that leverage machine learning to simulate complex scenarios and behaviors, CYOA emphasizes user-driven narrative exploration and decision-making. This human-computer interaction (HCI) approach fosters empathy development and critical thinking skills among learners by immersing them in interactive storytelling experiences (Wang et al., 2021). Future research in ontology development for interactive storytelling could explore advancements in AI integration to enhance narrative adaptability and emotional realism. By dynamically adjusting story elements based on user interactions and feedback, ontologies can further enrich learning experiences and improve training outcomes in healthcare and other educational domains (Cao et al., 2023; Chrysanthakopoulou et al., 2021)

2.10. Monitoring and Platform Choices

Monitoring is essential in digital health interventions. The choice of platform influences the monitoring tools and methods available. CommCare[2] was initially selected but was later found to be unsuitable for the project's specific needs. Understanding why the initial choice was incorrect and exploring alternative options is vital to ensure effective monitoring, data collection, and assessment of the intervention's impact. Platform decisions impact the success, sustainability, and relevance of the intervention in resource-constrained settings, making them a pivotal aspect of the development process.

In the context of developing SHiMA, the researcher embarked on examining key platforms namely ODK, Redcap, web-based platforms, SMS platforms, native mobile app development, and CommCare. The selection of these platforms was not arbitrary; each was chosen for distinct reasons that reflect their unique attributes and capabilities.

ODK, for instance, is favoured for its open-source nature, making it a cost-effective and adaptable choice, aligning well with the often budget-limited nature of healthcare initiatives in resource-constrained settings. Redcap, on the other hand, is highly regarded for its robust data management and secure infrastructure, which is particularly important when dealing with sensitive patient information in healthcare applications.

Web-based platforms are another popular platform for digital health interventions and can be accessed through a web browser on any device with internet connectivity. Web-based platforms can also be designed to be highly customizable and flexible, which can help tailor the intervention to the specific needs and context of the intervention. However, web-based platforms may require technical expertise to set up and maintain and also require an internet connectivity during data collection.

SMS-based platforms are simple and straightforward platforms that can be accessed through text messaging on any mobile phone. Some of the mhealth SMS-based platforms are, “Kilkari and mMitra in India; Healthy Pregnancy, Healthy Baby Text Messaging Service (Wazazi Nipendeni) in Tanzania; Aponjon in Bangladesh; and MomConnect in South Africa” (Peter et al., 2018). SMS-based platforms can also be designed to be highly scalable in resource-constrained settings (Barron et al., 2018; Seebregts et al., 2018). However, SMS-based

[2] CommCare is a mobile data collection and case management platform designed to support collection of data and delivery of services in low-resource communities in the fields of global health

platforms may be limited in terms of the amount of information (Sharifi et al., 2013) and interactivity that can be provided through text messaging for CYOA-based applications.

Native mobile apps are a popular platform for digital health interventions, as they can be easily accessed and used on smartphones and tablets (Goldberg et al., 2022; Molapo & Densmore, 2015). Native mobile app development represents a more versatile approach, allowing for custom-tailored solutions that could provide an interactive and engaging experience, which can help keep users interested and motivated to use the intervention. This choice provides the flexibility to meet specific project requirements but may demand a higher resource investment compared to other options. Additionally, building a native CYOA mobile app requires coding expertise needed to launch new stories which is not the case with no-code platforms for instance, for the case of SHiMA, this would require PMHP staff to have the necessary coding expertise in case they want to add the stories, or they would incur expenses to hire someone to do this, which can be costly in the long run.

Meanwhile, CommCare stands out for its specialized focus on mobile health solutions, offering a range of pre-built tools designed explicitly for healthcare workers, streamlining development processes in this particular sector. CommCare is a mobile data collection and case management platform designed to support collection of data and delivery of services in low-resource communities in the fields of global health (Dimagi, 2023a). CommCare has been leveraged by several organizations such as “United Nations International Children's Emergency Fund (UNICEF), the World Health Organization (WHO)” in the development of applications for healthcare workers (Center for Health Market Innovations, 2023; UNICEF). CommCare platform comprises of the mobile application and CommCare HQ interfaces (Vasudevan et al., 2020).

CommCare provides a friendly form builder interface that allows users who may not be tech experts to create custom apps and workflows that meet their specific needs without extensive knowledge (Dimagi, 2023b) using CommCare HQ web interface which does not require any programming. The platform also offers other advantages such as training and support services to help organizations implement and use the platform, offline capabilities to facilitate the use of applications in areas with limited or no internet connectivity (Chhetri et al., 2019). These qualities influence end-user affordance and support the efficiency and effectiveness of developing applications.

While CommCare offers a range of advantages, it is important to acknowledge its limitations, particularly when contemplating its suitability for projects demanding extensive customization, rich media content integration, or specific offline and integration capabilities. Here are some of the limitations encountered by the researcher during the development of SHiMA.

2.11. Summary of the chapter

In this chapter, the researcher conducted a literature review on interactive narratives within the healthcare domain. It elucidated the influence of contemporary technological advancements on the healthcare sector. Additionally, the chapter outlined the potential of digital storytelling as a mechanism for fostering empathic skills development among healthcare professionals. The utilization of persuasive health technologies was also expounded upon, highlighting their potential for tailored behavioural interventions. Moreover, the discourse extended to explore the intricate interplay between digital technologies and empathy. The following chapter

explores the research methodology utilized in this study, providing details on the approach taken to fulfil the research objectives.

CHAPTER 3: METHODOLOGY

This chapter outlines the systematic approach taken to develop and implement the CYOA Secret History Mobile Application (SHiMA). The chapter provides an overview of the research methods, design considerations, and development strategies. Below is a detailed description of the activities that took place.

3.1. Study design

The study followed a qualitative approach that was descriptive and sought to understand how to adapt an existing teaching curriculum into a digital learning tool for empathy using a CYOA framework.

3.2. Study setting

The study took place in the Western Cape province, specifically within the city suburbs of Cape Town, South Africa. The participants involved in the study were associated with organizations in the region, including the Perinatal Mental Health Project (PMHP) of the University of Cape Town, the Bhabhisana Baby Project (BBP), and the Al-Nisa Maternity Home. The involvement of stakeholders significantly shapes the development of a product. Additionally, the influence of stakeholders within an organization significantly impacts project success. According to a study by Bano et al. (2018), individuals with power in an organization can wield control over people and resources during decision-making and change implementation, leading to frequent project failures (Bano et al., 2018). In contrast, our engagement with PMHP aimed to counteract misinformation and guarantee alignment with project objectives. This also enabled us to empower both PMHP and midwives by giving them the ability to influence decisions and get a sense of control and ownership of the mobile application. Below is a detailed description of the stakeholders involved in this study;

- Perinatal Mental Health Project (PMHP) - PMHP which is the main implementer of the SH workshop method is located within the Centre for Public Mental Health at the University of Cape Town and focuses on addressing mental health challenges among pregnant women and new mothers. PMHP aims to support the integration of quality maternal mental health care into maternal and child platforms through advocacy and policy development work, capacity building, service design, research, and resource development (Honikman et al., 2020).

- Al-Nisa Maternity Home - is a private health organization that provides care and support to pregnant women before, during, and after childbirth. The maternity home offers a range of services, including prenatal care, delivery assistance, and postnatal support, ensuring that mothers and their newborns receive comprehensive care in a safe and supportive environment.

- Bhabhisana Baby Project (BBP) - is an initiative that emerged in 2015 due to the collaborative efforts of speech and language therapists, a physiotherapist, and an occupational therapist. Recognizing a significant gap in services available to newborns, the project focuses on the critical aspect of early intervention for addressing neonatal challenges. This project is geared towards assisting families and newborns during the crucial

transitional period after birth and before any diagnosis of a disability is made. The project's main goal is to facilitate a seamless transition for families from neonatal health units to local health services for paediatrics, ensuring that infants receive the necessary support during this vulnerable period.

3.3. Study population

The study population comprised midwives from a private health facility and expert informants. The expert informants in this study included staff from the PMHP, who are familiar with the Secret History approach, and experts from the BBP, who are therapists with extensive experience working with patients who have experienced obstetric violence. The study excluded mothers due to the nature of the method; specifically, the Secret History workshop design focused on training healthcare workers, not on including mothers.

3.4. Sampling

For convenience, a purposive sampling strategy was chosen due to the project's limited scope and time constraints. The research adopted a participatory design approach, and the sample comprised 5-10 expert informants and 5-10 midwives from the private health sector in the Western Cape province of Cape Town. Expert informants from PMHP were specifically chosen as the primary participants for this study because of their prior experience with the secret history approach, supporting the integration of quality maternal mental health care into initiatives for mothers and children in resource-constrained, low- to-middle-income settings.

3.5. Demographic profile of participants

Table 1 shows a summary of the participant's demographic profile. Based on the inclusion criteria of the study, two people who had initially worked with PMHP and participated in the development of the SH workshop method were interviewed. One of the participants was male and the other was female. The co-design workshops with PMHP had 6 participants of which 5 were female and 1 male. Of the six participants, 1 was a registered sister, 1 was a doctor, and 4 were researchers. 3 therapists from the Bhabhisana baby project participated in the focus group discussion and these were female. Our co-design workshops with Al-Nisa maternity home comprised 5 participants and of these 4 were midwives and one was a registered sister.

Table 1: Demographic profile of the participants

Activity	Demographic		Number
Interviews with PMHP	Gender	Male	1
		Female	1
Co-design workshop with PMHP	Gender	Male	1
		Female	5
	Title/Rank	Registered nurse	1
		Doctor	1
		Researcher	4
Co-design workshop with Al-Nisa Maternity Home	Gender	Male	0
		Female	5
	Title/Rank	Registered sister	1
		Midwife	4
Focus Group Discussion with BBP	Gender	Male	0
		Female	3
	Title/Rank	Therapist	3

3.6. Data collection tools

The data was collected through semi-structured interviews with the secret history experts to enable us to have a deeper understanding of what the SH workshop method is and get their thoughts on having a digital learning tool following the same curriculum. The sessions lasted one hour each and the discussion was audio-recorded with the consent of the participants. The interviews were guided by an interview guide in Appendix A.

The researcher then conducted co-design workshops with expert informants from PMHP and the midwives at Al-Nisa Maternity Home. The co-design workshops lasted for three hours each. Lastly, focus group discussions with expert informants from BBP were conducted and this lasted for two hours. These workshops were conducted to enable us to get feedback on our existing storyboards and our initial secret history mobile application prototype. Audio-recorded discussions and notes were taken to help during the data analysis stage. The Focus group discussion guide and workshop protocol have been added to Appendix B and C, respectively. At the end of the study, pilot deployment of the mobile application was conducted with the midwives at the Al-Nisa Maternity home. A discussion which was guided by the proposed agenda and focus group discussion guide on Appendix D and E respectively was conducted to get their feedback on the application.

Furthermore, secondary data sources, including images, videos, and documents acquired from the Perinatal Mental Health Project detailing secret history activities, were incorporated to guide the platform's design. These resources were also shared with stakeholders to evaluate their suitability for use on the platform. Table 2 and Figure 1 below show some of the images that were used in the app.

Table 2: Showing the icons used in SHiMA

ICON	Reference
	Health worker actions
	Patient actions
	Secret history reveal
	Health worker feelings and needs
	Patient feelings and needs
	Skills check box
	Video resources
	Text based resources
	URLs and Websites

Figure 1: Screenshot showing images incorporated in the stories on the app

3.7. Data collection procedure

3.7.1. Getting permissions

The researcher sought administrative clearance from the line managers of the participants to have access to the participants. All study procedures were approved by the Faculty of Science Ethics Committee at the University of Cape Town. The ethics approval letter has been included in Appendix F of this thesis.

3.7.2. Recruitment

Potential participants were invited to participate in the study email and instructed to show interest by contacting the researcher. Snowball sampling was also employed wherein initial participants referred to other expert informants who were willing to contribute to the study.

3.7.3. Data collection

The CYOA application underwent a structured design and development process, following a phased approach. Data collection occurred in four distinct steps, as detailed below.

Step 1: Needs assessment phase

The design process commenced with interviews and focus group discussions with SH experts, including staff from PMHP and therapists from BBP. The aim was to gain insights into the secret history approach and empathetic training. During these sessions, discussions delved into the nature of the problem, explored the CYOA concept, and received feedback on the initial prototypes.

Step 2: Content development phase

This stage involved having focus group discussions and codesign workshops with the expert informants. The objective was to build storyboards that would inform the design of the mobile application. The activities at this stage included summarizing the interviews, empathy building, secret history activities using the secret history content and starting to build the Choose-Your-Own-Adventure storyboards.

Step 3: Application co-design phase

The co-design of the application encompassed two series of iterative co-design workshops, during which successive digital prototypes were presented for feedback and continual co-design. Additionally, a review and adjustment of initially designed storyboards occurred in this phase. Figures 2 and 3 below show the initial app prototypes designed.

Figure 2: Initial CYOA app prototype

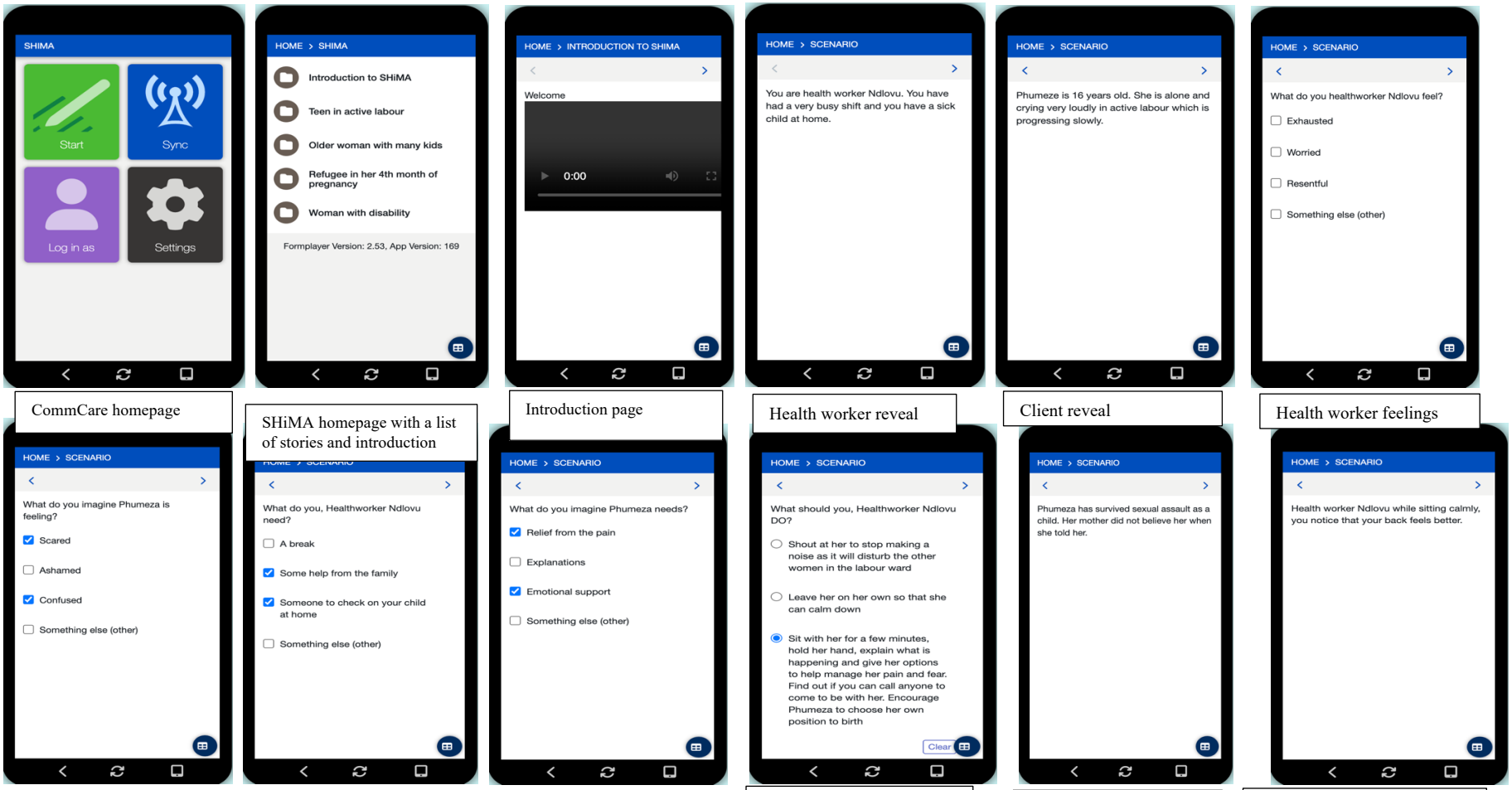
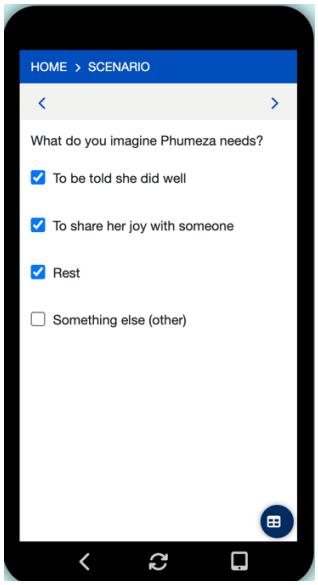
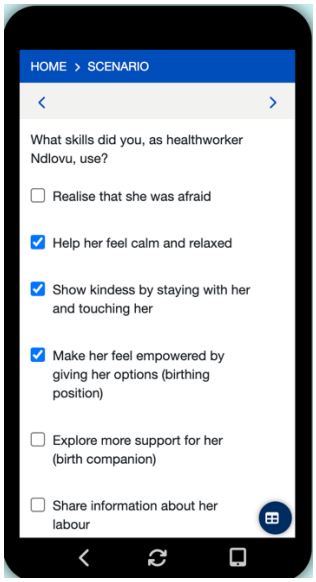


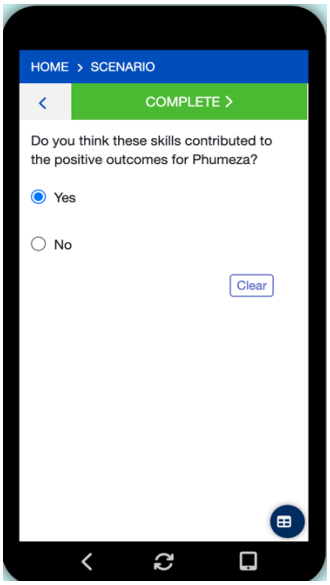
Figure 3: Continuation of initial app prototype



Client needs based on health worker choice of action



List of skills that the health worker could have used



Final screen with a review of if the skills contributed to how client felt in the end

Step 4: Pilot deployment phase

This is the user testing stage of the mobile application which involves pilot evaluation of the application with health workers from Al-Nisa maternity home. The pilot study was an opportunity to field-test SHiMA with health workers in a maternity setting. The study consisted of five participants and of these, three were midwives and two were nurses. The participants were asked for their consent before the pilot study and of the five participants, only three midwives consented to take part whereas the other two nurses were excused from the study because they were not comfortable with the terms of the consent. Each of the participants had an android mobile phone which was a basic requirement for one to take part in the study. The application was loaded on each of the mobile phones upon first, installation of CommCare from the Google Play store and installation of SHiMA through scanning of the QR code that was availed to them. During testing two participants played one story each whereas the other participant played two stories. The researcher was available to offer any support as needed and to record any observations using the application. This was followed by a focus group discussion session to collect insights and feedback from participants to inform improvements to the application.

The four steps listed above enabled us to answer the main research question *"What are the adaptations that can be made to the secret history workshop method to support digital training using CYOA?"* Steps 1, 2, 3, and 4 facilitated answering the first sub-question stating, "What are the design considerations for adapting secret history narratives to a CYOA format?", Also, Step 3 enabled us to answer the second sub-question on "What are the design and functionality requirements for the use of CYOA to support the SH workshop method?"

Table 3: Summary of the data collection steps

Time Frame	June/July 2022	July/September 2022	October/November 2022	April 2023
Steps	Step 1	Step 2	Step 3	Step 4
Objective	Needs assessment	Content development	Application design	Pilot deployment
Methods	Interviews	Workshops Focus group discussions	Workshops	Focus group discussion
Number of Participants	2 - PMHP expert informants	6 – PMHP expert informants 3 - BBP expert informants	5 - PMHP expert informants 5 -Midwives from Al-Nisa Maternity home 3 - BBP expert informants	3 -Midwives from Al-Nisa maternity home

3.8. Implementation of the Secret History Mobile Application (SHiMA)

The researcher implemented the Secret History Mobile Application (SHiMA) using the CommCare platform, which is known for its specialization in mobile health solutions. CommCare was selected for several reasons, including its reputation for being user-friendly and accessible, particularly in low-resource settings. Its platform offers a form builder interface that allows for the creation of custom applications without requiring extensive programming knowledge, making it ideal for healthcare workers who may not be tech experts. CommCare utilizes eXtensible Markup Language (XML) as the main programming language for the design of applications to structure and define forms and workflows. Additionally, CommCare's offline capabilities were essential for ensuring that SHiMA could be used in areas with limited or no internet connectivity, which is a common challenge in many healthcare environments.

The decision to integrate SHiMA into CommCare was also driven by the platform's strength in handling branching narratives, which is essential for the Choose-Your-Own-Adventure (CYOA) format that SHiMA employs. This format was adapted from the Secret History (SH) workshop method, originally designed to enhance healthcare workers' empathic skills through role-play and scenario-based learning. By transitioning from a workshop format to a digital tool, SHiMA was developed to enhance accessibility and scalability, overcoming the logistical and cost-related challenges of in-person training.

A key aspect of SHiMA's implementation is its emphasis on knowledge representation and ontology, which are critical for structuring the application's content. Knowledge representation in SHiMA involves organizing and presenting information in a way that is accessible and meaningful to the user, ensuring that healthcare workers can navigate the app's interactive narratives effectively. The ontology within SHiMA serves as a formal framework that defines the relationships between various narrative elements, enabling the app to simulate real-life healthcare scenarios with accuracy and depth. As users engage with SHiMA, they encounter a series of decision points that guide the progression of the story. The ontology's role is to map out these choices and their consequences, creating a dynamic and responsive narrative structure. This approach not only enhances user engagement but also fosters a deeper understanding of empathy and patient care. By exploring different outcomes based on their decisions, healthcare

workers can reflect on the impact of their actions, gaining insights into both their own and their patients' "secret histories".

Through this careful integration of knowledge representation and ontology, SHiMA ensures that the training experience is both educational and immersive. The structured narrative pathways allow users to experience the complexities of empathic care in a controlled yet reflective environment. This approach is crucial for developing a training tool that is adaptable to the diverse needs of healthcare professionals, providing them with the skills necessary to navigate the ethical and emotional challenges of maternity care.

3.9. Data management

A systematic approach was used to manage the large amount of textual data. To ensure easy accessibility and organization, all transcripts and field notes were imported into qualitative data analysis software. To ensure participant anonymity, each transcript was given a unique identifier. Individual-level data was de-identified before sharing. To maintain confidentiality, demographic data has only been shared at an aggregated level. Throughout the research process, data security was a top priority. All digital data was kept on a password-protected encrypted drive that was only accessible to authorized researchers.

3.10. Data analysis

Thematic analysis was utilized to detect recurring themes and patterns within the interview transcripts, focus group discussions, and co-design workshops (Braun & Clarke, 2019). NVivo was employed for data analysis, and codes were devised to facilitate the thematic analysis process. This method involved a six-phase process: familiarization with data, generating initial codes, searching for themes, reviewing themes, defining and naming themes, and producing the report.

3.11. Dissemination of study findings

This research aimed at developing a digital training tool for supporting empathic skills development in maternity settings. The findings of the study will be disseminated through academic publications and presentations at conferences.

3.12. Study rigor

The credibility of the study results was established through prolonged engagement with the data, peer debriefing, and member checking done by the academic supervisor. Thick descriptions and direct quotes will be used to enhance the transferability of findings.

3.13. Ethical considerations

All participants were provided with consent forms (see Appendix G and H) detailing the study's purpose, procedures, risks, benefits, and their rights as participants. Throughout the study, confidentiality and anonymity were maintained. To safeguard participant identities in the

reporting of findings, participant codes were assigned to all participants.

3.14. Summary of chapter

In this chapter, the researcher expounds on the systematic approach undertaken to conceptualize, develop, and implement SHiMA. The chapter provides a comprehensive overview of the research methods, design principles, and development strategies employed to ensure the efficacy of the mobile app. The development phase adhered to a well-structured sequence of phases encompassing the needs assessment, content development, application co-design, and pilot deployment of the mobile app.

To understand the fundamental goal of adapting the SH workshop method into a CYOA format, attention was given to the story creation and branching narratives. The narratives were crafted to offer diverse story outcomes based on user choices, balancing narrative complexity while ensuring an engaging user experience. To ensure the creation of a captivating and user-centred experience, SHiMA was developed using CommCare an open-source platform that can be accessed using an Android device. Ethical considerations were carefully addressed, ensuring user data privacy, informed consent, and adherence to ethical guidelines during the app's development and deployment.

CHAPTER 4: INSIGHTS FROM THE IMPLEMENTATION OF SHIMA

In this chapter, the researcher reports the results from two (2) interviews, four (4) co-design workshops, and two (2) focus group discussions with expert informants from PMHP and BBP, and midwives at the Al-Nisa Maternity Home. Each section is linked to the steps described in Section 3.7.3, which outlines the data collection procedure. The data collected in steps 1 through 4 was analysed to understand the effectiveness of this approach in enhancing empathy among healthcare workers in maternity settings. The main themes and patterns that emerged from the thematically analysed data are presented below. For this thematic analysis, participants' quotes are attributed with unique codes to preserve anonymity while providing context to the extracted themes.

The interview transcripts, focus group discussions, and co-design workshops were audio-recorded and then transcribed verbatim by the researcher to capture the full richness of the data. The transcription process was meticulously checked for accuracy, with a focus on ensuring that all spoken words were accurately represented in the transcripts. The analysis was conducted by the same researcher, who was responsible for coding the data to ensure a thorough and detailed examination of the information. The coding process involved assigning meaningful labels to segments of data that were relevant to the research questions. To enhance the reliability and validity of the findings, discussions were held with collaborators to discuss any discrepancies and to reach a consensus on the coding and interpretation of the data (Guest et al., 2012). This approach ensured that multiple perspectives were considered, thus enriching the analysis. Table 4 below shows codes assigned to each participant during the study.

Table 4: Participant Code attribution

Participant Group	Code Format	Example Code
PMHP Expert Informants	PA-1, PA-2, PA-3	PA-1 (PMHP Expert Informant 1)
BBP Expert Informants	BA-1, BA-2, BA-3	BA-1 (BBP Expert Informant 1)
Midwives	MW-1, MW-2, MW-3	MW-1 (Midwife Informant 1)

4.1. The secret history approach and empathic training

From the interviews conducted with expert informants (PA-1 and PA-2) during the needs assessment phase, they shared why it was a secret history training package was necessary highlighting the National Department of Health's request to develop a module for respectful maternity care as part of the obstetric emergencies program stating that;

> *"The National Department of Health asked us to design a module for respectful maternity care that could be used across the country as part of the essential steps in managing the obstetric emergencies package program upon realizing that we were teaching people how to save lives, but not addressing their*

attitudes." [PA-1 and PA-2]

The participants further posited that, at that time, they were running a pilot program in which they could integrate the training package into a mental health routine on the realization that there were several challenges that caused the health workers to be abusive to their patients. Meanwhile, an expert informant (PA-1) stated that;

> *"There was a toxic setting where health staff mistreated women in various harmful ways, including physical abuse and psychological abuse and a mental health program cannot thrive in an unhealthy setting…" [PA-1]*

Therefore, to promote respectful maternity care, the expert informants had their independent submissions stating what needed to be done. Expert informant (PA-2) shared that there is a need to;

> *"Unpack baggage that people have, understand that everybody is going through stuff in their lives and that not everybody can be treated the same…" [PA-2]*

and expert informant (PA-1) emphasised the need to;

> *"…develop a training package that addresses obstetric violence and helps staff understand their behaviors, fostering a safe environment for self-awareness and acknowledging the impact on patients..." [PA-1]*

4.2. Usefulness of a CYOA-based training

In physical workshops, a facilitator plays a crucial role in guiding participant interactions and creating a conducive learning environment. During the secret history workshop training, the facilitator acts as a mediator between the participants and the narrative. They introduce the workshop, set the context, and guide participants through the storytelling process and roleplay activities drawing on Augusto Boal's Theatre of the Oppressed which was stated in the literature review section of this thesis. From the interviews, the participants stated why it would be useful to have the secret history training app. From their independent submissions, expert informant (PA-2) envisioned that the mobile app

> *"Could be used for sensitizing health workers, retraining more experienced people still abusing women, orientation of new staff and equipping them to provide care in a respectful patient-centered care…" [PA-2]*

whereas expert informant (PA-1) shared that the app could

> *"…act as an independent training resource that doesn't depend on formal training courses, facilitators which require time off work, or additional funds and logistics. It can be game-like, and enjoyable for people …" [PA-1]*

Additionally, with the CYOA format, the interactivity and decision-making aspects mimic the roleplay and participant engagement seen in live workshops. According to midwife informant (MW-1),

"The app is an effective way of training as it forces you to participate by playing a given story on your device at your desired time…." [MW-1]

During the workshops, the participants saw the adaptation of the secret history training package as a way of supplementing existing training tools. According to the expert informants (PA-1 and PA-2), the tool could be used alongside the existing secret history physical workshop or independently. The findings from the interviews with the PMHP expert informants indicate that the mobile app may not necessarily replace face-to-face training but complement it i.e.

"Potentially act as a supplement to face-to-face training on empathic skills or face-to-face secret history training for we know from a lot of the training, behavioural change literature that one off training seldom makes substantial changes but and quite often one needs proper training…" [PA-2]
"I would love the app to be integrated into the National training curriculum. I think because the secret history training package is already embedded within the ESMOE program. So, this would be a resource that is more trainers to use…" [PA-1]

4.3. Multifaceted story paths

The CYOA format inherently encourages active engagement, where participants are not passive recipients but active decision-makers who shape the unfolding of the narrative. As part of the initial CYOA story structure, alternate story paths were brought forth as one of the proposed features of the CYOA mobile application. This involves creating multiple outcomes and narrative directions that participants can explore based on their decisions. During the interviews with PMHP, codesign workshops and focus group discussions focused on content development with PMHP and BBP expert informants, one of the proposed features for the CYOA mobile application, that participants were asked to comment on was the use of alternate stories as a mechanic. Expert informant (PA-2) and midwife informant (MW-2) posited *that*

"…the idea of using the app and having different options for the stories is something that the health workers can use on their own without needing a facilitator..." [PA-2 and MW-2]

Different choices have consequences that impact subsequent segments of the story, and some choices might lead to positive and negative story outcomes. Additionally, the findings indicate that the use of alternate storylines acts as a way of fostering imagination in more than one way to engage with the patients, and according to expert informant (PA-1), *"That is true to an adventure, and I think it relates brilliantly to secret history because it allows people to imagine more than one way of engaging with clients or patients…" [PA-1].* As a way of fostering engagement with the outcomes of the story, expert informant (PA-2) said that they are more interested in what happens at the end of the story. They stated that:

"...I would like to know what happens afterward from the choices made in the story…" [PA-2]

The health workers also agreed with this statement and said that the outcomes and events that follow based on the choices they make while playing the stories motivate them i.e.

"Our interest in the app on what happens next and the story itself motivates us

to select the skills we could have used in such a scenario…" [MW-1, MW-2 and MW-3]

Also, according to an expert informant (PA-2), the exploration of scenarios following a multifaceted story path fosters a deeper understanding and reflection of their secret histories from different angles i.e.

"This shows there was an interaction, there was this path chosen and there was an outcome and then there is a take-home message..." [PA-2],

the expert informants from BBP collectively agreed that;

"…it reinforces and makes the health workers reflect on their experience as they play the stories to maximize learning" [BA-1, BA-2, and BA-3]

And the midwife informants also added that:

"The app makes you aware of your colleague's struggles or what they may be going through, and you learn how to relate to them…" [MW-1, MW-2 and MW-3]

Healthcare workers become emotionally invested in the story's outcomes which profoundly drives their engagement as they make choices and witness the consequences of the narrative. This empowerment fuels their curiosity about the unfolding story and motivates them to select relevant skills for specific scenarios, as expressed by the healthcare workers.

4.4. Development of stories

The adaptation of the SH to a digital format involves the development of stories that align with the CYOA format and the goals of empathic training for health workers. To ensure coherent storytelling, and balance engagement and learning, the stories must maintain coherence and consistency to ensure that each narrative path contributes to the overall learning experience. However, one of the concerns expressed by one of the participants is that *"The scenario might get old or stale quite quickly."* The participant added that continually introducing unique scenarios of the narrative are important *"so as to keep people interested you would need to have a big bank of different flows and algorithms around the narratives and that would take quite a bit of ongoing work …" [PA-1].*

Additionally, since the stories are tailored to healthcare contexts, incorporating relevant scenarios, challenges, and decision points that the health worker might encounter is important. To ensure the participants are entertained and informed, expert informant (PA-1) added

"…we would need to feed the app with enough different scenarios to keep it fresh and, to keep the options wider in terms of the different stories" …[PA-1].

Therefore, maintaining narrative coherence and consistency is crucial to strike a balance between engagement and learning, although concerns have been raised regarding potential

monotony over time. The multiplicity of scenarios not only keeps the content fresh but also broadens the range of options within different stories.

4.5. Audience inclusion in story development

4.5.1. Inclusion of hospital management

The narrative scenarios presented in the CYOA format can be designed to mirror real-world situations relevant to healthcare workers. This approach facilitates practical learning and application. During our co-design workshops, the healthcare workers advised that much as it was important for them to learn empathic skills, it was also relevant to have a story tailored to the environment they work in.

> *"You should not only draw focus on workers on the ground but also go to the midwifery management because midwives treat their patients that way based on how they are treated by the management" [BA-1, BA-2, and BA-3]*

In response to this, a story was developed incorporating scenarios related to the hospital management and the healthcare worker.

4.5.2. Inclusion of persons with disabilities

Although our application primarily targets healthcare workers, in our focus group discussion with the therapists at Bhabhisana the participants stated that it would be good to have a story of a woman with a disability. They said;

> *"It is important to include that group of mothers/ patients who have had a difficult birth experience and have a child who now needs extra care. Or they have been told that now there is a problem with the baby, and they are going to have a disability. Because unfortunately, that community is often neglected..." [BA-1, BA-2 and BA-3]*

This is because a significant portion of their work involves caring for babies with special needs. The participants added that the story aims to provide insights into the experiences and needs of individuals with disabilities when they seek medical assistance at such facilities and also enables health workers to reflect on and learn how to best support patients in similar situations. However, since our focus of the app is to support health workers with empathic skills development, we instead added a story of an older woman with a disability. During the pilot study, the midwife informants said,

> *"This story makes you more aware of what this patient could be going through and ways in which you could be more supportive to them…" [MW-1, MW-2 and MW-3]*

This feedback indicated that this story heightened their awareness of the environment they work in and enhanced their ability to provide empathetic care for individuals with disabilities.

4.6. User-friendly experience

Designing a user-friendly interface is crucial for ensuring participants can easily navigate and engage with the CYOA mobile application. The expert informants said that to prompt participants to play the stories, all fields in the story should be made required so one must choose to continue. While exploring the stories on the app, the midwife informants collectively agreed with PMHP and said that,

> *"I liked the idea of not being able to proceed to the next part of the story without making a selection…" [MW-1, MW-2 and MW-3]*

Additionally, the healthcare workers liked the idea of making multiple choices on the sections where they must make selections on how they feel, what they think they need, what the patient needs, and how they imagine the patient is feeling.

> *"Sometimes you may feel more than one of the suggested choices and it is good that the app gives you the option of selecting more than one…" [MW-1, MW-2 and MW-3]*

To ensure there is a smooth flow while participants are navigating the story clearly, the expert informants from PMHP and midwives stated that clear instructions (added as text description in the app) should be added to enhance engagement. This is to create clarity and reduce confusion on the story aspects where the healthcare worker must make more than one choice of selection, they suggested that.

> *"Add an instruction in brackets i.e., choose as many as you can" and the part where only one selection needs to be made in the action part, emphasize that the user makes only one choice i.e. choose only one option …" [PA-1, PA-2, PA-3 and MW-1, MW-2, MW-3]*

For the final app design, all suggested changes were made and all sections that involved the healthcare worker's needs, feelings, and the patient's needs and feelings have an instruction asking the healthcare worker to "Tick all that apply". And, sections that require them to make only a single selection have an instruction directing the healthcare worker to "select one."

The initial design of the application involved having most of the text-based content, especially the empathic skills in the resources section which required the healthcare worker to scroll through the entire screen to view all content. According to the expert informants from PMHP,

> *"…some information does not fit on one screen, you could preferably limit the words, especially in wordy sentences..." [PA-1, PA-2, and PA-3]*

In response to this, in the final app design, the number of words presented on each screen were limited and the content was made clickable instead of scrollable. This was to allow the participants to view a single piece of content on a single phone screen.

Furthermore, storage constraints are one of the limiting factors that could impact every aspect of the user experience of a mobile app. Addressing concerns about storage constraints due to the multimedia content, such as images and videos in SHiMA, the research team sought feedback from healthcare workers regarding the app's impact on mobile phone space. Their positive response affirmed that the app's data space requirement, approximately 90MB, was well within acceptable limits, reflecting a thoughtful balance between content richness and user-friendly storage requirements.

4.7. Feedback and improvement process

Gathering user feedback is an essential way to enhance the digital training experience of participants. During the pilot testing of the mobile app, the participants felt the content presented in the stories was relatable but had a few concerns. For instance, according to midwife informant (MW-3),

> *"…the story was quite confusing at the beginning as I have to go back and forth about the secret history reveals to understand what is happening..." [MW-3],*

but as they went deeper into the story, it became quite easier to navigate through. While the use of mobile applications could be a good tool for healthcare worker training, the healthcare workers shared that not everyone would embrace this initiative i.e.

> *"The older generations may not embrace the app so well and may have challenges using it whereas the other groups of people would find it great and exciting…" [MW-1, MW-2, and MW-3]*

Additionally, the user feedback and data collected could be used to iteratively improve the mobile application. To add to this aspect, expert informants 2 and 3 added that.

> *"The mobile app allows providers to open up a sort of internal vision that can be broadened to appreciate the ritualized, standardized way of doing things, and that there are alternatives…" [PA-2].*

> *"I think it is a nice learning tool, instead of going through the options and having choices to change your mind and whatever, there is an opportunity of seeing how you could get a better outcome…" [PA-3].*

As a way of ensuring a consistent style of storytelling, all narratives started with unveiling the secret history of the healthcare worker followed by that of the patient to create an immersive and cohesive experience. The healthcare workers in the pilot deployment phase said that.

> *"I love the fact that you start with the health worker's story before going into detail. This enables the midwives to own the app since you are talking about them in the application before talking about the patient" [MW-1, MW-2, and MW-3]*

Also, as a means of having multi-stakeholder involvement, the healthcare workers, and expert informants from PMHP and BBP suggested that;

> *"While evaluating the system, you could interview the clients if they are willing to share how they are treated by healthcare workers who use the app, to determine the effectiveness of the application" [PA-1, PA-2, PA-3 and BA-1, BA-2, BA-3]*

This approach would provide insights into the application's effectiveness beyond the perspective of midwives, ensuring a more comprehensive assessment of its impact.

4.8. Summary of chapter

This chapter offers a comprehensive account of the findings derived from the research methods, encompassing interviews, co-design workshops, and focus group discussions with expert informants from PMHP and BBP, as well as midwives at the Al-Nisa Maternity Home. It provides a detailed description of the recurring themes and concepts for the adaptation of the Secret History workshop method to a digital training tool. The main themes and patterns that emerged from the thematically analysed data include a discussion on the secret history approach and empathic training, the Role of the facilitator and CYOA interaction, Multifaceted story paths and Development of stories, and Design and functionality of the mobile app. Further findings relate to the iterative codesign steps undertaken to develop the final CYOA flow structure with a description of key changes made to the initial structure as detailed in Chapter 5.

CHAPTER 5: CYOA STORY STRUCTURE DEVELOPMENT

Adapting the Secret History Workshop method for digital training involves transforming the narrative structure significantly. In digital training using a CYOA format, narrative restructuring entails crafting a storyline that evolves based on participant choices. Unlike traditional secret history workshops, where the facilitator guides a linear narrative, CYOA breaks the narrative into segments, each tied to a decision point. Participants' choices lead them down different story paths, revealing specific aspects of the secret history. This chapter references Steps 2-4 providing a detailed description of all the steps that led to the development of SHiMA

5.1. Description of the initial CYOA story structure

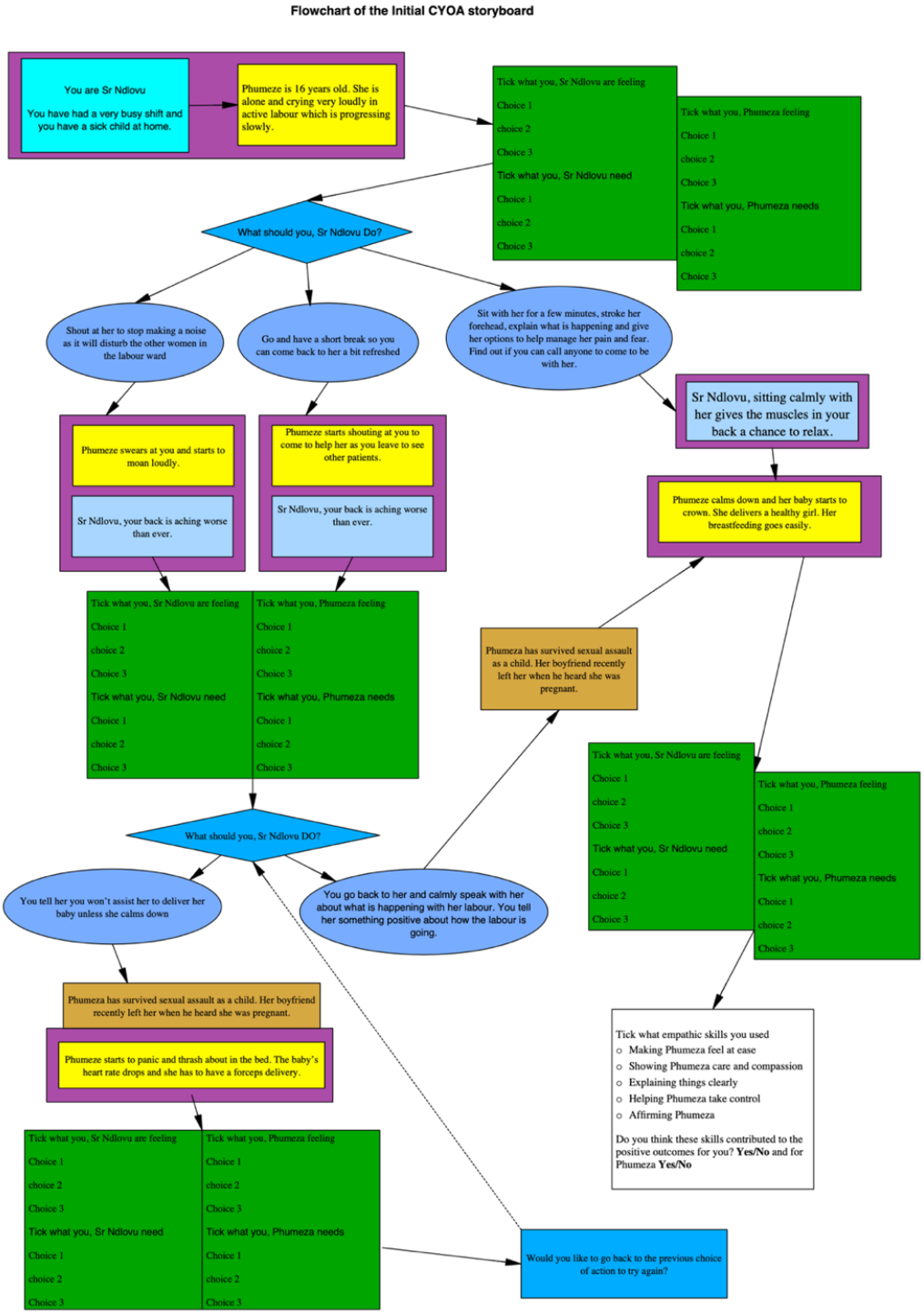
The initial CYOA structure was a result of conducting interviews during the needs assessment phase with expert informants at PMHP between June and July 2022 which involved first an understanding of the secret history and later co-design workshops during the content development phase which led to the development of the first CYOA storyboard structure. The initial structure comprised the "secret history reveals" for both the health worker (Sister (Sr) in this case) and the patient.

Upon unveiling both secret histories, the health worker is prompted to tick choices of what they feel and tick what their patient feels. They are then redirected to the branching aspect of the story where the health worker is asked "What do you, Sr Ndlovu do?" Three choices are given i.e., a bad choice, an intermediate choice, and a good choice for her to select from. Whichever choice she decides to take takes her to a different path. In this case, another secret history is revealed about the patient and the health worker will be availed to her based on what path she took. Here, she will then be asked to tick what she feels, and needs, and tick what the patient feels and needs based on her choice of path. Next, the health worker will be asked again "What should you, Sr. Ndlovu do?" And she will have two choices to select from i.e., a bad choice and a good choice. Whichever path she decides to take, whether good or bad, based on her choice of action, another reveal about the patient will be displayed to her. She will then have to again tick on what she will be feeling, what she needs, and tick what the patient would be feeling and what she needs.

In other words, for every decision the health worker makes while playing the story, they are taken on an adventure. This adventure keeps changing based on the choice of action in the story. For instance, should the health worker select the bad choice throughout the entire story, they will be taken through the different adventures along the selected path, and in the end, they will be asked if they would like to go back and try the same story again. Here they will have two choices "Yes/No" and if they answer yes, they will submit their initial story and then try again, however, if they say no, their adventure will end there. Should the health worker choose a good choice throughout the adventure, they will also be asked to select the different empathic skills they used while playing the story. They will also be asked if they think these skills

contributed to the positive outcomes of them and their patients. In Figure 4, the researcher shows the initial structure of the choose-your-own-adventure secret history mobile application.

Figure 4: Initial CYOA storyboard



When this initial storyboard was shown to the midwives during the application design phase between October and November 2022, the health workers shared that the health worker choices were obvious. According to the midwife participants,

"Moving from bad to somehow bad and viable choice of action makes it direct, and no health worker can choose a bad option. It would be great if you interchange these somehow, so it does not make it obvious on the app" [MW-1, MW-2, and MW-3]

The health workers also provided their insights on the resource section where they are asked to select the skills they might have used while playing the stories. According to MW-2 and MW-3, the reflection aspect should be tailored more to the health workers rather than the patients i.e.

"Let it be tailored to how the midwife feels e.g., do you need to go and lie down in a case where the health worker's back is hurting…" [MW-2 and MW-3]

Furthermore, expert informants at BBP supported the idea of tailoring the resource section to the needs of health workers, facilitating the collection of specific feedback on their feelings at the end of the story.

"…tailoring the resource section to the health worker is a good idea and provides room to collect more specific feedback on what the health worker feels at the end of the story…" [BA-1, BA-2 and BA-3]

The story structure developed provides a safe and controlled environment that allows the healthcare workers to interact and engage with the stories in the app while reflecting on their attitudes and learning empathy skills. It's important to note that, at this stage, considering time limitations, readers should be reminded of the choice made to consult experts and midwives rather than government health workers for this study. These findings have limitations since they rely on the opinions of individuals who are not actual end-users. However, the trustworthiness of these insights is supported by the participants' valuable experience, whether they were part of the target group, shared similar responsibilities, or had extensive experience working with the target group.

5.2. Changes to Co-Design

In this section, the researcher discusses the changes that were made to the initial storyboard based on the findings from the codesign workshops and also presents the flowchart of the final storyboard structure. The relationship between the initial storyboard and the final CYOA structure highlights the iterative refinement of both the visual design and narrative flow. In the early stages, the storyboard served as a foundational guide for mapping out the healthcare worker and client reveals, along with their respective feelings and needs. As the design evolved, feedback from co-design workshops helped refine the visual elements; icons, layout, and navigation ensuring a better user experience. The final CYOA structure, built upon this visual framework, allows for smoother transitions between narrative branches, enhancing the decision-making process. This evolution from the initial storyboard to the final structure ensured that both the storytelling and the user interface worked together to create an engaging empathy training tool.

5.2.1. Visual Elements and Co-design of the CYOA Story Structure

5.2.1.1. Navigating visual elements in the design of SHiMA

From the co-design workshops and the interviews, major concerns about the use of visual elements such as images, videos, and animations were brought forth during the discussions. Every participant had their concerns as regards the choice of visual element that could be incorporated into the mobile application. All initial feedback was against the use of videos because of storage issues that participants expressed. Since the researcher had not exploited the aspect of visuals in depth, they decided to give it a go in the final application design. The researcher made use of images and animations to emphasize the different features such as unveiling who the patient is in the story, the health worker's reveal, the feelings, and needs associated with each of them, and the health worker's choice of action.

In addition, the researcher incorporated low-sized videos and the different URLs to text-based online resources in the resources section of the application. A player can access this upon completion of the adventure, and they can view the videos within the application. Should they want to watch and learn more information based on the video, full URL links to the sources of the videos have been provided and this would need them to use their data.

The initial story structure only prompted participants to access the resources upon exploring the positive path (good choice) while they were playing the stories. With the new structure, a player can access the resources even when they select the negative path (bad choice) provided they select "No" when they are told "Sorry! It did not go well this time for you and for your patient. Would you like to go back to the beginning to play again and choose another path?" and then select "yes" on the next question where they are asked "Would you like to discover what skills may have helped?"

5.2.1.2. Final CYOA Secret History story structure

Throughout the development of the stories and the CYOA structure, the researcher referred to the core goals and principles of the SH workshop method, a training curriculum aimed at training maternity staff for mental health promotion (https://pmhp.za.org/wp-content/uploads/PMHP-Secret-History-Evaluation.pdf). The idea of reflecting on one's actions is one of the critical aspects of the SH workshop method. While developing the final CYOA story structure, the researcher tried to mimic some of these aspects. Figure 11 shows the final CYOA structure that was developed. This structure incorporates the use of different CYOA components such as story nodes, branching, and multiple choices as a medium of flow to add eight different stories to the mobile application. Story nodes refer to specific points in the narrative structure where the story can branch based on user choices or interactions. Within the CYOA ontology, the narrative is divided into discrete story nodes, each representing a distinct point in the storyline. These nodes encapsulate text, scenarios, and detailed information about the characters and situations encountered in the story. Providing granularity to the narrative enables the learner to navigate the healthcare training experience effectively. The description of various parts of the general flow of the stories is described below with an example story description of "Phumeza who is a teen mother".

5.2.1.3. Relationship between the story structure and flow

In the CYOA story structure, the interplay between the healthcare worker (HW) and client reveals, feelings, and needs are important in driving the narrative and fostering empathy. The

HW's reveal provides personal background information, such as stress or exhaustion, which influences their emotional state and decisions. Similarly, the client's reveal offers insight into their vulnerability or fear, giving the HW context for empathic care. As the HW navigates the narrative, they reflect on their feelings and needs while also considering the client's emotional and physical needs. These reflective moments guide the HW's choices, with each decision leading to different outcomes based on how well they balance both their own and the client's needs. Appendix J shows an example of a story created using the flowchart.

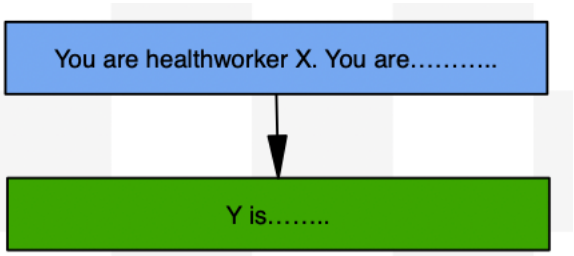
Health worker reveals

This is the back-end story/ secret history of the health worker and provides an overview of who the health worker is in that story. An example of the health worker reveal is: *"You are health worker Ndlovu. You have had a very busy shift, and you have a sick child at home"* for a story about a teenager in labour."

Client reveals

This is the back-end story of the client and provides the health worker with the details of who their client is in that story. An example of the client reveal is: *" Phumeza is 16 years old. She is alone and crying very loudly in active labour. Her labour is progressing slowly. She says she wants to push, but she is only 8cm dilated."*

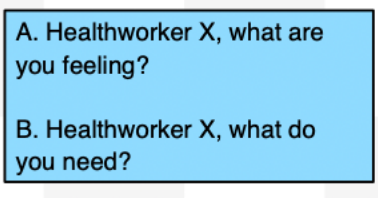
Figure 5: Health worker and Client reveals



Health worker feelings and needs

This is an emotion and needs aspect of the story and provides the health worker with options of what they think they are feeling and what they think they need after reading their story and that of their client.

Figure 6: Health worker feelings and needs



An example of what the health worker is feeling and what they need are shown below as extracted from the teen story:

Health worker Ndlovu, what are you feeling?

- A break
- Some help from your family.
- Some help from your colleagues

➔

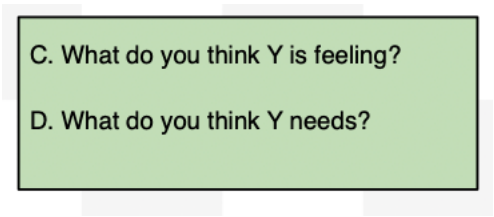
Health worker Ndlovu, what do you need?

- Exhausted
- Worried
- Resentful

Client feelings and needs

This is an emotion and needs aspect of the story that provides the health worker with options they might imagine what their client is feeling and what they think their client needs. Examples of the health worker feelings and needs for the teen story are reflected on the app.

Figure 7: Client feelings and needs



An example of what the client is feeling and what they need are shown below as extracted from the teen story:

What do you think Phumeza is feeling?

- Scared
- Ashamed
- Confused

➔

Health worker Ndlovu, what do you need?

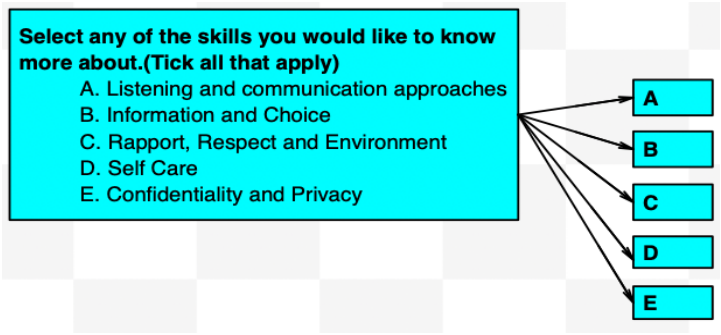
- Relief from pain
- Explanations
- Emotional support

Skills

- This is the resource section of the CYOA story. It provides the health worker with the various skills to select from and they can learn more about the selected skill. The skills comprise the description of the given skill and more resources in the form of videos and PDF materials that the health worker can access. Some of the skills of the teen story include;

- Listening and communication: Realised that she was afraid and reflect this feeling to her
- Helped her feel calm and relaxed
- Gave her accurate and clear information about her labour
- Showed kindness by spending time with her, holding her hand, and rubbing her back
- Asked her permission to do the vaginal exam
- Explored more support for her (birth companion)
- Freedom in choosing a birthing position
- Shared information about her labour
- Used a short break to look after your body
- Used a short break to find support for your needs at home

Figure 8: Skills and resource section



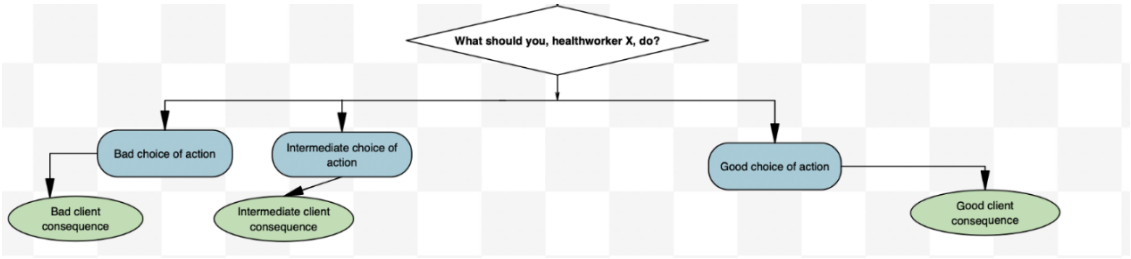
CYOA branching narratives

The initial narrative consists of two alternate story paths i.e., bad choice of action, intermediate choice of action, and good choice of action. Each of these once selected leads to a corresponding consequence i.e., bad, intermediate, or good dependent on the action decision made initially. An example of the actions and consequences for a given story (teen story) are shown in the table below and the layout of the branching narratives is shown in Figure 6;

Table 5: Example format of the initial CYOA actions and consequences

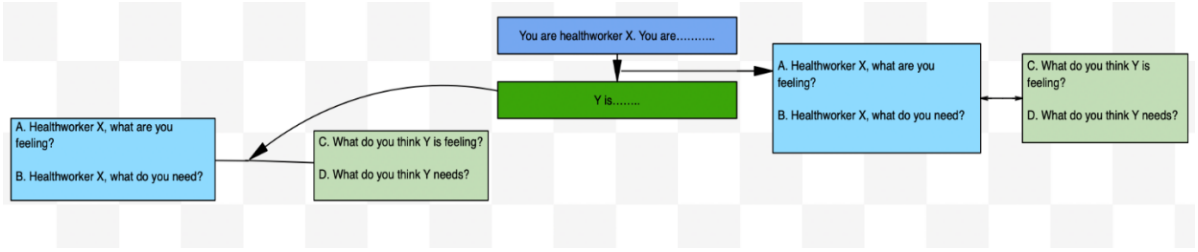
What should you, health worker X, do?		
Choice of action	**Example format for action**	**Example format for consequence**
Bad	Shout at her to stop making a noise as it will disturb the other women in the labor ward	Phumeza swears at you and starts to moan loudly.
Intermediate	Leave her on her own so that she can calm down	Phumeza starts shouting at you to come to and help her as you leave to see other patients.
Good	You sit with her for a few minutes, hold her hand, and say to her that it must be frightening for her. You explain what is happening and give her options to help manage her pain and fear like deep breathing. You ask if you can call anyone to come to be with her. You give Phumeza some options for birth positions and explain why it is too early to push.	Phumeza calms down and asks if she can call her boyfriend. On all fours, her pain seems more manageable. She follows your advice not to push yet.

Figure 9: initial CYOA choices



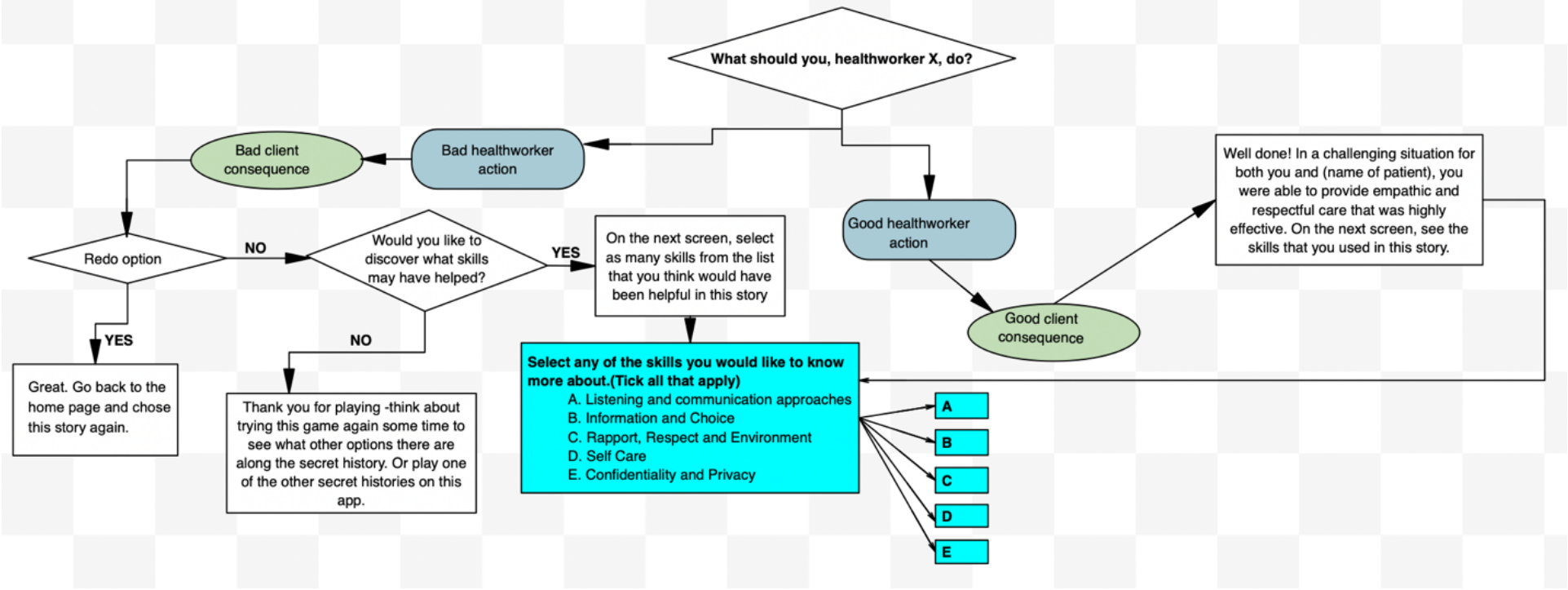
Also, apart from the initial reveals, once the health worker has taken on a given path in a story, they are introduced to a new reveal about themselves and their client. From this aspect, they are asked what their feelings are, their needs, what they think their client might be feeling, and what they think they need. These are in response to the actions that one decided to choose e.g. Bad or intermediate or good.

Figure 10: Health worker and client reveals during narrative branching



On the next step, the health worker will be availed with two options i.e., bad, and good choice of action and they will be prompted to select one of them. For whichever option they decide to take, they will be taken to a different outcome as illustrated in figure 8 below. A summary of the entire secret history CYOA flow chart showing what happens at the different decision points is shown in Figure 9 appendix I. The screenshots showing the final prototype of SHiMA are also shown in Appendix J (where a good choice has been made while playing the story) and Appendix K (an alternate path where a bad choice has been made while playing the story). The implementation of SHiMA following the branching narratives on the storyboard is described in detail in section 3.8 of this thesis.

Figure 11: Final CYOA story paths and outcomes



CHAPTER 6: DISCUSSION AND ANALYSIS

This chapter entails a discussion of the findings obtained from the qualitative research study conducted on the development of a platform that supports the representation of secret history materials using CYOA to facilitate healthcare worker training. To recap from Chapter 1, the study seeks to understand what adaptations can be made to the SH workshop method to support digital training using CYOA. Below the researcher discusses the knowledge representation of empathy skills using the CYOA format and how the choice of platform for the development of such a framework may affect the viability and sustainability of the application while drawing examples from related literature. The researcher reflects on the lessons learned throughout the study and provides further directions for future work in the conclusions chapter.

6.1. Knowledge representation of empathy skills and assessment

The CYOA ontology, like any other "interactive digital storytelling ontology, allows a user to become an active part of a narrative and affects how a story folds" (Smed et al., 2019) (Recap from section 2.10). CYOA ontology for healthcare worker training in maternity settings is underpinned by a unique story structure, which sets it apart from other ontologies used in training and education. The ontology's story structure, co-designed with PMHP, is specifically tailored to create an engaging and effective training tool. It incorporates various specific structures, such as story nodes (as described in section 5.2.2 of chapter 5), choices, branching logic, and multiple endings, each of which plays a crucial role in shaping the narrative and the learning experience as detailed below.

Choices

The heart of CYOA storytelling lies in the choices healthcare workers make as they progress through the narrative. These choices are visually represented as connections between story nodes, allowing users to make decisions at critical junctures in the story. This interactive aspect fosters a deeper engagement with the content and provides healthcare workers with a sense of agency, which is not typically a feature of traditional story ontologies used in training.

Branching Logic

CYOA narratives involve multiple branching pathways based on user choices. This branching logic is implemented in the ontology as decision trees or rules that govern how the story unfolds in response to user decisions. This dynamic nature is a notable departure from linear storytelling and traditional training ontologies, where the story's course is predetermined.

Multiple Endings

In line with the CYOA format, the ontology supports multiple possible endings to the story. These endings are incorporated into the ontology's structure, ensuring that the outcome is influenced by the choices made by the healthcare workers. This feature encourages replayability and reinforces the idea that their decisions matter.

The CYOA ontology shares similarities with general story ontologies, such as the use of story nodes and connections between them, as well as the inclusion of multiple endings. However, it stands out by focusing on interactivity, personalization, and empathy development, which are not as prominently featured in other training ontologies. The CYOA ontology allows healthcare workers to actively participate in shaping the narrative, thereby enhancing their training experience. Additionally, the CYOA ontology can be seen as related to ontologies of oral histories. It offers a controlled, interactive environment for healthcare workers to explore various scenarios and perspectives, even if the content isn't historically related to their context. This interactive aspect can contribute to their preparedness for real-life healthcare situations, providing valuable training dynamically and engagingly.

Furthermore, to support the scale of SH materials in a digital format, CYOA has been used as a formal, explicit specification of an ontology. This study works on extending work by Nakasone and Ishizuka (2006), where the researchers propose ontologies as a model for stories (Nakasone & Ishizuka, 2006) by developing a structure of the stories they represent and characterising the CYOA elements of story branching as a model of concepts. The CYOA structure has been developed to support future CYOA developers by allowing them to craft stories and link them to educational resources. Some ontologies such as the virtual patient ontology and the Graph-based multi-hop Reasoning on Emotional Causality (GREC) ontologies incorporate AI for knowledge representation. For example, the "Virtual Patient" ontology uses interactive narratives to simulate real-life patient scenarios and help healthcare workers develop empathy skills (A. A. Kononowicz et al., 2019; Suárez et al., 2022) and GREC incorporates the emotional causality into an empathic response by exploring “how the emotion emerges and provides a deeper understanding of the speaker’s emotion” (Wang et al., 2021). While these examples and CYOA are one of the ways of knowledge representation to learn about the characteristics and behaviours of agents, the CYOA structure employed offers a narrative approach that enhances empathy and understanding of patients by utilizing a storytelling format that allows users to choose their path through the narrative, making decisions that affect the outcome of the story.

6.2. Implications of platform selection

The type of platform to be considered for the development of digital health interventions can have a significant implication on its viability and sustainability in resource-constrained settings (Marais, 2011; Pade et al., 2008). Beginning with our initial considerations and requirements, which included factors like device limitations, intermittent connectivity, data costs, and learnability, the implications of platform selection become evident. The choice of the platform, encompassing both the device type and the mobile platform, (Molapo & Densmore, 2015) directly influences the success and effectiveness of the application. The challenge lies in balancing these considerations to ensure viability and sustainability. Additionally, long-term maintainability and learnability, both for healthcare workers and future content creators, must be prioritized to guarantee the continued relevance of the digital health intervention.

Data Constraints and Co-Design Process

In the realm of healthcare mobile app development, data constraints are often a critical factor that shapes the project's design and implementation. In resource-constrained environments, access to reliable internet connectivity can be erratic or absent. A study by (Mechael et al., 2010) found that limited connectivity is a common issue in healthcare service delivery in low-resource settings. Through the co-design process, these constraints were reaffirmed, and design requirements were adapted accordingly. The interactions with co-designers underscored the need for robust offline capabilities. This reaffirmed the requirement for the SHiMA app to operate seamlessly without a consistent internet connection, aligning with findings by Pokhrel et al., emphasizing the importance of offline functionality in healthcare apps (Pokhrel et al., 2021).

Maintenance in ICT4D Projects

Maintenance poses an enduring challenge in the realm of Information and Communication Technology for Development (ICT4D) projects, and its intricacies are influenced by platform choices. Notably, Gu and Li, illuminate the issue of fragmentation within Android ecosystems, emphasizing the complexity of ensuring consistent software updates in contrast to the more streamlined approach in the iOS ecosystem, thereby underscoring the platform's role in influencing maintenance costs (Gu & Li, 2022). Mechael et al.'s study underscores the significance of considering costs when selecting a platform in the context of digital health interventions, particularly in resource-constrained settings (Mechael et al., 2010). Furthermore, Agarwal et al.'s research highlights the prevalence of Android devices in low-income countries, emphasizing the importance of platform choices in reaching a broader user base (Agarwal et al., 2015). The debate between iOS and Android platforms, as informed by these research findings, profoundly affects the accessibility and sustainability of digital health initiatives, shaping development efforts and the potential to extend the reach of such interventions.

CYOA and Educational Resources

In the context of educational resources using the Choose Your Own Adventure (CYOA) format, the choice of platform holds substantial sway over the extent of customization and the effective integration of multimedia elements. Palioura and Dimoulas', which delves into interactive storytelling platforms, provides valuable insights into the pivotal role of these considerations when crafting educational CYOA resources (Palioura & Dimoulas, 2022). Their findings emphasize the importance of selecting a platform that offers an intuitive interface for educators and content creators, enabling them to easily create and adapt interactive narratives in alignment with educational goals. Furthermore, the platform's ability to seamlessly incorporate multimedia elements, including videos and images, emerges as a key factor in enriching the overall educational experience. In light of this research, it becomes evident that customizability, content creation simplicity, and multimedia integration serve as pivotal criteria when evaluating platform options for CYOA-based educational resources.

Limited Customization Options (Font style and background colours)

One of the limitations of CommCare is the limited ability to customize the user interface. The platform restricts developers from changing font styles and background colours. This was a drawback when trying to create a branded or visually appealing application, as the customization options are limited.

Limited Support for Rich Media (Multiple images on one screen)

CommCare has limitations when it comes to incorporating multiple images on one screen. This can be a significant limitation for applications that require visual content or multimedia presentations hindering the creation of an immersive user experience. For instance, during the app development, there were some instances in the stories on the application that the stakeholders wanted to have at least more than one image added but this was not possible since it is not supported by CommCare.

Saving user progress (Tracking story engagement)

CommCare lacks the necessary features for comprehensive engagement tracking and user progression management. For instance, when the healthcare worker starts exploring a given story on the app, they must complete the entire story in one sitting, and should they be interrupted at any point in the story and they are unable to continue playing, their progress will not be saved, and they will be required to play the story again.

Cost Considerations

CommCare is a freemium platform that offers only limited features using the free plan and the use of a full range of features on the licensed packages which are costly. Additionally, the free plan allows up to only 5 users which is a limitation if a project has many participants.

Learning Curve

CommCare has a unique development environment and workflow that may require some time for developers and project managers to learn and adapt to. For instance, during the study, it took the researcher some time to learn how different logic expressions could be used to bring out a CYOA perspective in the app. This learning curve can be a limitation for organizations looking to quickly deploy mobile applications without extensive training and preparation.

The limitations stated above emerged during the codesign workshops with our participants when they were interacting with the prototype of the app where they wanted different features to be incorporated into the SHiMA. All these emerging requirements opened room for more flexibility on which platform could have been considered for the development of the app rather than CommCare.

Based on the findings in this study and the limitations mentioned above, storytelling needs a platform that supports;

1) more customizability to make it more aesthetically pleasing (creating a fun audience instead of a more work-data-oriented data collection),
2) user experience optimization and narrative progression i.e., stories are typically nonlinear, interactive narratives and not structured surveys and forms,
3) that supports the collection of interaction data for apps aimed at supporting behaviour change (CommCare makes it hard to collect this kind of data).

In conclusion, while the CommCare platform supported the development of the CYOA mobile application, its limitations, such as its limited customization capabilities, may affect the sustainability of the intervention in the long term. Table 7, highlights the strengths and

weaknesses of choosing Redcap, building native mobile apps, SMS-based platforms, and Web-based platforms (recap from section 2.11 about these platforms).

Table 6: Comparison table of platforms to support the development of storytelling apps for behaviour change

Feature	Platform type	Strengths	Weaknesses
Customizability	Redcap	Designed for non-linear data collection	Not suitable for linear storytelling
	Building native apps	Offers high levels of customizability of the mobile apps	App development is time-consuming, costly, and demands expertise
	Web-based platforms	Provides flexibility to design and aesthetics using CSS, HTML and JavaScript languages	Requires web development skills for advanced customizations and interactivity
	SMS -based platforms	Supports customizability through text-messaging	Limited visual customizations due to text-based nature. Limited multimedia support
user experience optimization and narrative progression	Redcap	Designed for data collection which may not align with storytelling's linear nature	Has limited support for advanced storytelling game mechanics. Could require extensive customization for behavior change specific features
	Building native apps	Offers full control over user experience and narrative progression. Supports multiple mobile based operating systems i.e., both Android and iOS.	Development time can be consuming and costly requiring expertise in app development.
	Web-based platforms	Offers full control over user experience and narrative progression. Supports multiple operating systems i.e., both Android and iOS for phones.	Can be limited in terms of scalability with very large-scale apps. Could require constant updates and maintenance which become costly in the long run
	SMS-based platforms	Offers control for linear text-based narratives.	Limited interactivity for behavior change
Data collection for behavior change apps	Redcap	Designed specifically for data collection making it suitable to track forms and surveys. Supports offline data collection	Requires extensive customization for behavior change specific features
	Building native apps	Can be tailored to collect app interaction including user engagement and behavior change metrics. Supports offline data collection	Requires extensive customization for behavior change specific features
	Web-based platforms	Offers a wide range of tools for collecting user interaction.	Limited support for offline data collection
	SMS-based platforms	Collects data for only text-based interactions. Supports offline data collection	Limited interactivity for behavior change

CONCLUSION

In summary, the development of SHiMA marks a significant step towards enhancing empathy among healthcare workers through an innovative digital approach. This CYOA self-learning tool was designed to foster an understanding of empathy's pivotal role in healthcare interactions. By enabling healthcare workers to navigate diverse narratives, SHiMA employs a digital storytelling approach that allows users to explore various narratives, unveiling both healthcare workers' and clients' perspectives. Additionally, it empowers them to reflect on their attitudes towards clients and their influence on care quality.

In the study, the researcher explored the design considerations for adapting secret history to CYOA while balancing creativity and incorporating elements that ensure a narrative flow and an immersive experience with multiple outcomes based on the path taken in the story. These features empower healthcare workers to reflect on their behaviour towards patients. Furthermore, a discussion on what factors need to be considered while choosing a platform for CYOA storytelling apps for behaviour change has been added (Recap from chapter 5) for any future CYOA app developers to consider while developing such apps.

The final CYOA story flowchart in Appendix I offers significant strengths for developing interactive narratives, such as fostering deep engagement and reflective practice among healthcare workers by allowing them to make critical decisions and reflect on emotions and needs. It also provides a dynamic learning experience with branching logic and multiple outcomes, enhancing replayability and learning. However, its complexity in design and implementation, coupled with the need for significant resources to maintain multimedia elements, poses challenges. Additionally, the potential for cognitive overload and technical constraints in low-resource settings are critical weaknesses that need careful management to ensure effective use.

The integration of the SH workshop method into a mobile application, while retaining the core elements of role play and reflection, presents a promising approach to fostering interactive and personalized learning experiences for healthcare workers. Similar to a study conducted by Molapo et al. which highlights the effectiveness of roleplay in enabling community health workers to explore their interactions with clients through drama format, this study introduces a novel dimension of this approach **(**Molapo et al., 2016a**)**. The CYOA mobile app supports interaction by providing the health worker with a story entailing their secret history and that of their client.

Furthermore, this study draws on findings from a study conducted by Beck et al. (2017) which focuses on CYOA as an evidence-based learning strategy in medical education (Beck et al., 2017), by giving participants the freedom to make independent decisions regarding their preferred paths and allowing ample time for self-reflection on the outcomes. However, the unique aspect that sets our approach from this is that it enables health workers to delve deeper into the consequences of their decisions without the pressure of immediate responses. Also, our pilot study demonstrated the efficacy of this approach when participants actively discussed the various stories, perceptions, and their implications amongst themselves. This high level of engagement and intellectual involvement among the participants indicates the potential of our

interactive mobile application to optimize and promote active learning within the healthcare workforce.

Acknowledging certain limitations, the researcher recognizes that additional usability tests with health workers post-pilot evaluation were not conducted to gauge the application's effectiveness comprehensively. In upcoming research, employing feasibility studies with healthcare workers in public health centres will provide insights into the app's impact on patient care. This effort will seek to refine and validate SHiMA's effectiveness in enhancing empathy among healthcare workers and improving patient-centred care.

The exclusion of mothers from the study was primarily driven by the nature of the method that was being adapted. However, including mothers in future work could significantly enrich the study. Mothers, being primary stakeholders in maternity care could provide invaluable insights into their experiences and perspectives, offering a more comprehensive understanding of the effectiveness of the CYOA tool. Their involvement would allow for a direct assessment of the tool's impact on the target audience i.e. those directly experiencing maternity care. Their experiences would also contribute to refining the narratives. Including mothers in future research would not only address the current gap in participant representation but also enhance the study's depth, relevance, and potential impact on improving maternal healthcare outcomes.

Future project work will also involve formal evaluation of the app with many healthcare workers. This study will aim to evaluate the feasibility, acceptability, and initial outcomes of SHiMA. The participants involved will be midwives in maternity obstetric units. The health workers will be given two weeks to engage with the application and both baseline and end-line assessments including enrolment, focus group discussions, and surveys on self-assessment of empathy will be conducted. Additionally, other means of representing the CYOA structure of the SH workshop method will be explored. A chatbot interface to interact with the stories so that platforms such as WhatsApp can be leveraged to convey the stories will be explored.

The feedback received from midwives revealed concerns about the installation process through CommCare, suggesting the need for a more user-friendly installation approach. The midwives also recommended exploring an option to save the progress of the narrative, catering to users who have not been able to complete the story in one sitting. Future work will consider developing an application that can support the saving of the narrative progression.

REFERENCES

Agarwal, S., Perry, H. B., Long, L. A., & Labrique, A. B. (2015). Evidence on feasibility and effective use of mHealth strategies by frontline health workers in developing countries: systematic review. *Trop Med Int Health*, *20*(8), 1003-1014. https://doi.org/10.1111/tmi.12525

Aldrich, C. (2005). *Learning by doing: A comprehensive guide to simulations, computer games, and pedagogy in e-learning and other educational experiences*. John Wiley & Sons.

Alqahtani, F., & Orji, R. (2020). Insights from user reviews to improve mental health apps. *Health informatics journal*, *26*(3), 2042-2066.

Angeli, E. L., & Campbell, L. (2017). Intuition in healthcare communication practices: Initial findings from a qualitative inquiry. 2017 IEEE International Professional Communication Conference (ProComm),

Bano, M., Zowghi, D., & Rimini, F. d. (2018). *Power and Politics of User Involvement in Software Development* Proceedings of the 22nd International Conference on Evaluation and Assessment in Software Engineering 2018, Christchurch, New Zealand. https://doi.org/10.1145/3210459.3210477

Barron, P., Peter, J., LeFevre, A. E., Sebidi, J., Bekker, M., Allen, R., Parsons, A. N., Benjamin, P., & Pillay, Y. (2018). Mobile health messaging service and helpdesk for South African mothers (MomConnect): history, successes and challenges. *BMJ global health*, *3*(Suppl 2), e000559.

Beck, J., Rooholamini, S., Wilson, L., Griego, E., McDaniel, C., & Blankenburg, R. (2017). Choose your own adventure: leading effective case-based learning sessions using evidence-based strategies. *MedEdPORTAL*, *13*, 10532.

Bird, M., McGillion, M., Chambers, E., Dix, J., Fajardo, C., Gilmour, M., Levesque, K., Lim, A., Mierdel, S., & Ouellette, C. (2021). A generative co-design framework for healthcare innovation: development and application of an end-user engagement framework. *Research Involvement and Engagement*, *7*, 1-12.

Bohren, M. A., Vogel, J. P., Hunter, E. C., Lutsiv, O., Makh, S. K., Souza, J. P., Aguiar, C., Coneglian, F. S., Diniz, A. L. A., & Tunçalp, Ö. (2015). The mistreatment of women during childbirth in health facilities globally: a mixed-methods systematic review. *PLoS medicine*, *12*(6), e1001847.

Boulos, M. N. K., Gammon, S., Dixon, M. C., MacRury, S. M., Fergusson, M. J., Rodrigues, F. M., Baptista, T. M., & Yang, S. P. (2015). Digital games for type 1 and type 2 diabetes: underpinning theory with three illustrative examples. *JMIR Serious Games*, *3*(1), e3930.

Bran, A., & Vaidis, D. (2019). Choose your own risks: measuring risk-taking through an interactive novel.

Braun, V., & Clarke, V. (2019). Reflecting on reflexive thematic analysis. *Qualitative research in sport, exercise and health*, *11*(4), 589-597.

Cao, Y., Ng, G.-W., & Ye, S.-S. (2023). Design and Evaluation for Immersive Virtual Reality Learning Environment: A Systematic Literature Review. *Sustainability*, *15*(3), 1964. https://www.mdpi.com/2071-1050/15/3/1964

Center for Health Market Innovations. (2023, 2023). *CommCare*. Center for Health Market Innovations webiste. Retrieved 27 September from https://healthmarketinnovations.org/program/commcare-0

Chemali, S., Mari-Sáez, A., El Bcheraoui, C., & Weishaar, H. (2022). Health care workers' experiences during the COVID-19 pandemic: a scoping review. *Human Resources for Health*, *20*(1), 27. https://doi.org/10.1186/s12960-022-00724-1

Chhetri, A., Iversen, M., Kaasbøll, J., & Kanjo, C. (2019). Evaluating mHealth Apps Using Affordances: Case of CommCare Versus DHIS2 Tracker. Information and Communication Technologies for Development. Strengthening Southern-Driven Cooperation as a Catalyst for ICT4D: 15th IFIP WG 9.4 International Conference on Social Implications of Computers in Developing Countries, ICT4D 2019, Dar es Salaam, Tanzania, May 1–3, 2019, Proceedings, Part I 15,

Cho, M.-K., & Kim, M. Y. (2024). Effectiveness of simulation-based interventions on empathy enhancement among nursing students: a systematic literature review and meta-analysis. *BMC nursing*, *23*(1), 319.

Christiansen, A. (2011). Storytelling and professional learning: A phenomenographic study of students' experience of patient digital stories in nurse education. *Nurse education today*, *31*(3), 289-293.

Chrysanthakopoulou, A., Kalatzis, K., & Moustakas, K. (2021). Immersive Virtual Reality Experience of Historical Events Using Haptics and Locomotion Simulation. *Applied Sciences*, *11*(24), 11613. https://www.mdpi.com/2076-3417/11/24/11613

Dimagi. *CommCare Fundamentals - CommCare Overview*. Dimagi. Retrieved 27 September from https://confluence.dimagi.com/display/commcarepublic/CommCare+Fundamentals+-+CommCare+Overview

Dimagi. (2023a, 2023). *CommCare, The digital platform for impactful frontline work everywhere*. Dimagi. Retrieved 20 September from https://www.dimagi.com/commcare/

Dimagi. (2023b). *Explore CommCare's powerful features.* Retrieved 27 September from https://www.dimagi.com/commcare/features/

El-Rashidy, N., El-Sappagh, S., Islam, S. M. R., H, M. E.-B., & Abdelrazek, S. (2021). Mobile Health in Remote Patient Monitoring for Chronic Diseases: Principles, Trends, and Challenges. *Diagnostics (Basel)*, *11*(4). https://doi.org/10.3390/diagnostics11040607

Fatimah, D. (2018). Script knowledge representation in game designing for instructional media. IOP Conference Series: Materials Science and Engineering,

Freedman, L. P., Ramsey, K., Abuya, T., Bellows, B., Ndwiga, C., Warren, C. E., Kujawski, S., Moyo, W., Kruk, M. E., & Mbaruku, G. (2014). Defining disrespect and abuse of women in childbirth: a research, policy and rights agenda. *Bulletin of the World Health Organization*, *92*, 915-917.

Goldberg, S. B., Lam, S. U., Simonsson, O., Torous, J., & Sun, S. (2022). Mobile phone-based interventions for mental health: A systematic meta-review of 14 meta-analyses of randomized controlled trials. *PLOS Digital Health*, *1*(1), e0000002. https://doi.org/10.1371/journal.pdig.0000002

Gu, G., & Li, Z. (2022). Technology Fragmentation, Platform Investment, and Complementary Innovation. *Platform Investment, and Complementary Innovation (March 14, 2022)*.

Guest, G., MacQueen, K. M., & Namey, E. E. (2012). *Applied thematic analysis*. sage.

Honikman, S., Field, S., & Cooper, S. (2020). The Secret History method and the development of an ethos of care: Preparing the maternity environment for integrating mental health care in South Africa. *Transcultural Psychiatry*, *57*(1), 173-182.

Hsieh, M.-C., & Lee, J.-J. (2018). Preliminary study of VR and AR applications in medical and healthcare education. *J Nurs Health Stud*, *3*(1), 1.

Jenkins, H. (2004). Game Design as Narrative Architecture In Wardrip-Fruin, N. & Harrigan, P.(eds.) First Person: New Media as Story, Performance, and Game. *Cambridge: The MIT PRess. Recuperado de http://www. electronicbookreview. com/thread/firstperson/lazzi-fair el*, *25*(01), 2018.

Jewkes, R., & Penn-Kekana, L. (2015). Mistreatment of women in childbirth: time for action on this important dimension of violence against women. *PLoS medicine*, *12*(6), e1001849.

Jin, Y., Wu, Y., & Li, J. (2022). Midwife empathy and its association with the childbirth experience: a cross-sectional study. *BMC Pregnancy and Childbirth*, *22*(1), 1-10.

Kapadia, M., Muniz, C. M., Sohn, S. S., Pan, Y., Schriber, S., Mitchell, K., & Gross, M. (2019). JUNGLE: an interactive visual platform for collaborative creation and consumption of nonlinear transmedia stories. Interactive Storytelling: 12th International Conference on Interactive Digital Storytelling, ICIDS 2019, Little Cottonwood Canyon, UT, USA, November 19–22, 2019, Proceedings 12,

Katule, N., Rivett, U., & Densmore, M. (2016). A family health app: Engaging children to manage wellness of adults. Proceedings of the 7th Annual Symposium on Computing for Development,

Kharrazi, H., Faiola, A., & Defazio, J. (2009). Healthcare game design: behavioral modeling of serious gaming design for children with chronic diseases. Human-Computer Interaction. Interacting in Various Application Domains: 13th International Conference, HCI International 2009, San Diego, CA, USA, July 19-24, 2009, Proceedings, Part IV 13,

Knapp, C., Honikman, S., Wirsching, M., Husni-Pascha, G., & Hänselmann, E. (2018). Adapting a perinatal empathic training method from South Africa to Germany. *Pilot and Feasibility Studies*, *4*, 1-9.

Koivisto, J., & Hamari, J. (2019). The rise of motivational information systems: A review of gamification research. *International journal of information management*, *45*, 191-210.

Komaromy, M., Ceballos, V., Zurawski, A., Bodenheimer, T., Thom, D. H., & Arora, S. (2018). Extension for Community Healthcare Outcomes (ECHO): a new model for community health worker training and support. *Journal of Public Health Policy*, *39*(2), 203-216. https://doi.org/10.1057/s41271-017-0114-8

Kononowicz, A, A., Woodham, L. A., Edelbring, S., Stathakarou, N., Davies, D., Saxena, N., Car, L. T., Carlstedt-Duke, J., Car, J., & Zary, N. (2019). Virtual patient simulations in health professions education: systematic review and meta-analysis by the digital health education collaboration. *Journal of medical Internet research*, *21*(7), e14676.

Kononowicz, A. A., Woodham, L. A., Edelbring, S., Stathakarou, N., Davies, D., Saxena, N., Tudor Car, L., Carlstedt-Duke, J., Car, J., & Zary, N. (2019). Virtual Patient Simulations in Health Professions Education: Systematic Review and Meta-Analysis by the Digital Health Education Collaboration [Review]. *J Med Internet Res*, *21*(7), e14676. https://doi.org/10.2196/14676

Kumar, N., & Anderson, R. J. (2015). Mobile phones for maternal health in rural India. Proceedings of the 33rd annual acm conference on human factors in computing systems,

Kumar, N., Perrier, T., Desmond, M., Israel-Ballard, K., Kumar, V., Mahapatra, S., Mishra, A., Agarwal, S., Gandhi, R., & Lal, P. (2015). Projecting health: community-led video education for maternal health. Proceedings of the Seventh International Conference on Information and Communication Technologies and Development,

Marais, M. A. (2011, 2011-10). Analysis of the factors affecting the sustainability of ICT4D initiatives.

Mbunge, E., Batani, J., Gaobotse, G., & Muchemwa, B. (2022). Virtual healthcare services and digital health technologies deployed during coronavirus disease 2019 (COVID-19) pandemic in South Africa: a systematic review. *Global Health Journal*, *6*(2), 102-113. https://doi.org/https://doi.org/10.1016/j.glohj.2022.03.001

Mburu, C. W., Wardle, C.-J., Joolay, Y., & Densmore, M. (2018). Co-designing with mothers and neonatal unit staff: use of technology to support mothers of preterm infants. Proceedings of the Second African Conference for Human Computer Interaction: Thriving Communities,

McLean, A. (2020). MHealth apps as effective persuasive health technology: Contextualizing the "necessary" functionalities. *JMIR nursing*, *3*(1), e19302.

Mechael, P., Batavia, H., Kaonga, N., Searle, S., Kwan, A., Goldberger, A., Fu, L., & Ossman, J. (2010). Barriers and gaps affecting mHealth in low and middle income countries: Policy white paper.

Mirzania, M., Shakibazadeh, E., Bohren, M. A., Hantoushzadeh, S., Babaey, F., Khajavi, A., & Foroushani, A. R. (2023). Mistreatment of women during childbirth and its influencing factors in public maternity hospitals in Tehran, Iran: a multi-stakeholder qualitative study. *Reproductive Health*, *20*(1), 79. https://doi.org/10.1186/s12978-023-01620-0

Molapo, M., & Densmore, M. (2015). How to choose a mobile phone for an ICT4D project. Proceedings of the Seventh International Conference on Information and Communication Technologies and Development,

Molapo, M., Densmore, M., & DeRenzi, B. (2017). Video consumption patterns for first time smartphone users: Community health workers in Lesotho. Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems,

Molapo, M., Densmore, M., & Morie, L. (2016a). Apps and skits: Enabling new forms of village-to-clinic feedback for rural health education. Proceedings of the 7th Annual Symposium on Computing for Development,

Molapo, M., Densmore, M., & Morie, L. (2016b). Designing with community health workers: enabling productive participation through exploration. Proceedings of the First African Conference on Human Computer Interaction,

Moreau, K. A., Eady, K., Sikora, L., & Horsley, T. (2018). Digital storytelling in health professions education: a systematic review. *BMC medical education*, *18*(1), 1-9.

Morrise, L., & Stevens, K. J. (2013). Training patient and family storytellers and patient and family faculty. *The Permanente Journal*, *17*(3), e142.

Moudatsou, M., Stavropoulou, A., Philalithis, A., & Koukouli, S. (2020). The Role of Empathy in Health and Social Care Professionals. *Healthcare*, *8*(1), 26. https://www.mdpi.com/2227-9032/8/1/26

Munabi-Babigumira, S., Glenton, C., Willcox, M., & Nabudere, H. (2019). Ugandan health workers' and mothers' views and experiences of the quality of maternity care and the use of informal solutions: A qualitative study. *PLOS ONE*, *14*(3), e0213511. https://doi.org/10.1371/journal.pone.0213511

Nakasone, A., & Ishizuka, M. (2006). Storytelling ontology model using rst. 2006 IEEE/WIC/ACM International Conference on Intelligent Agent Technology,

Negesa, S., & Densmore, M. (2023). *Self-directed digital learning for maternity health workers A Choose-Your-Own-Adventure application for empathic care* Proceedings of the 6th ACM SIGCAS/SIGCHI Conference on Computing and Sustainable Societies, Cape Town, South Africa. https://doi.org/10.1145/3588001.3609375

Oh, J., Lim, H. S., & Hwang, A. H.-C. (2020). How interactive storytelling persuades: The mediating role of website contingency and narrative transportation. *Journal of Broadcasting & Electronic Media*, *64*(5), 714-735.

Orji, R., Mandryk, R. L., Vassileva, J., & Gerling, K. M. (2013). Tailoring persuasive health games to gamer type. Proceedings of the sigchi conference on human factors in computing systems,

Orji, R., Nacke, L. E., & Di Marco, C. (2017). Towards personality-driven persuasive health games and gamified systems. Proceedings of the 2017 CHI conference on human factors in computing systems,

Orji, R., Vassileva, J., & Mandryk, R. L. (2013). LunchTime: a slow-casual game for long-term dietary behavior change. *Personal and ubiquitous computing*, *17*, 1211-1221.

Pade, C., Mallinson, B., & Sewry, D. (2008). An Elaboration of Critical Success Factors for Rural ICT Project Sustainability in Developing Countries: Exploring the DWESA Case. *Journal of Information Technology Case and Application Research*, *10*(4), 32-55. https://doi.org/10.1080/15228053.2008.10856146

Palioura, M., & Dimoulas, C. (2022). Digital Storytelling in Education: A Transmedia Integration Approach for the Non-Developers. *Education Sciences*, *12*(8), 559. https://www.mdpi.com/2227-7102/12/8/559

Perry, H. (2013). A brief history of community health worker programs. *Developing and strengthening community health worker programs at scale: a reference guide and case studies for program managers and policymakers, USAID, MCHIP*.

Perry, H. B., Zulliger, R., & Rogers, M. M. (2014). Community health workers in low-, middle-, and high-income countries: an overview of their history, recent evolution, and current effectiveness. *Annual review of public health*, *35*, 399-421.

Peter, J., Benjamin, P., LeFevre, A. E., Barron, P., & Pillay, Y. (2018). Taking digital health innovation to scale in South Africa: ten lessons from MomConnect. In (Vol. 3, pp. e000592): BMJ Specialist Journals.

Pokhrel, P., Karmacharya, R., Taylor Salisbury, T., Carswell, K., Kohrt, B. A., Jordans, M. J. D., Lempp, H., Thornicroft, G., & Luitel, N. P. (2021). Perception of healthcare workers on mobile app-based clinical guideline for the detection and treatment of mental health problems in primary care: a qualitative study in Nepal. *BMC Medical Informatics and Decision Making*, *21*(1), 21. https://doi.org/10.1186/s12911-021-01386-0

Proctor, K., Perlesz, A., Moloney, B., McIlwaine, F., & O'Neill, I. (2008). Exploring theatre of the oppressed in family therapy clinical work and supervision. *Counselling and Psychotherapy Research*, *8*(1), 43-52.

Ramachandran, John Canny, Prabhu Dutta Das, & Edward Cutrell. (2010). *Mobile-izing health workers in rural India* Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, Atlanta, Georgia, USA. https://doi.org/10.1145/1753326.1753610

Ramachandran, D., Goswami, V., & Canny, J. (2010). Research and reality: using mobile messages to promote maternal health in rural India. Proceedings of the 4th ACM/IEEE international conference on information and communication technologies and development,

Ribeiro, S. (2015). Digital storytelling: an integrated approach to language learning for the 21st century student. *Teaching English with technology*, *15*(2), 39-53.

Schoeman, F. (2019). *Digital tools for training frontline health workers in low and middle-income countries: A systematic review* OpenUCT. http://hdl.handle.net/11427/30913

Schwartz, A., Bhavsar, M., Cutrell, E., Donner, J., & Densmore, M. (2014). *Optimizing Mobile Deployments*. https://www.microsoft.com/en-us/research/publication/optimizing-mobile-deployments/

Seebregts, C., Dane, P., Parsons, A. N., Fogwill, T., Rogers, D., Bekker, M., Shaw, V., & Barron, P. (2018). Designing for scale: optimising the health information system architecture for mobile maternal health messaging in South Africa (MomConnect). *BMJ global health*, *3*(Suppl 2), e000563.

Sharifi, M., Dryden, E. M., Horan, C. M., Price, S., Marshall, R., Hacker, K., Finkelstein, J. A., & Taveras, E. M. (2013). Leveraging Text Messaging and Mobile Technology to Support Pediatric Obesity-Related Behavior Change: A Qualitative Study Using Parent Focus Groups and Interviews. *J Med Internet Res*, *15*(12), e272. https://doi.org/10.2196/jmir.2780

Smed, J., Trygg, N., Skult, P., & Hakonen, H. (2019). The digital campfire: an ontology of interactive digital storytelling. In *Modern Perspectives on Virtual Communications and Social Networking* (pp. 174-195). IGI Global.

Suárez, A., Adanero, A., Díaz-Flores García, V., Freire, Y., & Algar, J. (2022). Using a Virtual Patient via an Artificial Intelligence Chatbot to Develop Dental Students’ Diagnostic Skills. *International Journal of Environmental Research and Public Health*, *19*(14), 8735. https://www.mdpi.com/1660-4601/19/14/8735

Tekinbas, K. S., & Zimmerman, E. (2003). *Rules of play: Game design fundamentals*. MIT press.

UNICEF. *CommCare, Build a custom mobile data collection platform.* UNICEF App Catalogue. Retrieved 27 September from https://www.unicef.org/appcatalogue/commcare

van Ginneken, N., Lewin, S., & Berridge, V. (2010). The emergence of community health worker programmes in the late apartheid era in South Africa: An historical analysis. *Soc Sci Med*, *71*(6), 1110-1118. https://doi.org/10.1016/j.socscimed.2010.06.009

Vasudevan, L., Schroeder, K., Raveendran, Y., Goel, K., Makarushka, C., Masalu, N., & Zullig, L. L. (2020). Using digital health to facilitate compliance with standardized pediatric cancer treatment guidelines in Tanzania: protocol for an early-stage effectiveness-implementation hybrid study. *BMC Cancer*, *20*(1), 254. https://doi.org/10.1186/s12885-020-6611-3

Waltham, M., & Moodley, D. (2016). An analysis of artificial intelligence techniques in multiplayer online battle arena game environments. Proceedings of the Annual Conference of the South African Institute of Computer Scientists and Information Technologists,

Wang, J., Li, W., Lin, P., & Mu, F. (2021). Empathetic response generation through graph-based multi-hop reasoning on emotional causality. *Knowledge-Based Systems*, *233*, 107547.

Wilson, E. D., Helal, S., Bull, C. N., & Honary, M. (2019). Persuasive health: Back to the future. Proceedings of the 13th EAI International Conference on Pervasive Computing Technologies for Healthcare,

Winskell, K., Sabben, G., & Obong'o, C. (2019). Interactive narrative in a mobile health behavioral intervention (Tumaini): theoretical grounding and structure of a smartphone game to prevent HIV among young Africans. *JMIR Serious Games*, *7*(2), e13037.

Yalcin, Ö. N., & DiPaola, S. (2018). A computational model of empathy for interactive agents. *Biologically inspired cognitive architectures*, *26*, 20-25.

LIST OF APPENDICES

Appendix A: Interview Guide

SHiMA Interview guide

Name:

Gender:

Hi, my name is Sharifa, and the purpose of this interview is for me to learn more about the Secret Hx approach to health worker empathy and for us to discuss how it might be adapted for health worker self-learning in a mobile app.

May I record this interview?

Thank you!

1. To start with, please tell me more about your involvement with the design and testing of the Secret History protocol.
2. What do you think are the [three] most important elements or features of the protocol.
3. We have been talking about adapting the protocol to a mobile app; what do you think the value of a mobile app version of the protocol would be? Why is it important?
4. What do you think would be lost in the app when compared to the workshop format?
5. What are some of your reservations or worries about an app-based approach?
6. What are some of the ways we might approach the app design to address these problems?
7. For you (may be a repeat of 3) - what would be the goal of the app
8. How do you imagine the app being used?
9. How do you imagine the app changing behaviors or teaching empathy skills?
10. How would it work in relation to other training for health workers?

There are many ways we can approach representing the SHx protocol as an app, we are choosing for this project a CYOA approach in which the user will encounter alternate storylines based on use of empathic skills.

11. Firstly – what do you think of this idea? Why?
12. Please comment on the following proposed features:
    a. Alternative stories
    b. Emotion Surveys
    c. Teaching
    d. Badges and Stickers (gamification) to mark completion of stories?
13. What do you think would be the best mediums for teaching (e.g., video, text, audio, drawings). Why?
14. As PMHP, what kind of metrics and data are you interested in gathering from app usage? Why? How would you use the data.

Now I will show you an early prototype of the app. Please note that this isn't the final idea. It's just an example of what might be done to help convey the concept. Do not hesitate to give me any ideas for how we might change or replace the app to better match your ideas of what can be done. At this point – comments about color or layout are not what I'm looking for – but rather whether this represents what you think the app should be.

Appendix B: Focus Group Discussion Guide for BBP

Name:

Gender:

Profession:

Hi, my name is Sharifa, and the purpose of this interview is for me to discuss with you the secret history workshop format in which participants are invited to alternately play-act the roles of parents and health workers in various circumstances and for us to discuss how it might be adapted for health worker self-learning in a mobile app.

May I record this interview?

Thank you!

1. To start with, please tell me more about your involvement with the Bhabhisana Baby Project?
2. We are working with the Perinatal Mental Health Project (PMHP) and discussing how we might contribute to the secret history workshop protocol. Briefly tell me what you know about this workshop protocol?

The Perinatal Mental Health Project www.pmhp.za.org of the University of Cape Town developed the Secret History method in 2004. This was a response to the realisation that public service staff engaging with mothers have the opportunity to add to or alleviate levels of distress experienced by vulnerable women.

The project has refined and used this training approach in a wide variety of settings in South Africa and with a range of health worker cadres involved with mothers and children. The training has undergone qualitative internal and external evaluation. The aim of the training is to improve empathic engagement skills of health workers working with mothers vulnerable to psychological distress.

The interactive training method enables real life responses toward 'the other'/the patient. Identifying with 'the other' is a critical element of the training and allows for dissolution of cognitions leading to blame, disapproval, and abuse of clients.

A process of polarisation and reintegration allows participants to engage with a wider context of maternal care, one which encourages empathy for the 'other' and validates sympathy for the 'self'. Participants are then able to develop their own solutions to address difficulties in the workplace, interpersonal challenges with colleagues and clients, and to generally be more aware, responsive, and supportive of the needs of patients, and each other.

The method comprises a 2-hour interactive role-play, facilitated by 2 trainers, with about 20 participants of the same staff rank. Half the participants assume or 'become' the role of the nurse/health worker and the other half take the role of the client/patient as they embark on a journey through a pregnancy into the postnatal period.

Based on realistic life histories from the local setting, the private narrative of each role is revealed in stages. At each stage, participants are assisted in identifying their feelings and needs – two separate columns are populated with these feelings and needs on a white board for each role.

At the same time facilitators encourage interaction between the two roles.

The second part of the session is a debriefing where staff are able to align their own feelings with the needs of the 'other'/patient. This informs their development of new strategies in providing empathic care for their patients and self-care for themselves.

There are many ways we can approach representing the SHx protocol as an app, we are exploring for this project an approach in which the health workers will encounter alternate storylines based on use of empathic skills. We call this "choose your own adventure, or CYOA" based on a storybook series using the same concept. For example… [give examples] – walk them through a SHx storyboard.

3. Firstly – what do you think of this idea? Why?
4. Please comment on the following proposed features (concept vs look and feel now?)
    a. Alternative stories – This is basically linked to the choices a person makes in a story. Every choice they make impacts the outcome e.g., Someone may start with a wrong choice and end up with a right option.
    b. Emotion Surveys – So in case someone finishes a story, an option of getting to know how they did in the entire story
    c. Teaching
    d. Badges and Stickers (gamification) to mark completion of stories?
5. What do you think would be the best mediums for teaching (e.g., video, text, audio, drawings). Why?

Now I will show you an early prototype of the app. Please note that this isn't the final idea. It's just an example of what might be done to help convey the concept. Do not hesitate to give me any ideas for how we might change or replace the app to better match your ideas of what can be done. At this point – comments about color or layout are not what I'm looking for – but rather whether this represents what you think the app should be.

Appendix C: Secret history Mobile Application workshop method

SECRET HISTORY MOBILE APPLICATION (SHiMA) CO-DESIGN WORKSHOP

SHiMA Co-design Protocol

Pre-Co-design Activities

1. **Ethics Clearance Amendments**

The co-design activities will be in person through workshop group discussions. Each group will consist of 2 to 3 participants and 2 facilitators. COVID-19 safety precautions will be put into consideration, and these include:

- Facilitating sanitizing stations for participants and facilitators to sanitize while entering the workshop.
- Facilitators will be prompted to always wear face masks
- The workshops will take place in a well-ventilated area.

2. **Participant Recruitment**

Participants in this study are secret history experts from the Perinatal Mental Health Project (PMHP), NGO members from the Bhabhisana Baby Project (BBP) as well as midwives from El-Neesa Maternity clinic. Participants will be recruited by sending them an email or signing up through a link which will also be provided to them to show interest in participating in the co-design activities of the study.

3. **Facilitators Training**

The co-design activities will be conducted and assisted by facilitators who will receive in-person training before the codesign activities. The training will involve guiding the facilitators on how to conduct co-design activities. The training will involve a walk-through of the co-design workshop protocol to give facilitators an understanding of the activities and for a discussion on how to best communicate the activities to the participants. The facilitators will be introduced to and guided through the secret history choose-your-own-adventure approach and the various phases the workshop will involve.

Secret history activities which encompass health worker empathy will be conducted. Participants will be allowed to take up any character of their choice in a story and act it out. Every decision that the participant makes impacts the outcome of the story and this will either show an empathic engagement or a non-empathic engagement of the participant in the story. Overall, the participants will get a teaching affirmation (Lesson learned) from whichever choice they made at the end of the story as shown in Figure 1.

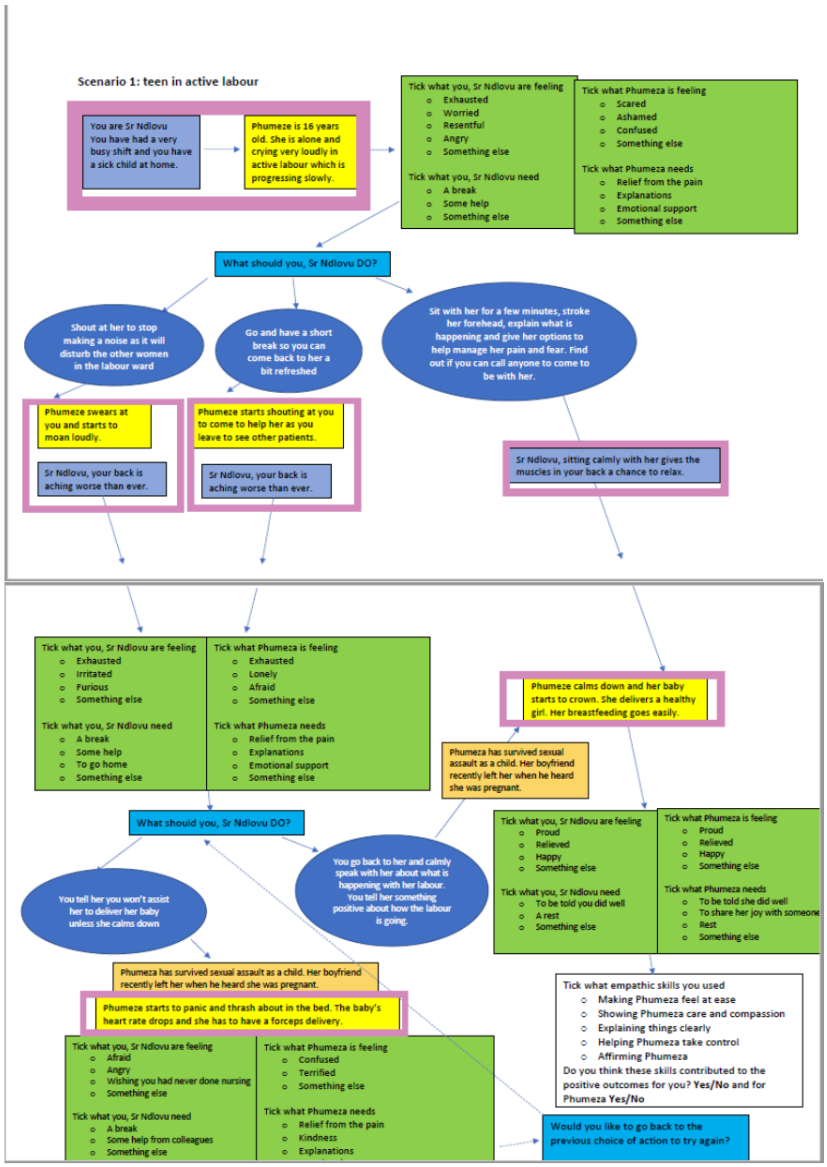


Figure 1: Teen in Active Labour

4. Informed Consent

Facilitators will read the consent form to participants, and they will provide their voluntary, oral informed consent to participate in the co-design activities before engaging in any co-design activities. Audio recording of this consent will take place. This consent form will be translated into the language of their preference.

Co-design Approaches and Activities

Welcome and Orientation (5 minutes)

Participants will be gathered in groups of 2-4 participants. The research team will consist of the facilitator and one research assistant. The external researchers will serve as assistants especially when it comes to voice recording the sessions and organizing and handing out the design materials.

To be done by Facilitators:

1. Informed consent will take place with everyone before the group activities.
2. Welcome participants and brief them on the order of activities: icebreaker, discuss secret history activities using secret history story content, empathy building, brainstorm ideas, and co-design ideas.
3. Lay out stationery and design cards, facilitator walks through the different design cards
4. Warm-up: Use the design cards to tell a story of how their reaction toward the patients impacts the patient's wellbeing.

Ice breaker

Co-design Activities (2 hours)

5. Divide participants into two groups (of 2-4 persons each).
6. Give each group a Bag of Stuff and describe the contents to the participants. The Bag of Stuff includes 2 sheets of A3 paper, 3 sheets of color paper, stationery including markers, pencils, erasers, and design cards related to various objects, scenarios, or use cases, stickers, and emoticons. ***(5 minutes)***
7. Describe what they need to do: Together they will use the bag of stuff to prototype the CYOA stories. Examples of output*: storyboards, physical prototypes demonstrating system models.*
    a. Participants sketch or create their ideas of possible actions and choices for the story, using the stationery from the Bag of Stuff. Encourage rough design that attempts to convey an idea, concept, or object rather than produce high-fidelity drawings. Participants will be encouraged to use the design cards to illustrate their idea as well as how IT will fit into their context. This would be a combination of (a) and (b). *(1 hour 45 minutes)*
    b. *Storyboard*: Participants create a storyboard using the Design Cards from the Bag of Stuff. This storyboard will include the different scenarios, the actions, and outcomes of their choice of actions presented by the design cards, with a written paragraph at the end of each choice taken stating the teaching affirmation/ lesson learned at the end of the activity. ***(1 hour 45 minutes)***
8. Debrief: participants will be asked to present their prototype to the facilitator.
9. The facilitator will do a cognitive walkthrough with the participants to understand the CYOA approach the participants have chosen.
10. The facilitator will describe what they see (think aloud) in the presented solution and ask if that matches the participant's intention.
11. The facilitator will ask participants to provide feedback regarding their experience with the co-design activities.
12. Thank participants for their participation.

Agenda

Activity	Time	Format
Orientation I would like to thank you all for being available to attend this workshop. In this workshop, we will review and adjust an initial storyboard of a CYOA Secret history protocol and provide feedback on the initial digital (app) design of the application. We will participate in this study in groups of two and each group will provide their input on where they feel changes should be made. -Demo of initial paper storyboard (Figure 1)	**10:30 -10:50**	Plenary
Co-design Activity **Ice breaker –** **First Activity**- We will brainstorm on secret history activities using secret history content. I will distribute sticky notes and white paper and each of them will write down what they think of empathy in a maternity setting. -Demo of the mobile application (Figure 2) **Second Activity**- Provide each group with Sticky notes, and markers and each participant will prototype how they would like the application to look.	**10:50- 11:00** **11:00- 11:30** **11:30- 11:50**	Plenary
Short Break	**11:50-12:10**	Snacks
Feedback **Last Activity**- Each group will present their prototype to the researcher & other participants and have feedback from other participants. 1. Ask participants to write their feedback on each group's prototype on the whiteboards.	**12:10-12:30 (**10 minutes presentation per group, 5 minutes for feedback**)** **12:30-12:45**	Plenary
2. The researcher will do a cognitive walkthrough with the participants to understand the solution in more depth. The researcher will describe what they see (think aloud) in the presented solution and ask if that matches the participant's intention.	**12:45-13:10**	
3. Each Group will then rate the application that was presented by the researcher	**13:10-13:30**	
4. Participants will rate features that were prototyped based on priority.	**13:30-13:50**	
Thank All Participants for attending	**13:50 – 14:00**	

Initial app design of SHiMA

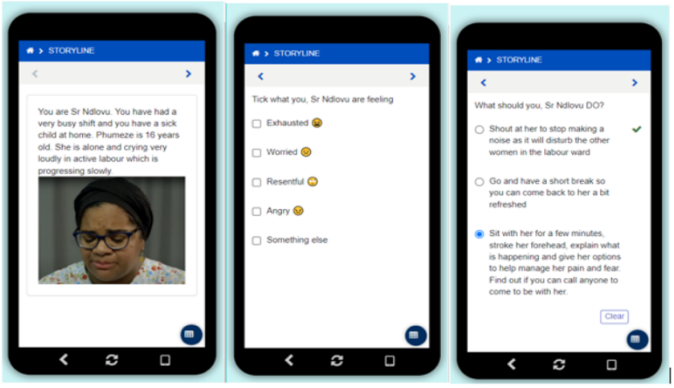


Figure 2: Initial SHiMA design

Appendix D: Agenda for the Pilot Deployment

SHIMA PILOT

Main research question: What are the adaptations that can be made to the secret history workshop protocol to support digital training using CYOA?

Aim of the study: The main aim of the study is to develop a digital platform that supports the representation of secret history materials using Choose-Your-Own-Adventure to facilitate health worker training.

Objective of the pilot

- To get a baseline idea of how SHiMA works with health workers in private health facilities before evaluating it with more resource constrained health workers.

Al-Nisa SHiMA pilot Agenda 19/04/2023

S/N	ACTIVITY	TIME	PERSON IN CHARGE
1.	Introduction and Informed Consent	10 mins	Sharifa
2.	Session intro and Video	10 mins	Sharifa
3.	App download and Installation	15 mins	Sharifa
4.	SHiMA exploration	30 mins	Al-Nisa team
5.	RedCap Survey	20 min	Lele and Emma
6.	Break	15 min	All
7.	Focus group discussion	45 min	Sharifa and Al-Nisa team
8.	Debrief and Closing	10 min	All

Appendix E: Focus group discussion guide for Pilot Deployment

SHiMA Pilot -Focus Group Questions

Hi, my name is Sharifa, and I would like to thank you for taking some time off to be part of this pilot study. The purpose of this Focus Group Discussion is for us to get an idea of how the Secret history Mobile Application works with the private health workers before evaluating it with staff at Mowbray Maternity Hospital. We will have a discussion about your experience thus far with the Secret History Mobile Application. Please note there are no right or wrong answers – we are curious to know your opinions, preferences, and ideas.

May I record this interview?

1. How would you describe your overall experience with the app?
    a) For instance, how did you find the process of downloading the application?

    Probe for technically difficulties, time consuming, space on phone

    b) What did you think about the introduction film?
    c) How did you find moving/navigating the different parts of the app? i.e. trying view more stories or making any choices as you explore a story? Checking out the resources available for the skills section?
2. What did you like the most about using this app?
3. What did you think of the appearance of the application?
4. What do you think about the way stories and information were presented?
5. Do you think you will you keep using this mobile app? Please give reasons for your answer
6. What did you like the least about using the app?
7. What, if anything, surprised you about the experience?
8. What, if anything, caused you frustration?
9. What are your thoughts on other health workers using this app?

    Probe for issues related to transferability of content to other areas, technical issues, time, interest, relevance

10. What are your thoughts on people using this app instead of other forms of training for RMC and empathic care?
11. What are your thoughts on the app being used to train maternity care workers in RMC or empathic care in South Africa?

SHIMA PILOT

Name:
Gender:
Profession/Rank:

1. On a scale from 1 to 5 (1=not at all, likely, 5=very likely), how likely are you to recommend this app to a colleague?

Very unlikely ☐ Unlikely ☐ Neutral ☐ Likely ☐ Very likely ☐

2. On a scale of 1 to 5 (1=Never, Sometimes, 5 = Always),how frequently would you use this app?

Never ☐ Rarely ☐ Sometimes ☐ Often ☐ Always ☐

3. Do you have **any other comments** you would like to make that will help us to understand your experience?

Appendix F: Faculty of Science Ethics Approval letter

UNIVERSITY OF CAPE TOWN
IYUNIVESITHI YASEKAPA • UNIVERSITEIT VAN KAAPSTAD

Faculty of Science
University of Cape Town
Rondebosch
South Africa 7701

E-mail: jan.buys@uct.ac.za
Tel: 021 650-9111

3 August 2022

Sharifa Negesa
Department of Computer Science

Empathy in Maternal and Child Health: Adapting the secret history protocol to a Choose-Your-Own-Adventure (CYOA) framework

Dear Sharifa Negesa

I am pleased to inform you that the Faculty of Science Research Ethics Committee has approved the above-named application for research ethics clearance, subject to the conditions listed below.

- Restrictions on involving human participants in research must be adhered to, given current concerns about the spread of Covid-19. Please ensure that you are aware of and comply with UCT policy on this, as communicated by management.
- Implement the measures described in your application to ensure that the process of your research is ethically sound; and
- Uphold ethical principles throughout all stages of the research, responding appropriately to unanticipated issues: please contact me if you need advice on ethical issues that arise.

Your approval code is: **FSREC 062 – 2022**

I wish you success in your research.

Yours sincerely

Dr Jan Buys
Deputy Chair: Faculty of Science Research Ethics Committee

Appendix G: Pre-app design Consent form

DEPARTMENT OF COMPUTER SCIENCE

UNIVERSITY OF CAPE TOWN
PRIVATE BAG X3
RONDEBOSCH 7701
SOUTH AFRICA

RESEARCHER/S: Sharifa/Negesa
TELEPHONE: +27633881709
E-MAIL: ngssha002@myuct.ac.za
URL: www.cs.uct.ac.za

Informed Voluntary Consent to Participate in Research Study

Project Title: Empathy in Maternal and Child Health: Adapting the secret history protocol to a Choose-Your-Own-Adventure (CYOA) framework

Invitation to participate, and benefits: You are invited to participate in a research study conducted with secret history expert informants and private health sector midwives. The study aims to develop a platform that supports the adaption of secret history material to a digital learning platform that uses the CYOA format for health worker training and assess whether this may be an effective approach for leveraging the Secret history materials toward building health worker empathy. I believe that your experience would be a valuable source of information, and hope that by participating you may gain useful knowledge.

Procedures: During this study, you will be asked to participate in the co-design of the CYOA story content and the tools to support the creation of the CYOA mobile application.

Recording: We may take photographs and record audio/video as part of the study. These will be used for analysis purposes. If you object to this, please indicate below.

Risks: There are no potentially harmful risks related to your participation in this study.

Feedback: You will receive feedback about the results of this research through an email you will have provided while filling out the consent form.

Disclaimer/Withdrawal: Your participation is completely voluntary; you may refuse to participate, and you may withdraw at any time without having to state a reason and without any prejudice or penalty against you. Should you choose to withdraw, the researcher commits not to use any of the information you have provided without your signed consent. Note that the researcher may also withdraw you from the study at any time.

Confidentiality: All information collected in this study will be kept private in that you will not be identified by name or by affiliation to an institution. Confidentiality and anonymity will be maintained as pseudonyms will be used.

What signing this form means: By signing this consent form, you agree to participate in this research study. The aim, procedures to be used, as well as the potential risks and benefits of your participation, have been explained verbally to you in detail, using this form. Refusal to participate in or withdrawal from this study at any time will have no effect on you in any way. You are free to contact me, to ask questions or request further information, at any time during this research.

Gender	☐ Male	☐ Female
I agree to participate in this research (tick one box)	☐ Yes	☐ No _____ (Initials)
I agree to be photographed	☐ Yes	☐ No _____ (Initials)
I agree to be audio-recorded	☐ Yes	☐ No _____ (Initials)
I agree to be video-recorded	☐ Yes	☐ No _____ (Initials)

_____	_____	_____
Name of Participant	Signature of Participant	Date
_____	_____	_____
Name of Researcher	Signature of Researcher	Date

Appendix H: Consent form for the Pilot Deployment

DEPARTMENT OF COMPUTER SCIENCE

UNIVERSITY OF CAPE TOWN
PRIVATE BAG X3
RONDEBOSCH 7701
SOUTH AFRICA

RESEARCHER/S: Sharifa/Negesa
TELEPHONE: +27633881709
E-MAIL: ngssha002@myuct.ac.za
URL: www.cs.uct.ac.za

Informed Voluntary Consent to Participate in Research Study

Project Title: Empathy in Maternal and Child Health: Adapting the secret history protocol to a Choose-Your-Own-Adventure (CYOA) framework

Invitation to participate, and benefits: You are invited to participate in a research study conducted with secret history expert informants and private health sector midwives. The study aims to develop a platform that supports the adaption of secret history material to a digital learning platform that uses the CYOA format for health worker training and assess whether this may be an effective approach for leveraging the Secret history materials toward building health worker empathy. I believe that your experience would be a valuable source of information, and hope that by participating you may gain useful knowledge.

Procedures: During this study, you will be asked to participate in the pilot testing of the Choose-Your-Own-Adventure Secret History Mobile Application (SHiMA)

Recording: We may take photographs and record audio/video as part of the study. These will be used for analysis purposes. If you object to this, please indicate below.

Risks: There are no potentially harmful risks related to your participation in this study.

Feedback: You will receive feedback about the results of this research through an email you will have provided while filling out the consent form.

Disclaimer/Withdrawal: Your participation is completely voluntary; you may refuse to participate, and you may withdraw at any time without having to state a reason and without any prejudice or penalty against you. Should you choose to withdraw, the researcher commits not to use any of the information you have provided without your signed consent. Note that the researcher may also withdraw you from the study at any time.

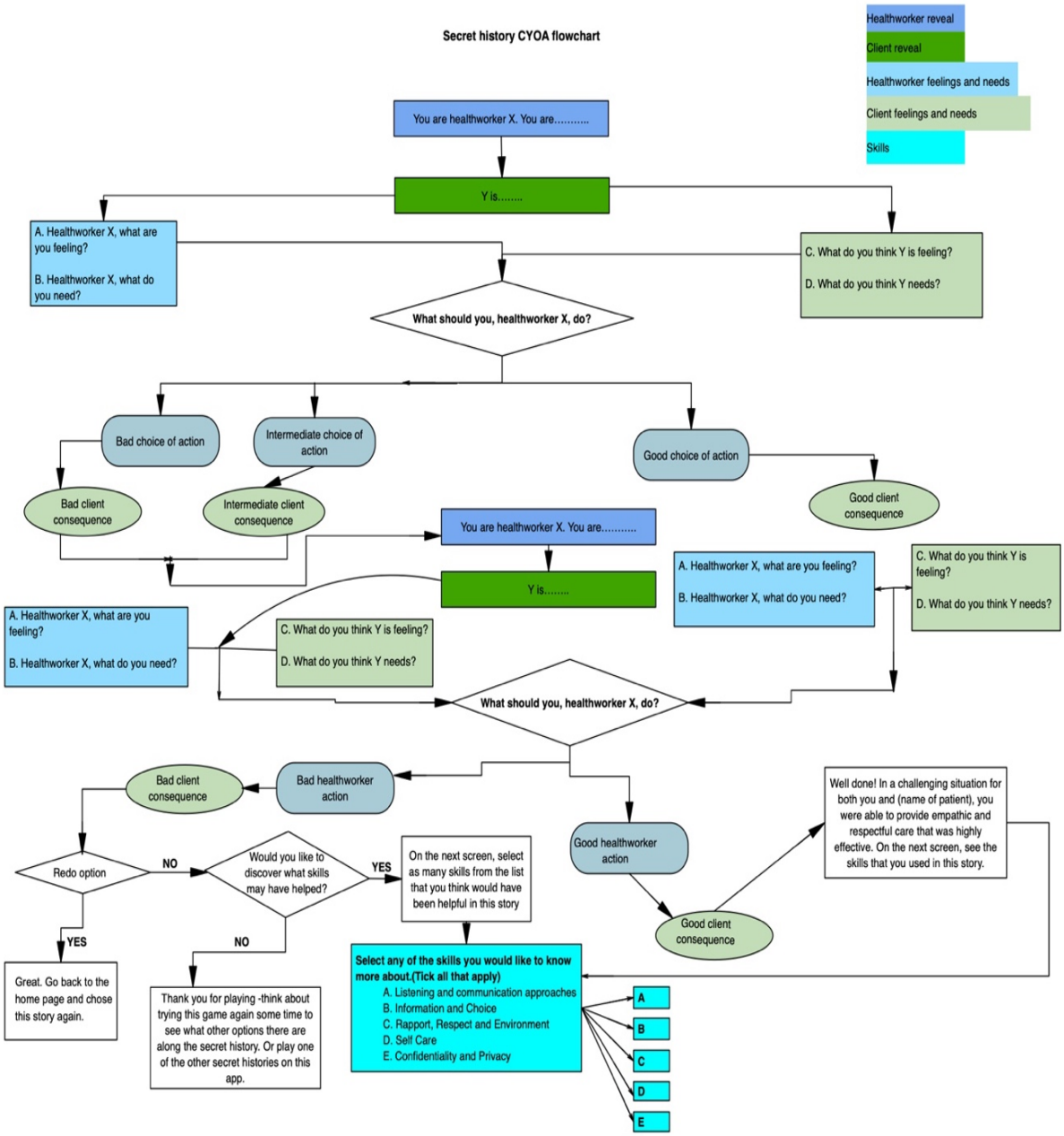
Confidentiality: All information collected in this study will be kept private in that you will not be identified by name or by affiliation to an institution. Confidentiality and anonymity will be maintained as pseudonyms will be used.

What signing this form means: By signing this consent form, you agree to participate in this research study. The aim, procedures to be used, as well as the potential risks and benefits of your participation, have been explained verbally to you in detail, using this form. Refusal to participate in or withdrawal from this study at any time will have no effect on you in any way. You are free to contact me, to ask questions or request further information, at any time during this research.

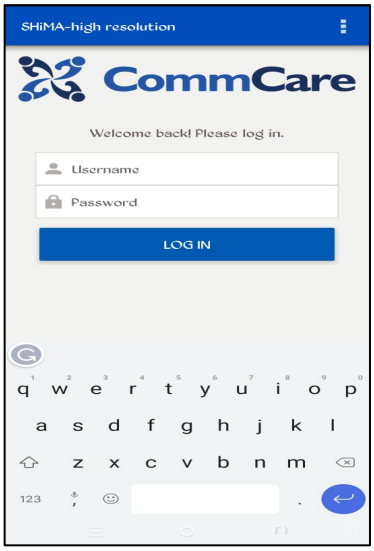
Gender	☐ Male	☐ Female
I agree to participate in this research (tick one box)	☐ Yes	☐ No _____ (Initials)
I agree to be photographed	☐ Yes	☐ No _____ (Initials)
I agree to be audio-recorded	☐ Yes	☐ No _____ (Initials)
I agree to be video-recorded	☐ Yes	☐ No _____ (Initials)

_____	_____	_____
Name of Participant	Signature of Participant	Date
_____	_____	_____
Name of Researcher	Signature of Researcher	Date

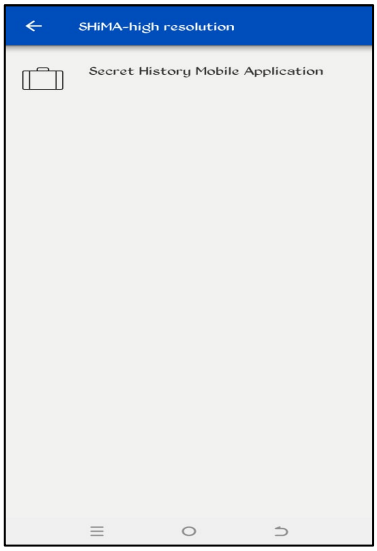
Appendix I: Final CYOA story flowchart



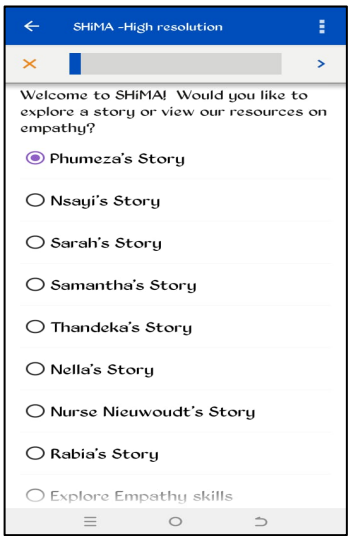
Appendix J: Screenshots of the final SHiMA prototype



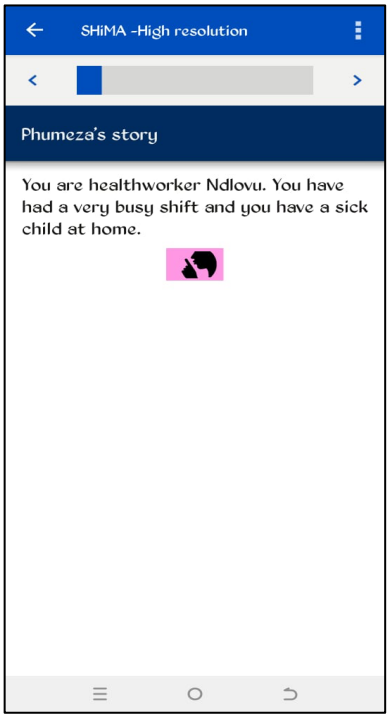
Login page



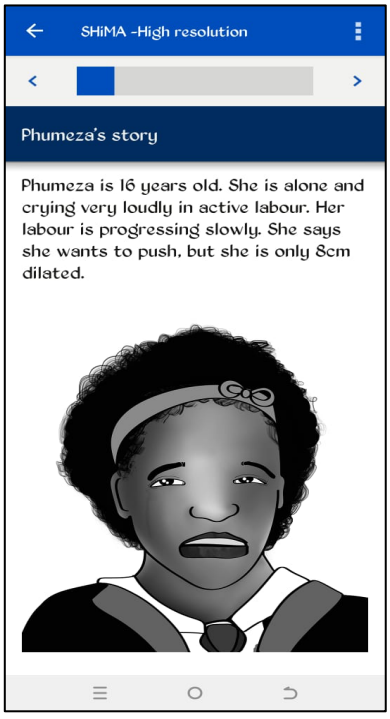
Screen 1 after login showing a list of applications



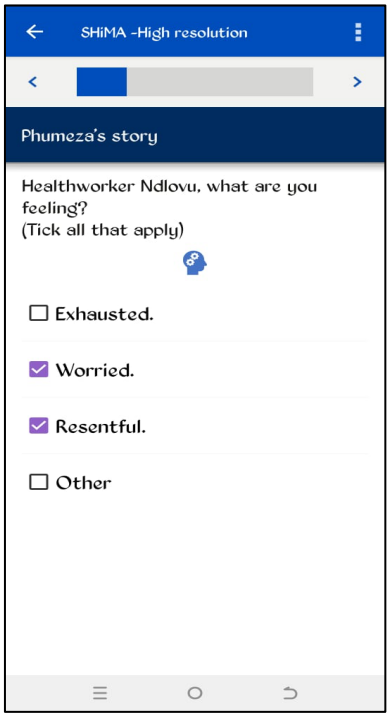
Welcome page with a list of stories



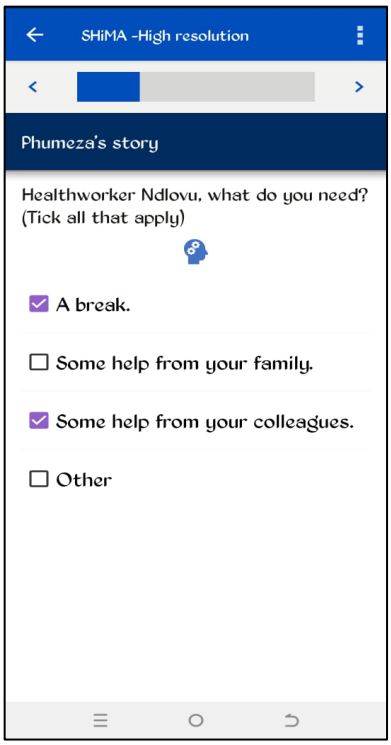
Screen showing one of the selected stories (Phumeza's story)



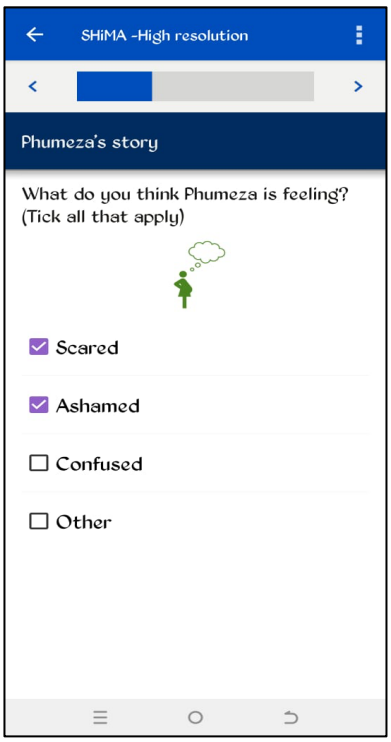
An introduction to Phumeza's story



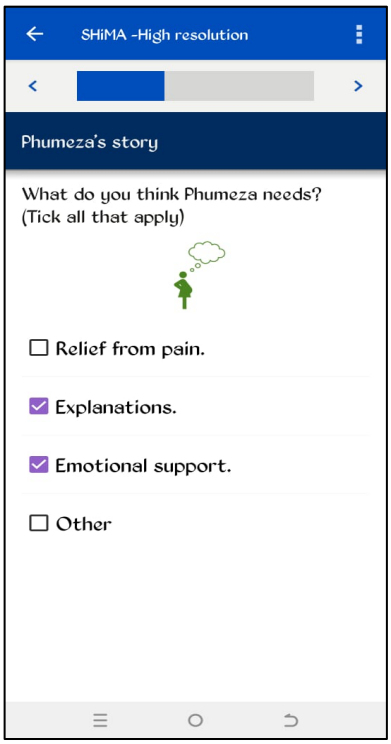
A list of options of what the health worker is feeling after reading Phumeza's story



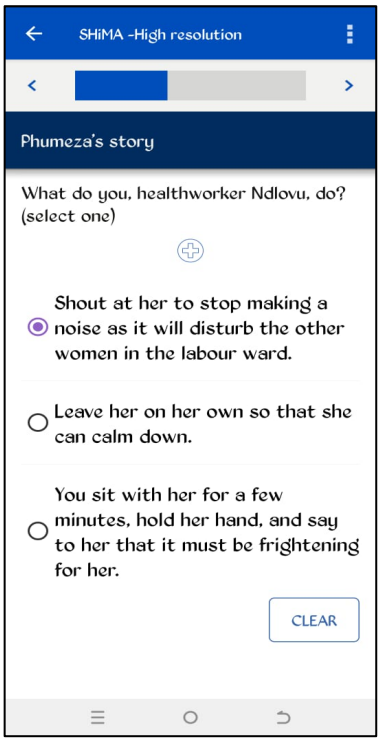
Screen showing what the health worker needs based on their feelings



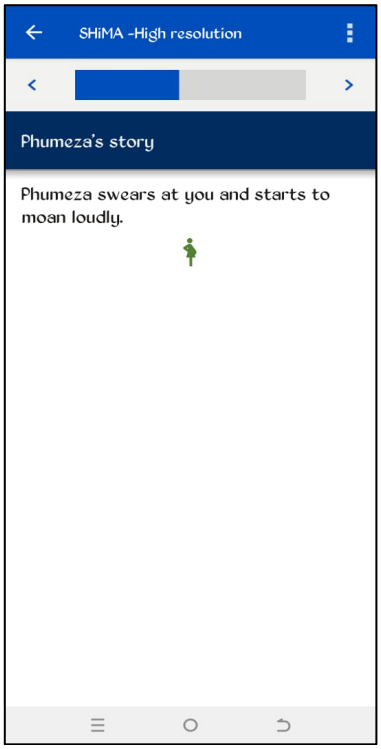
Screen showing what Phumeza is feeling



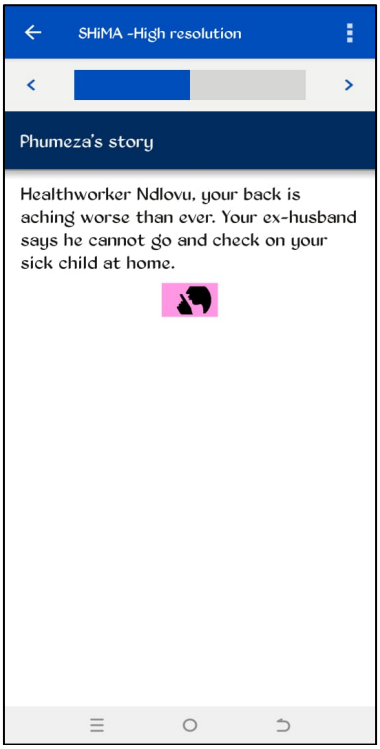
Screen showing what Phumeza needs based on her feelings



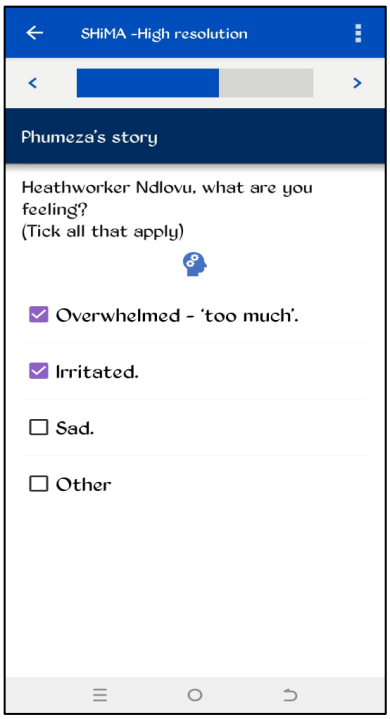
Screenshot of the different options the health worker can select from based on their feelings and needs



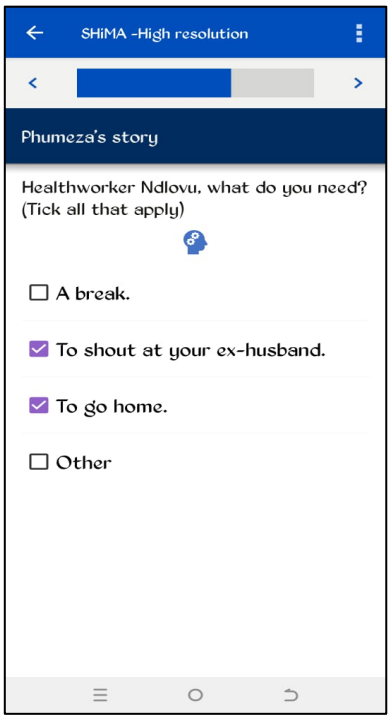
Phumeza's reaction based on the health worker's choice of action



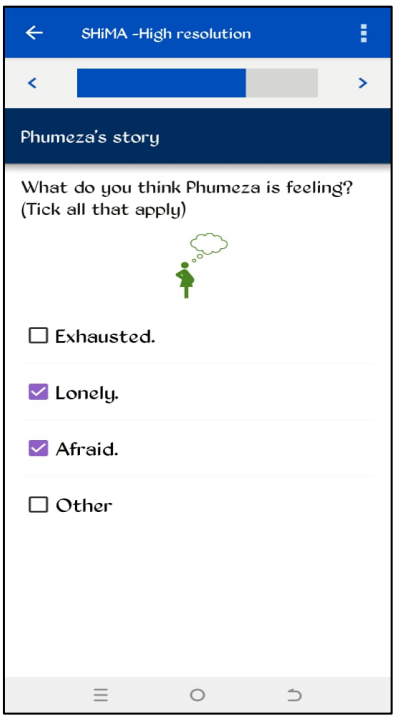
Screen showing health worker reveal



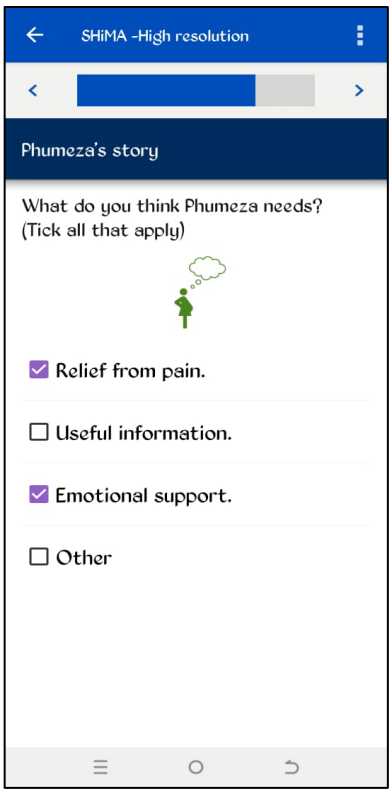
Screenshot Health worker feelings based on reveal and actions



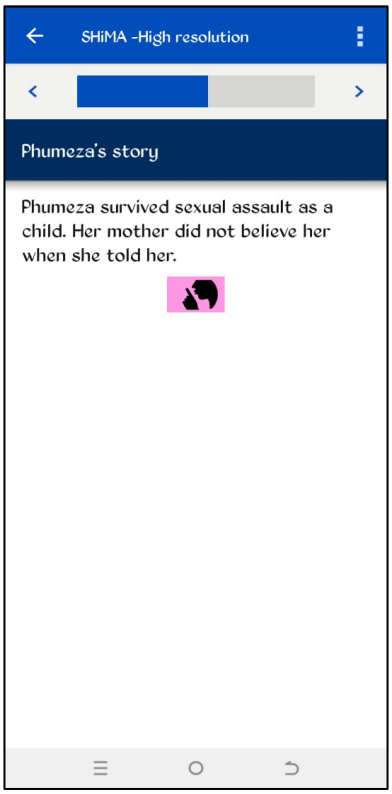
Screenshot of Health worker needs based on feelings



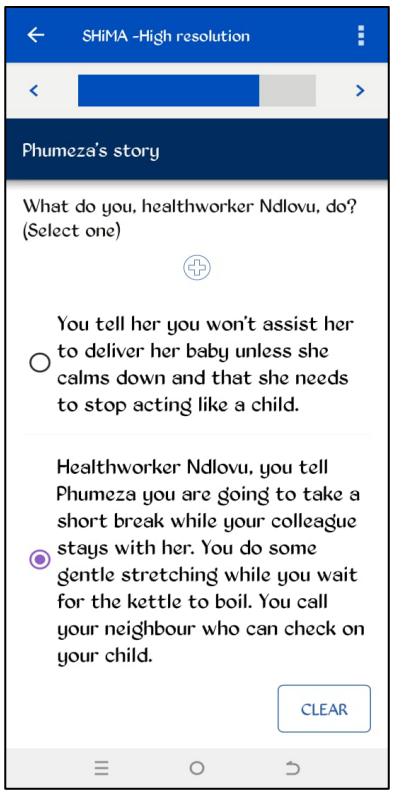
Phumeza's feelings based on health worker needs and feelings



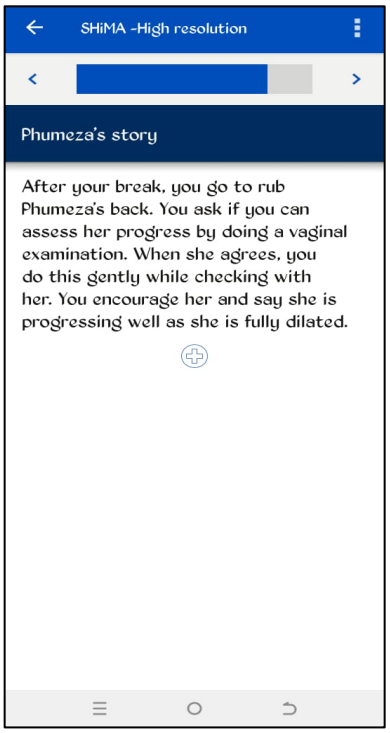
Phumeza's needs based on her feelings



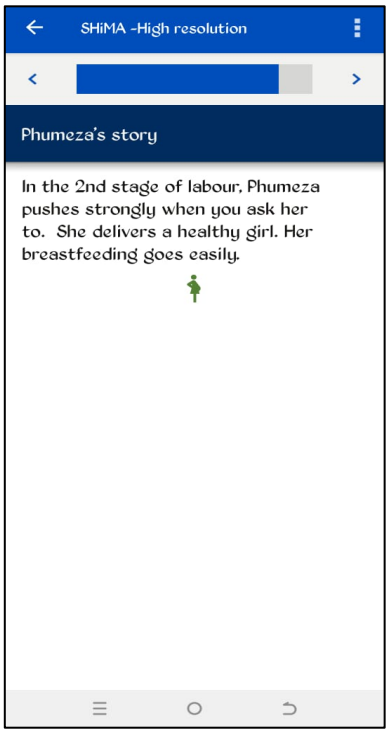
Phumeza's reveal



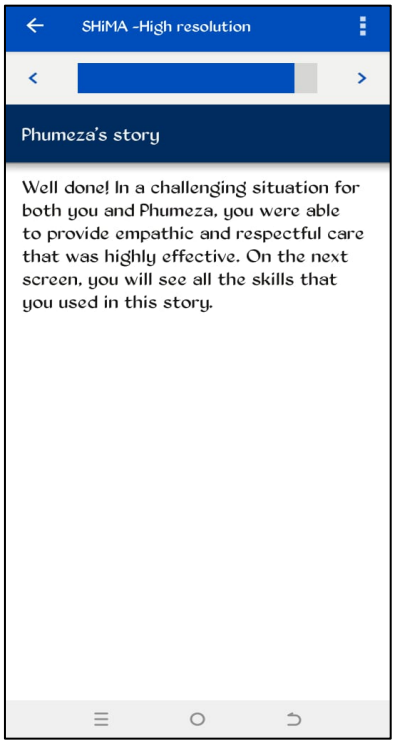
Health worker actions



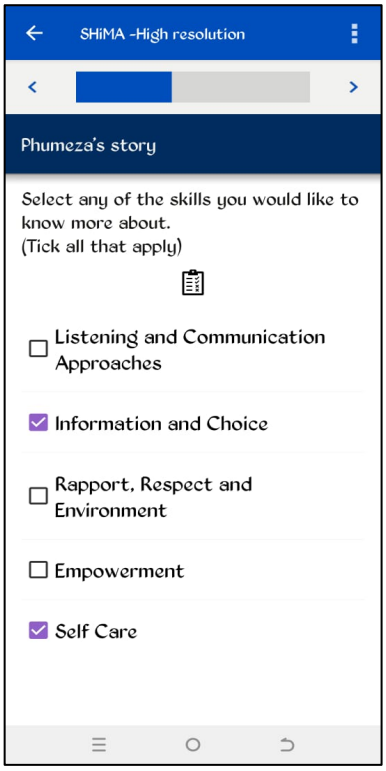
Client (Phumeza's) outcome based on health worker actions



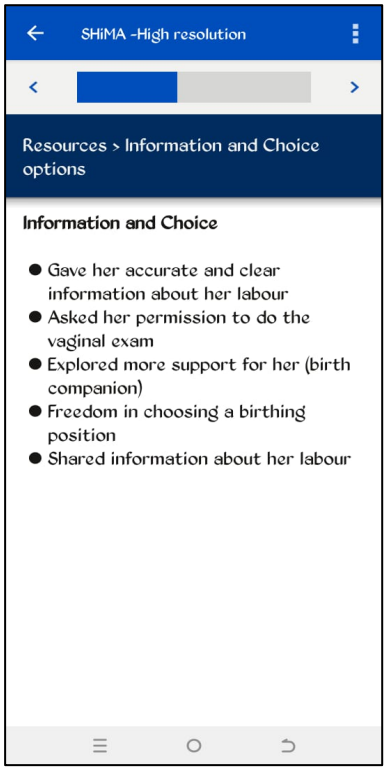
Continuation of Phumeza's outcome



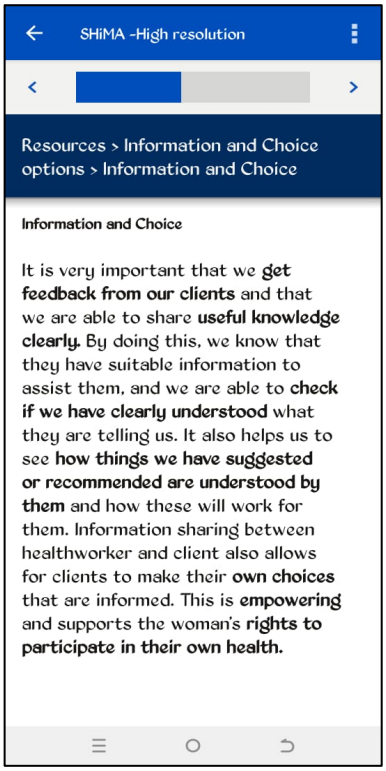
Continuation of Phumeza's outcome



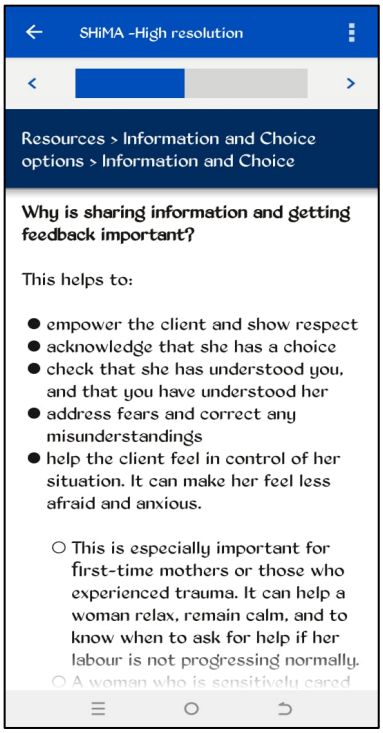
List of skills the health worker could have used achieve that client outcome



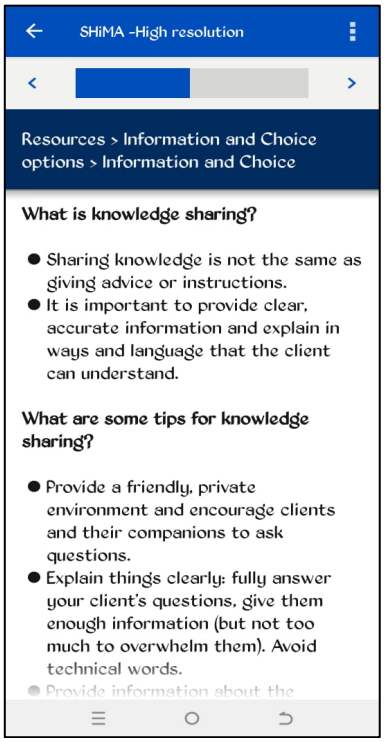
An in-depth description of the chosen choice



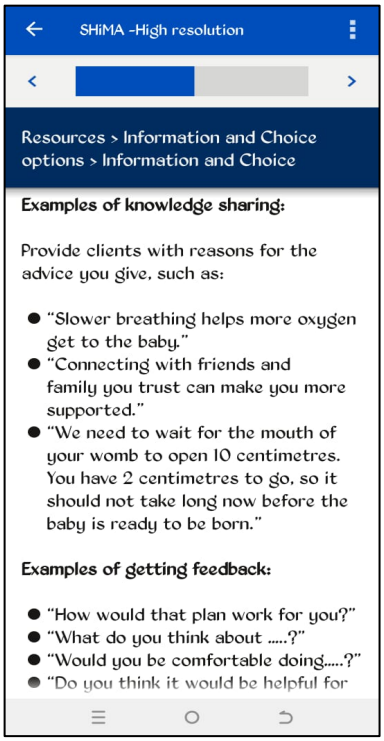
Continuation of an in-depth description of the chosen choice



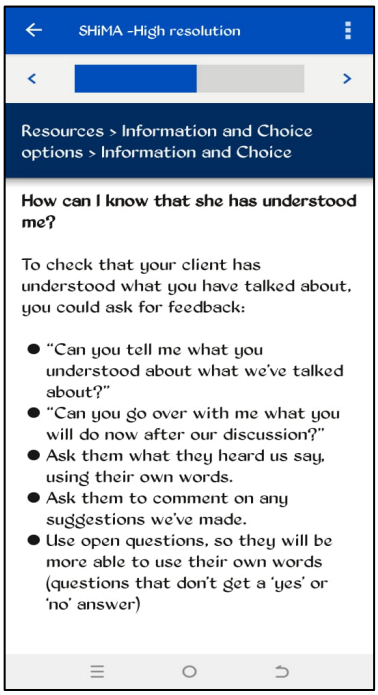
Continuation of an in-depth description of the chosen choice



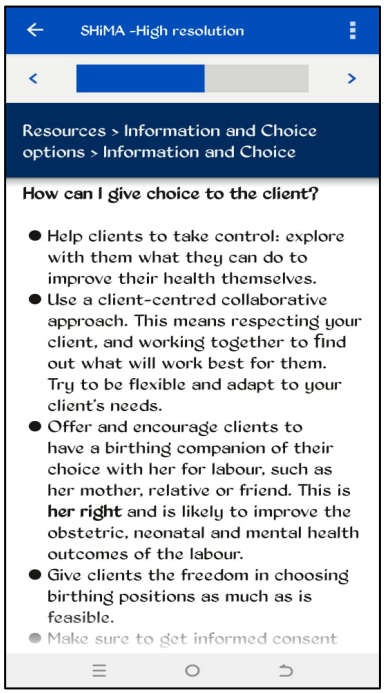
Continuation of an in-depth description of the chosen choice



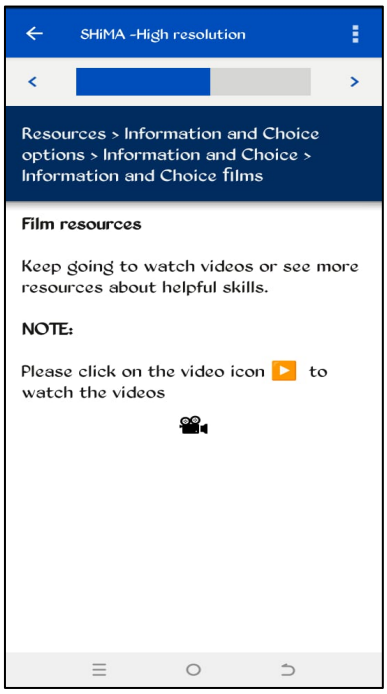
Continuation of an in-depth description of the chosen choice



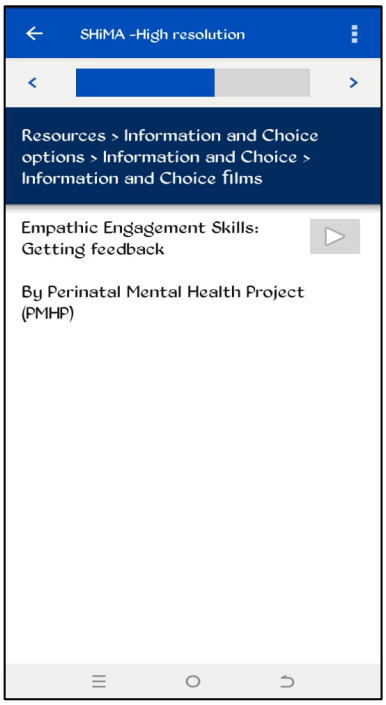
Continuation of an in-depth description of the chosen choice



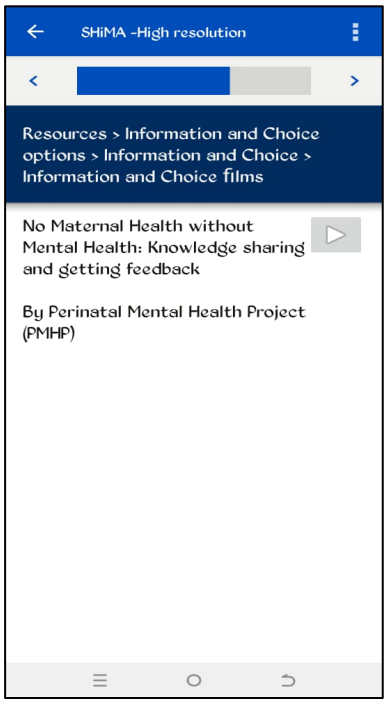
Continuation of an in-depth description of the chosen choice



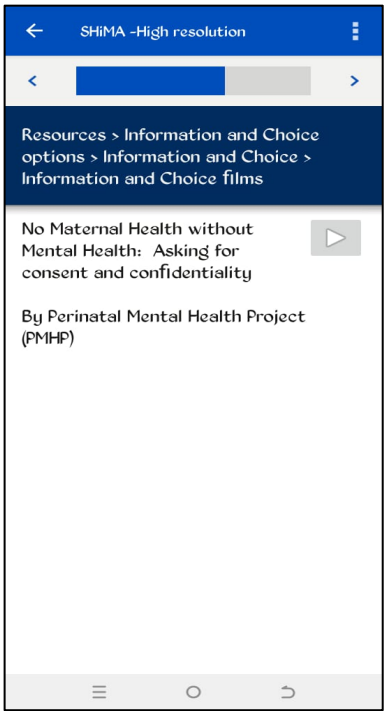
Screen showing how to access other multimedia resources



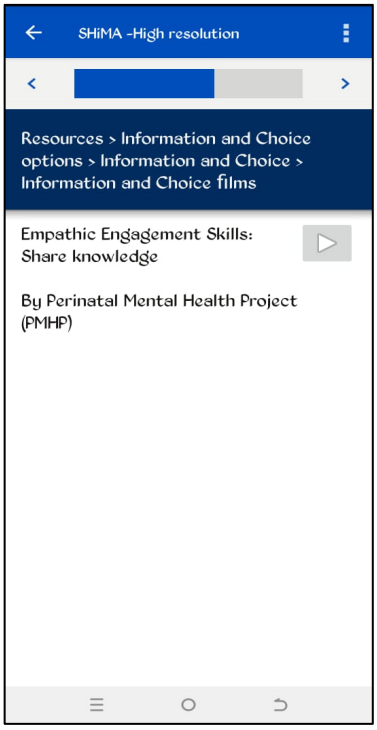
Screen showing access to one of the films



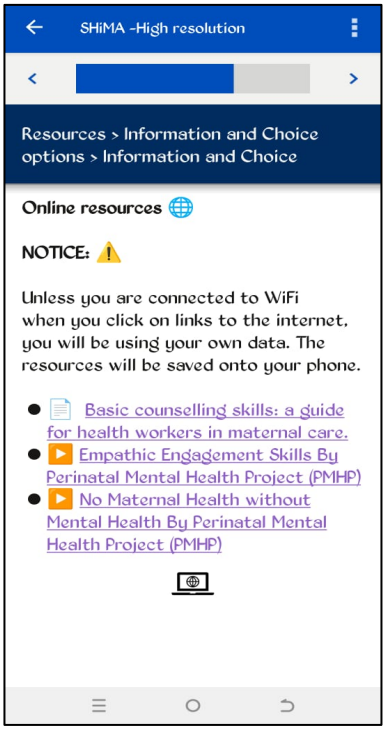
Screen showing access to another film



Screen showing access to a film



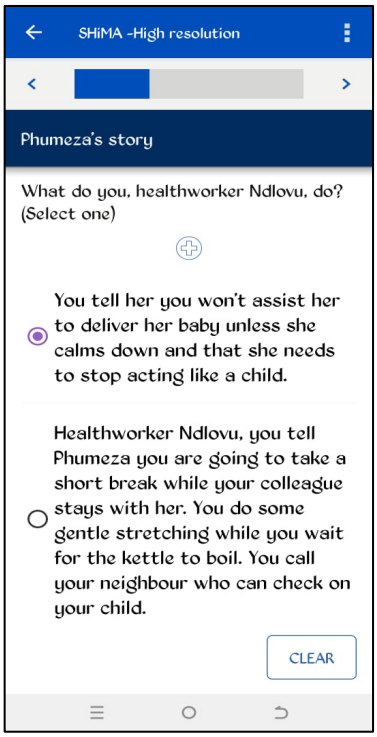
Screen showing access to a film



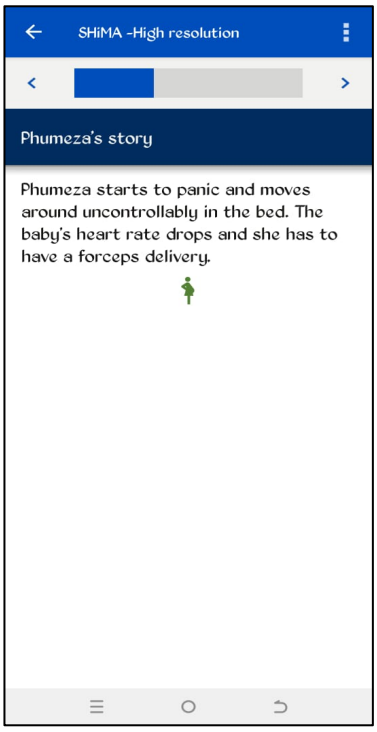
Screen showing access to online documents for further reading

Screen upon completion of a CYOA story

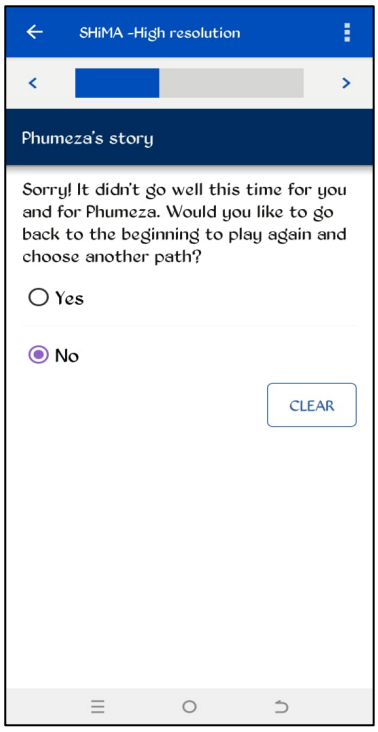
Appendix K: Alternate story path taken using SHiMA



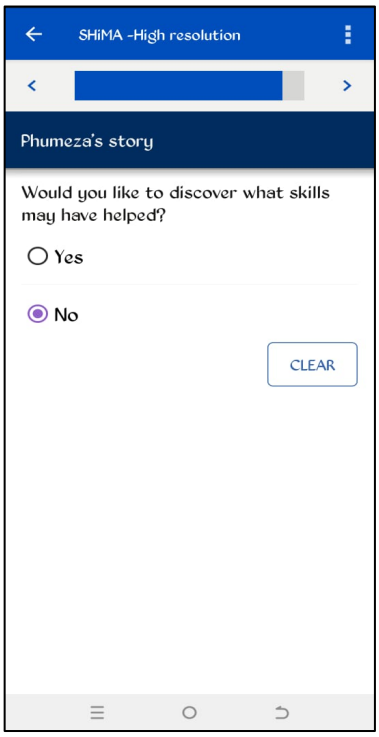
Health worker action (Bad choice of action)



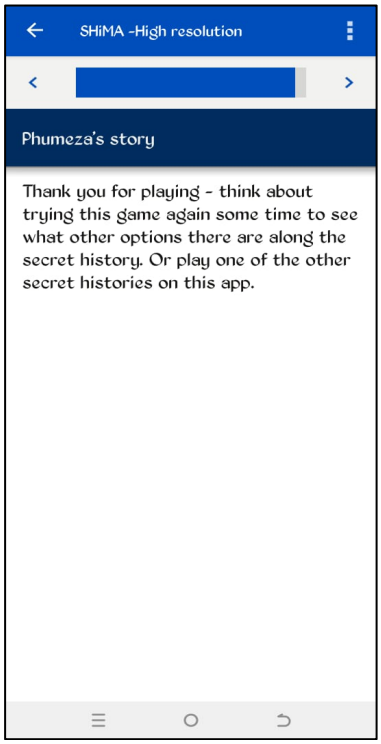
Phumeza's reaction based on health worker action



Story outcome based on health worker choices and action



Screen asking to view skills that could have been helpful



Based on selection from previous screen, the final screen at the end

Screen upon completion of a CYOA story

Appendix L: Summary of Participant Quotes as they emerged during the study

Category	Participant Code	Quote
The Secret History Approach and Empathic Training	PA-1 and PA-2	National Department of Health asked us to design a module for respectful maternity care that could be used across the country as part of the essential steps in managing the obstetric emergencies package program upon realizing that we were teaching people how to save lives, but not addressing their attitudes.
	PA-1	There was a toxic setting where health staff mistreated women in various harmful ways, including physical abuse and psychological abuse and a mental health program cannot thrive in an unhealthy setting… develop a training package that addresses obstetric violence and helps staff understand their behaviors, fostering a safe environment for self-awareness and acknowledging the impact on patients...
	PA-2	Unpack baggage that people have, understand that everybody is going through stuff in their lives and that not everybody can be treated the same…
Usefulness of a CYOA based training	PA-2	could be used for sensitizing health workers, retraining more experienced people still abusing women, orientation of new staff and equipping them to provide care in a respectful patient-centered care… Potentially act as a supplement to face-to-face training on empathic skills or face-to-face secret history training for we know from a lot of the training, behavioural change literature that one off training seldom makes substantial changes but and quite often one needs proper training…
	PA-1	act as an independent training resource that doesn't depend on formal training courses, facilitators which require time off work, or additional funds and logistics. It can be game-like, and enjoyable for people… I would love the app to be integrated into the National training curriculum. I think because the secret history training package is already embedded within the ESMOE program. So, this would be a resource that is more trainers to use…
	MW-1	The app is an effective way of training as it forces you to participate by playing a given story on your device at your desired time…
Multifaceted Story paths	PA-2 and MW-2	the idea of using the app and having different options for the stories is something that the health workers can use on their own without needing a facilitator...
	PA-1	That is true to an adventure, and I think it relates brilliantly to secret history because it allows people to imagine more than one way of engaging with clients or patients…
	PA-2	I would like to know what happens afterward from the choices made in the story…
	MW-1, MW-2 and MW-3	Our interest in the app on what happens next and the story itself motivates us to select the skills we could have used in such a scenario…

	PA-2	*This shows there was an interaction, there was this path chosen and there was an outcome and then there is a take-home message...*
	BA-1, BA-2 and BA-3	*it reinforces and makes the health workers reflect on their experience as they play the stories to maximize learning*
	MW-1, MW-2 and MW-3	The app makes you aware of your colleague's struggles or what they may be going through, and you learn how to relate to them…
Development of Stories	PA-1	The scenario might get old or stale quite quickly. so as to keep people interested you would need to have a big bank of different flows and algorithms around the narratives and that would take quite a bit of ongoing work … We would need to feed the app with enough different scenarios to keep it fresh and, to keep the options wider in terms of the different stories...
Audience Inclusion in Story Development	BA-1, BA-2 and BA-3	You should not only draw focus on workers on the ground but also go to the midwifery management because midwives treat their patients that way based on how they are treated by the management. It is important to include that group of mothers/ patients who have had a difficult birth experience and have a child who now needs extra care. Or they have been told that now there is a problem with the baby, and they are going to have a disability. Because unfortunately, that community is often neglected...
	MW-1, MW-2 and MW-3	This story makes you more aware of what this patient could be going through and ways in which you could be more supportive to them…
User-friendly experience	MW-1, MW-2 and MW-3	*I liked the idea of not being able to proceed to the next part of the story without making a selection…* Sometimes you may feel more than one of the suggested choices and it is good that the app gives you the option of selecting more than one…
	PA-1, PA-2, PA-3 and MW-1, MW-2, MW-3	*Add an instruction in brackets i.e., choose as many as you can" and the part where only one selection needs to be made in the action part, emphasize that the user makes only one choice i.e. choose only one option ...*
	PA-1, PA-2, and PA-3	*some information does not fit on one screen, you could preferably limit the words, especially in wordy sentences...*
Feedback and improvement process	MW-3	the story was quite confusing at the beginning as I have to go back and forth about the secret history reveals to understand what is happening...
	MW-1, MW-2, and MW-3	The older generations may not embrace the app so well and may have challenges using it whereas the other groups of people would find it great and exciting…
	PA-2	"The mobile app allows providers to open up a sort of internal vision that can be broadened to appreciate the ritualized, standardized way of doing things, and that there are alternatives…

	PA-3	I think it is a nice learning tool, instead of going through the options and having choices to change your mind and whatever, there is an opportunity of seeing how you could get a better outcome…
	MW-1, MW-2, and MW-3	I love the fact that you start with the health worker's story before going into detail. This enables the midwives to own the app since you are talking about them in the application before talking about the patient
	PA-1, PA-2, PA-3 and BA-1, BA-2, BA-3	While evaluating the system, you could interview the clients if they are willing to share how they are treated by healthcare workers who use the app, to determine the effectiveness of the application PA-1, PA-2, PA-3 and BA-1, BA-2, BA-3
Feedback on initial CYOA storyboard	MW-1, MW-2 and MW-3	Moving from bad to somehow bad and viable choice of action makes it direct, and no health worker can choose a bad option. It would be great if you interchange these somehow, so it does not make it obvious on the app
	MW-2 and MW-3	Let it be tailored to how the midwife feels e.g., do you need to go and lie down in a case where the health worker's back is hurting…
	BA-1, BA-2 and BA-3	tailoring the resource section to the health worker is a good idea and provides room to collect more specific feedback on what the health worker feels at the end of the story…