

**EFFECTIVENESS OF IMMERSIVE MEDIA AND
GAME-BASED LEARNING IN BUILDING EMPATHY
AMONG NURSING PROFESSIONALS IN INDIA**

A Thesis submitted to
UPES

For the award of

Doctor of Philosophy
in
Interaction Design

By
Manisha Mohan

March 2025

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DECLARATION

I declare that the thesis entitled “**Effectiveness of Immersive Media and Game-Based Learning in building Empathy among Nursing Professionals in India**” has been prepared by me, under the guidance of my supervisor, Dr Naveen Kumar, Assistant Professor of Interaction Design, UPES, and external supervisor Dr Anirban Chowdhary, Professor & Faculty-in-Charge (UX & IxD and Research) at Alliance School of Design and Creative Arts in Alliance University. No part of this thesis has formed the basis for the award of any degree or fellowship previously.



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CERTIFICATE

This is to certify that the research work contained in thesis entitled **“Effectiveness of Immersive Media and Game Based Learning in building Empathy among Nursing Professionals in India”** submitted by **Manisha Mohan** to UPES, for the award of Doctor of Philosophy in Design is a record of Bonafide research work carried out by her under my supervision. This work has not been submitted in part or full to any other University or Institute for the award of any other degree or diploma. She has successfully completed her research at the School of Design, UPES.



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Date: 26.02.2025

CERTIFICATE

(To Whom It May Concern)

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“All human beings are in truth akin, all in creation share one origin. When fate allots a member pangs and pain, no ease for other members then remains. If, unperturbed, another’s grief canst scan, thou are not worthy of the name of human.” —Saadi (classic Persian poet, 1210–1290 AD) (Gonnella et al., 2022)

ABSTRACT

Background and Objectives

Empathy is the unique ability to sense the pain and needs of others as if they were one's own. Evidence has continually been found that empathy helps healthcare providers in fostering therapeutic relationships with their patients - and is an essential component in the delivery of quality healthcare. Nurses are constantly in touch with patients and their families; therefore, they need to practice empathetic behavior throughout the patient's journey.

Nurses in India face diverse challenges owing to cultural differences, shortage of resources, and lack of synchronicity and support. Such stressors may act as barriers to empathy in the Indian context. However, there are limited published studies and educational interventions in building empathy in Indian nurses. Additionally, to improve empathy levels in Indian Nurses, the baseline empathy score needs to be measured. While there are globally recognized empathy measures such as the "Jefferson Scale of Empathy" (JSE), tools that consider the Indian Nursing context and challenges do not exist.

"Game based learning" (GBL) is growing in adoption as a tool for healthcare education, as it offers a framework with built in rewards, challenges and realistic contexts that help in training professionals in an effective way. Virtual Reality further offers an immersive environment that fosters learner engagement by providing realistic, safe and engaging experiences that can emulate real world interpersonal communication and decision-making. The overall objective of this investigative study is to determine the "Effectiveness of Immersive Media and Game Based Learning in building Empathy among Nursing Professionals in India".

Methodology

The mixed method was followed for this study including both quantitative and qualitative approaches. The study involved four major phases, with the goal of

achieving the overall objective for this research. The research was primarily conducted with the support of nursing professionals from All India Institute of Medical Sciences (AIIMS), Rishikesh, India.

Phase 1. Creation and Reliability Testing of a New Empathy Scale for Indian Nurses

A new empathy scale was designed which was aligned to the Indian nursing context. This evolved based on input from experts and a study of globally accepted scales such as the JSE. A 30-item empathy scale was developed, and a pilot study was conducted on 50 nurses from diverse backgrounds to test the reliability of the scale.

Phase 2. Design of Game Interventions to build and practice empathy among Indian Nurses

A focus group was conducted with 18 nurses to understand barriers to empathy and gather scenarios where empathy can be practiced. A scenario of a conversation between a nurse and a patient with stage 3 breast cancer was identified to create the game. Three types of game prototypes were created using diverse technology with the same scenario – 2D photographic, 360 Live Action and 3D Virtual Reality (VR).

Phase 3. Reliability Test of Learner Feedback form and Pilot Test of the 2D Photographic Game

A learner feedback form was created which included a 12-item survey on a seven-point Likert scale, that addressed aspects such as relatability to context, engagement and immersion, usability and perceived learnability. The 2D photographic game was pilot tested by 60 nurses followed by the administration of the learner feedback form and the results were statistically analyzed for reliability of learner feedback form and effectiveness of the scenario.

Phase 4. Effectiveness of three Game Interventions in Building Empathy among Indian Nurses

A comparative study was conducted by Random Control Trial (RCT) method on 120 nurses from the emergency, gynecology, cardiology and oncology wards using

the three game interventions, deployed on three different platforms and another batch, which was the control population where no intervention was given. The interventions included three games a. 2D photographic game on mobile; b. 360 Live Action Video on desktop; c. 3D VR game on Oculus Quest 2; d. Control where no intervention was given. The empathy scale was administered to the nurses before and after the administration of the interventions and the results were statistically analyzed to ascertain their relative ranking in terms of empathy building.

Discussion and Contribution of this research

While virtual reality-based formats have novelty and an enhanced visual experience – according to this study, the ease of use, relatability to context, engagement and the perceived learnability of mobile games was found to be higher among Indian Nurses. However, the virtual reality-based game intervention was found to be more effective in essential parameters for empathy, such as evoking an emotional or behavioural response. It is also concluded that repetitive play of multiple scenarios of different complexity levels would have a longer lasting impact on nurses' ability to practice cognitive and behavioural empathy.

The intent of this research is to contribute meaningfully towards building empathetic behaviour in Indian Nurses and in turn improve patient wellbeing and outcomes. Some of the contributions of this research include: a. The design of a reliable Empathy Scale for the Indian Nursing Context, b. The creation of three templates for a game to build empathy, which can be further built on to create multiple scenarios and can also be extended to building other nursing skills, c. The design of a reliable Learner Feedback form for gathering feedback on the game-based learning from nurses, c. The relative assessment of three media types that can be used for building soft skills such as empathy in Indian Nurses. d. Framework for building Virtual Reality based Games for soft skills such as Empathy. e. A concept for a scenario generator engine and Virtual Hospital for healthcare professionals.

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LIST OF ABBREVIATIONS

Abbreviation	Expansion
2D	Two Dimensional
3D	Three Dimensional
ACC	Anterior Cingulate Cortex
AI	Artificial Intelligence
AI	Anterior Insula
AIIMS	All India Institute of Medical Sciences
CARE	Consultation and Relational Empathy Measure
EQ	Empathy Quotient Scale
GBL	Game Based Learning
JSE	Jefferson Scale of Empathy
HCI	Human Computer Interphase
ICF	Intermediate Care Facility
IRI	Interpersonal Reactivity Index
mPEC	Medial Prefrontal Cortex
OBJ	Obstetrics and Gynaecology
OFC	Orbitofrontal Cortex
PPOS	Patient-Practitioner Orientation Scale
RPG	Role-playing-game
RO	Research Objectives
UID	Unitedworld Institute of Design
UI	User Interface
UX	User Experience
VR	Virtual Reality
vmPFC	Ventromedial Prefrontal Cortex

Abbreviation	Expansion
IEENV	Individual Empathetic Environment (New Empathy Scale)
INRES	Individual Stress Related to Resources (New Empathy Scale)
EMPMO	Empathy Related to Motivation (New Empathy Scale)
COGN	Cognitive Negative (New Empathy Scale)
COGP	Cognitive Positive (New Empathy Scale)
EMO	Emotional Factors (New Empathy Scale)

DEFINITIONS USED IN THIS THESIS

Terms	Definitions
2D	Abbreviation for two-dimensional where only two dimensions are required to ascertain the position of elements.
360 Video	An immersive type of media that displays a spherical view of the scene around the camera. Providing a panoramic and interactive visual experience - the viewer can navigate in any direction—up, down, left, right.
Affective	Pertains to emotions or feelings. Responses that are affective can include moods, feelings, attitudes, and emotional reactions.
Artificial Intelligence (AI)	Is a combination of technologies which enable machines to be programmed to think and learn like human beings.
Behavioural	Action or reaction of individuals or groups in response to internal or external stimuli.
Cognitive	Mental processes involved in gaining knowledge and comprehension. Cognitive functions encompass perception, memory, attention, language, and decision-making.
Empathy	The ability to comprehend emotions and needs of others.
Empathy Map	A collaborative visualisation tool which helps comprehend what a user says, thinks, does, feels.
Immersion	The sensation in which a user feels absorbed or present in the VR
MetaHumans	Highly detailed, realistic digital human beings created using advanced computer graphics and animation.

Metaverse	An interconnected network of immersive digital environments where people can interact with each other and the digital world around them.
Motion Capture (Mo-Cap)	A technology using sensors which is used to capture the movements of objects or people to be used for animation or game development.
Navigation	The process of determining and maintaining a course or path to a specific destination. It involves the use of tools to plan, record, and control the movement from one place to another.
Presence	Refers to the feeling of being physically or spatially located in a digital environment, even when one is not physically there.
Persona	A fictional character primarily used in user-centred design that represents a user type within a targeted demographic, attitude, and behaviour set.
Rigging	Process of creating a skeletal structure which enables a 3D object or character to move or deform.
User Interface (UI)	Interactive elements such as buttons, icons, menus, and other components that enable users to communicate with and control software applications, devices, or systems.
User Experience (UX)	A user's attitudes, emotions and feelings while using a particular product, system or service.
Virtual Reality (VR)	The use of digital media to simulate an environment that users can interact with in a realistic way.

CHAPTER 1: INTRODUCTION

1.1 Overview

“Empathy” finds its origins in the Greek word “empathia” which means “affection or passion with a quality of suffering” (Biswas et al., 2018). Empathetic behavior of healthcare professionals is essential for improved patient wellbeing, satisfaction and clinical outcomes, and is essential for the entire hospital experience for patients (Kansra & Jha, 2016, RM, 2016). Nurses are responsible for maintaining a connection with patients and their families through the treatment journey, therefore need to demonstrate empathy and compassion as a critical component of patient care (Kuo et al., 2012a). Empathy is different from Sympathy (RM, 2016), which involves being a part of another’s feelings, mainly by expressing sadness about their discomfort or pain, which may lead to nurse burnout, therefore is not desirable.

Although empathy a core element in patient treatment and well being, there are very few training interventions and limited research, and published data related to empathy in Indian nurses. The contrast between countries in terms of the studies related to empathy in nursing professionals since 1952 is shown in **Figure 1.1**. The Indian studies are the least in comparison to 13 other countries. Indian studies so far are limited to 23 nationwide, despite the need for sensitizing nurses to this critical component of patientcare. An analysis of these studies is a part of **APPENDIX C** of this thesis.

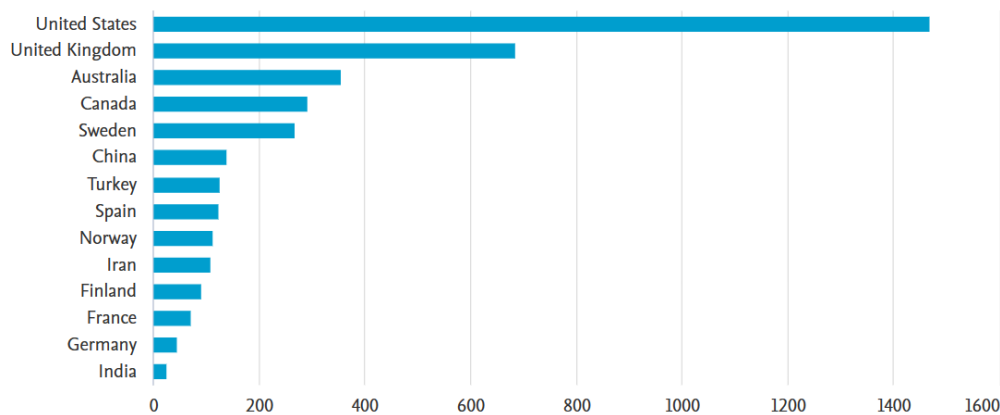


Figure 1.1. Studies conducted on Nurses and Empathy Globally 1952 -2024.

Out of a comparison of 14 countries – the US has the maximum number of publications, around 1500 on empathy in Nurses and India is the least at 23 studies. Research on empathy among Nurses in India is limited, however a standardized empathy scale and deeper study can generate valuable data, that could enable healthcare institutions and policymakers to improve care standards across the country. Empathy is expressed and understood differently across cultures, requiring contextual measures to accurately capture nuances better. Standard empathy scales developed in Western countries may not fully account for the spiritual, familial, and community-based care expectations common in India. This need for research and interventions for the Indian Nurses is further reiterated in included in sections 1.2, 1.3, 2.6 and 2.7.

1.2 The Indian Nursing Context

There are 33.41 lakh nurses in India including hospital nurses, women health visitors, midwives and auxiliary nurse midwives. The ratio is close to 40 % lower than WHO norms at 1.96 nurses for every 1000 patients, (Business Standard, 2022). Indian nursing professionals suffer challenges such as a shortage of resources and time due to this fact and there are stress factors that act as barriers to empathetic behavior in patient care. In India, after higher education, during work-place transition, the mentoring of novice nurses is conducted by senior nurses and doctors (Raletooane et al., 2022; 2014; Tourigny & Pulich, 2005). The focus of this

mentoring is primarily on clinical skills, not so much on soft skills and in the instances that it is conducted, outcomes are not easily measurable (Al Faouri et al., 2014).



Figure 1.2. Empathy an essential skill for Nurses in Indian Hospitals (AI Generated).

1.3 Empathy Measurement

The globally recognized empathy measurement scale in the healthcare context is the Jefferson Scale of Empathy (JSE) (Fields et al., 2004a). One of its known limitations is that it does not consider the Indian socio-demographic context, and challenges faced by nurses in India which include barriers to empathy (Chatterjee et al., 2017). Nurses in India come from diverse economic strata, in some cases their family background and educational background is not supportive of empathetic behavior. Additionally, shortage of resources, staffing challenges and cultural differences in the hospital would prove as stressors and barriers for empathetic communication.

Because of its cognitive, affective, and behavioral nature, empathy (Hojat et al., 2002), like other soft skills, may not be as effective if taught through traditional lecture-based methods. For relevant skills and behaviors to be transferred effectively to real life contexts, immersive and participative modelling techniques through VR and game-based learning methods may work more effectively (Shaheen et al., 2022; Steenstra & Erkoyuncu, 2014).

1.4 Role of Games and Virtual Reality

GBL encompasses experiences that are engaging, motivating, and encourage repetitive play for learners - and yet include pedagogic instructions, feedback, opportunities for reflection, and possibilities for transference to real-life contexts. Games which include role-play provide a safe and interactive medium to learn with the liberty to attempt, fail, and then try again (Bado, 2022). VR allows learners to walk in another's shoes therefore is a powerful medium for learning empathy (Schutte & Stilinović, 2017; Shin, 2018).

The objective of this research was to determine the effectiveness of VR and GBL in providing Indian Nurses a framework to practice and strengthen their skills in empathy. The research has been structured around testing of the hypothesis **“Virtual Reality based games are more effective than other approaches in building empathy in Indian Nurses.”** This is further detailed out in section 3.3.

1.5 Four Phases of Study

The research involved multiple stages based on the research questions articulated based on the literature review:

1. Creation of The New Empathy Scale and its Pilot testing and reliability study.
2. Creation of 3 Game interventions of a scenario (Empathetic interaction between a Nurse and Cancer patient) in 2D photographic, 360 VR, 3D VR styles.
3. Creation of the Learner Feedback Form Pilot and its reliability study. Testing of the 3 interventions on nurses along with a control population and administering a learner feedback form
4. Administering the New Empathy Scale before and 7 days after the nurses played the game interventions to compare the impact on empathy score of nurses using different types of games with the same scenario.

1.6 Research Motivation

While clinical skills are taught through various techniques such as classroom teaching, simulations and manikins, the interventions for training on behavioural skills and soft skills for Indian Nurses are limited. Additionally, immersive media and serious games allow learners to walk in another's shoes therefore naturally lend themselves to empathy training.

From a Design perspective there is also a need to visualise and develop scenarios that Indian nurses can relate to, and an interface which is user-friendly and intuitive for them to use. Storytelling can make the content more engaging for the audience and encourage retention of the concepts. Personally, having worked on VR and GBL interventions for healthcare professionals, including nurses, in the past, I wanted to investigate the effectiveness of a model through my PhD journey to arrive at a framework that was relevant and useful to Healthcare Professionals in India. Most of my prior work for healthcare professionals as an employee of Tata Interactive Systems has focused on the international audience (**Figure 1.3., 1.4., 1.5. and 1.6.**)



Figure 1.3. VR based Nursing Simulation for Teaching Soft skills to Chinese Nurses



Figure 1.4. VR based Nursing Simulation, Teaching Nurses how to examine a patient



Figure 1.5. VR based Nursing Simulation for Drexel Education, USA, Teaching Nurse Practitioners how to communicate with a patient.

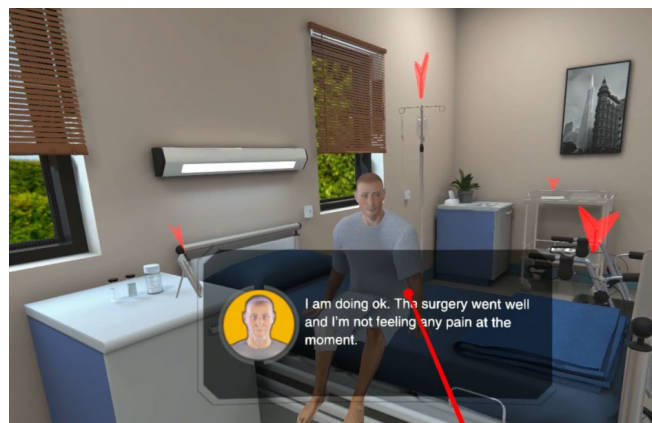


Figure 1.6 VR based simulation for training of agents based in Philippines, of a Health Insurance Company to practice interaction with a patient in a different country.

Working as the lead designer on multiple VR based games for global audiences, helped me understand the power of the medium to create a realistic experience for remote learners, and to build not only clinical skills, but essential soft skills and behavioural skills such as decision making, prioritization, communication and empathy. This was an opportunity for making a difference in the Indian context for Indian nurses and patients and also to measure the effectiveness of such a medium for building skills such as empathy.

At a personal level, my mother was a cancer patient, and I spent a lot of time in hospitals with her. I observed that empathetic behaviour of nurses went a long way making her feel better and better able to cope with the reality of her condition.

1.7 Thesis Chapter Summary

Encapsulated below is a chapter summary of this thesis.

Chapter 1: Introduction

The context for the entire research is set in this chapter in terms of defining empathy and its importance in the healthcare context, especially in the case of nursing professionals as they are responsible for being in constant communication with patients and their families. The introduction also establishes the challenges Indian nurses face in practicing empathy in the current environment and context. The research gap identified by this study is that there are no tools that consider empathy while measuring empathy and research in the area of building empathy in Indian Nurses. This is followed by my motivation to take up this research area and the definition of the overall objective for the research.

Chapter 2: Literature Review

This is a compilation of the inferences from multiple peer reviewed publications from SCOPUS, PubMed, Web of Science and other reputed databases. This has eight dimensions including the a. Empathy Defined; b. Empathy in the Global Context; c. Empathy in the context of Neuroscience; d. Empathy in the nurse-

patient interactions; e. Barriers to empathy in Indian Nurses; f. Tools to measure Empathy; g. Serious Games for Nursing Education; h. Virtual Reality and Empathy.

Chapter 3: Research Gap and Hypothesis

This section identifies the gap in the available literature on empathy in nursing professions in India. There are limited studies on empathy training for Indian Nurses using GBL and VR. It also defines the hypothesis and research objectives that form the basis for this study.

Chapter 4: Design of New Empathy Scale for Indian Nurses

Although there are multiple scales for measuring empathy, they do not consider the Indian Nursing context. The JSE is one of the most well recognized tools for healthcare professionals, especially physicians. However, it does not include questions that consider the cultural or socio demographic context of the nurse. This section describes the creation and reliability test of the empathy scale, including inputs from JSE.

Chapter 5: Design of three Game Interventions

This chapter covers the design process adopted for three Game prototypes. They are based on a common scenario and script; however, they branch out into different asset development processes using three different technologies and deployment platforms.

Chapter 6: Materials and Methods

This section follows the four research objectives identified for this study including a. The creation and reliability testing of the Empathy Scale that considers the Indian nursing context b. The creation and reliability testing of the Learner Feedback form to gather feedback on the game prototypes. c. The creation of the three game prototypes (2D photographic, 360 Live Action, 3D VR) d. The process followed to measure the effectiveness of the three game prototypes.

Chapter 7: Testing and Data Collection

This section includes a summary of the data collected while testing the empathy scale, learner feedback form and game prototypes on Indian Nurses in AIIMS

Rishikesh. It also includes the analysis of the data collected for ranking of the three game prototypes and their impact on the empathy of nurses.

Chapter 8: Discussion, Limitations, Future Scope and Conclusion

This section summarizes the research findings and co-relates them to the research that has been conducted in empathy for nurses globally. It brings out the outcomes of this research including the New Empathy scale in the Indian Context, the three game templates and the learner feedback form in terms of providing a framework for further use. The limitations of the research are also highlighted. This section also deliberates on the growing need for empathy as a key attribute of therapeutic care and the impact that immersive learning could have in the future in the field of healthcare education.

Chapter 9: References

This section includes references from peer reviewed literature around empathy, training in healthcare, nurse education, games and VR based learning.

Chapter 10: Appendix

This section includes scales, tables, charts and additional material that set a context to and support the entire research.

1.8 Thesis Chapter Summary Mind map

The mind map shown in **Figure 1.7.** summarizes the interconnections between chapters included within this Thesis with the research objectives as the core of the investigative study.

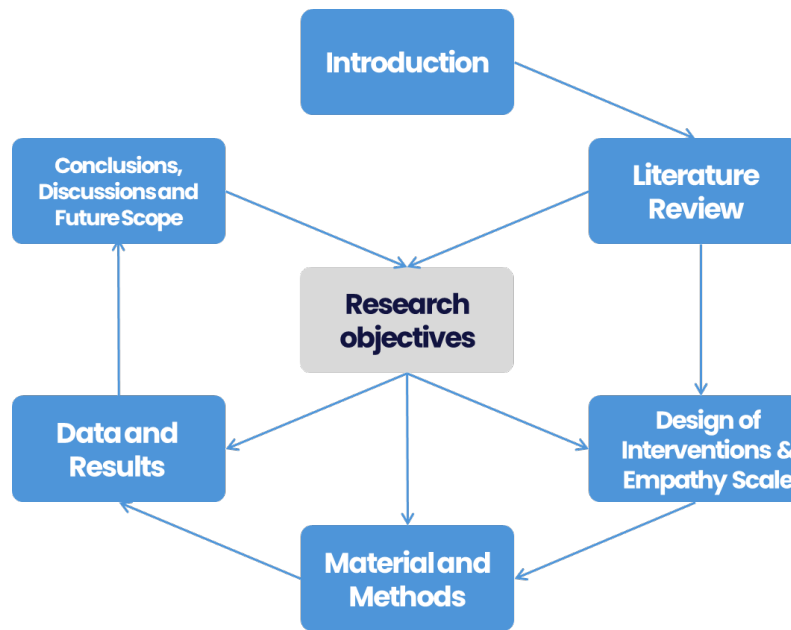


Figure 1.7. Mind map for Thesis Chapters and their interconnections.

As the sections of this investigative study were linked to the research objectives, the following chapter covers the review of literature which helped to define the research gaps and give a strong basis to research design.

CHAPTER 2: LITERATURE REVIEW

2.1 Overview

A study of existing published research aligned with the objectives of this study, was carried out, and key insights were derived from reliable sources of data in indexed journals. The SCOPUS, PubMed, Web of Science databases were reviewed for previous studies related to this research area. The following topics outlined in **Figure 2.1** formed the scope of the investigative study and insights are captured in this Chapter.

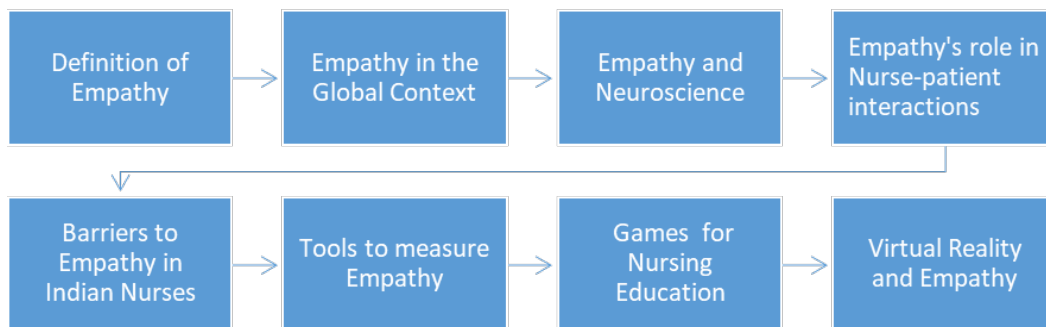


Figure 2.1: Focus areas for Literature Review.

2.2 Empathy Definition

Empathy has many definitions across numerous studies by philosophers and by scholars. It is the understanding of another individual's thoughts, feelings, emotions, and attitudes. In the healthcare world, it is described as the capacity perceive the world through the patient's lens (Banja, 2006). According to Hojat, empathy a cognitive attribute in the healthcare context, and includes perspective taking of patients, and sharing this understanding with the goal of easing their pain and suffering ((Fields et al., 2004a; Hojat et al., 2002). Additional to the cognitive dimension, empathy also includes affective and behavioural elements (Hojat et al., 2002; Preston & de Waal, 2002) as shown in **Figure 2.2**. It is also hypothesised that empathy enables a stronger comprehension of a patient's feelings because of its emotional and cognitive dimensions (Suartz et al., 2013).

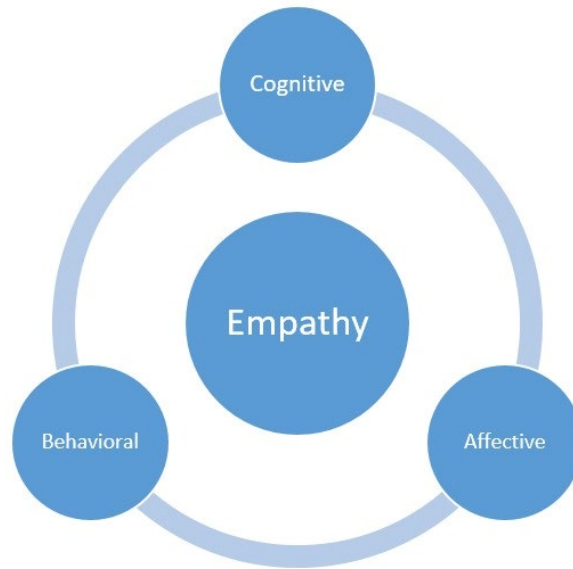


Figure 2.2. Empathy Components.

Empathy is at the core of nursing practice is essential for inculcating a positive relationship between caregivers and patients (Lina et al., 2022). Within the high stress, volatile healthcare environment, nurses remain connected with patients and their families, by not only supporting them clinically, but also providing understanding and support emotionally (McKenzie, 1977). Empathetic nurses are better able to understand and address patients' emotional needs, which in turn improves patient satisfaction, treatment plan adherence, and consequently leads to improvement in health outcomes (KA Brown, 1990; Parashar et al., 2022; Warner, 1992). Research has found that patient overall well-being and nurse empathy are strongly connected (RM, 2016).

2.3 Empathy in Global and Indian Contexts

As this research focused on empathy of nurses in the Indian context, there was a need to understand where India ranks in the context of empathy in comparison to other nations, and to also identify factors that influence empathy.

William Chopik of Michigan State University had studied the relative ranking of countries on different dimensions of empathy (Chopik et al., 2017).

According to this study, cultural practices bond people in diverse ways and empathy plays a role in sustaining these bonds. Data was collected from an adult population of 104,365 people across sixty-three countries, and it was found that countries with higher empathy also have a greater degree of unity, sincerity, cooperation, compassion, self-worth, sense of well-being, and benevolence. It was observed that the cultural dimensions of these metrics distinctly align with the economic development of a country, its access to education, standard of living (Gorodnichenko & Roland, 2011; Voronov & Singer, 2002).

The nations that scored highest in the empathy scale were Ecuador and Saudi Arabia, whereas the US scored 7th highest globally (Chopik et al., 2017). Africa had a low ranking of 52 and India scored an average at 35th rank on overall empathy (Chopik et al., 2017). However, Chopik drew attention to the fact that that cultures are constantly changing and variations in empathy scores could occur over time. The scores were also found less reliable in non-English speaking countries as there may have been challenges in comprehension of the scale.

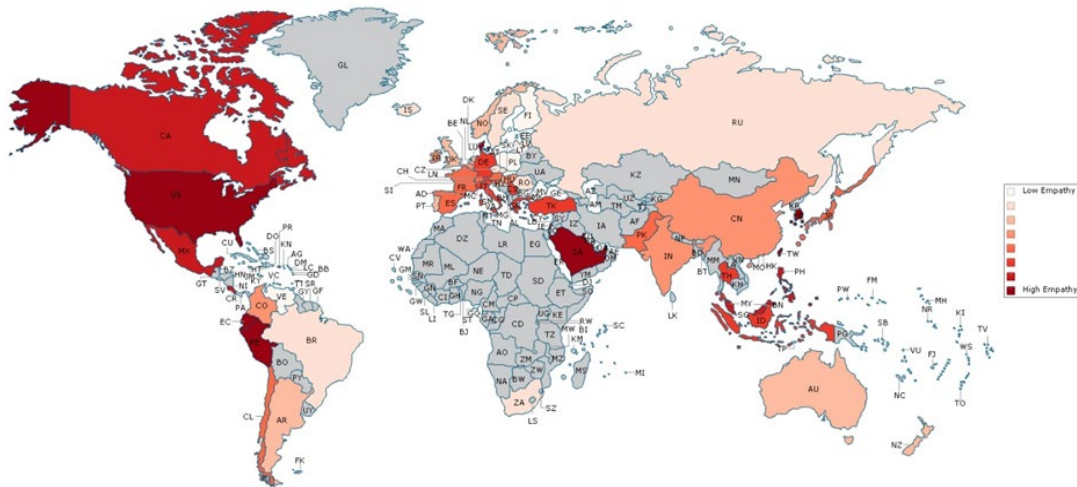


Figure 2.3. Nationwide Ranking on Empathy, Michigan University (Chopik et al., 2017).

A population's capacity for practicing empathy is significantly influenced by parenting practices and the education system. Age, gender, culture and upbringing all have an impact on the level of empathy of Individuals (Mohan et al., 2022).

Further to this research, other studies were investigated which identified the factors influencing empathy in the Indian context. Research was conducted on 249 undergraduate medical students from Kolkata on multiple factors including sociodemographic background, job satisfaction, career choice for the future, along with the measurement of empathy levels through the JSE. It was determined that the Indian medical students in this study scored low in comparison to other subjects outside of India and it was also found that that empathy reduced with each semester of medical college (Roff, 2015) .

2.4 Empathy and Neuroscience

Empathy involves intricate brain functions and is a core aspect of human interaction and relationships (Decety & Lamm, 2006). There are multiple components such as cognitive and behavioral aspects of empathy which are connected through complex neural networks in the brain (Bray et al., 2022; Decety & Jackson, 2004). Empathy is closely related to neuroscience principles and there are multiple ways in which the structure of the brain impacts and manifests empathetic behaviors. This section addresses some of the key findings and related research in this area.

2.4.1 Neural Basis of Empathy: The parts of the brain involved in empathy include sections of the temporal and parietal lobes, anterior singulate cortex and insula. Processing of emotions and social interaction is related with these parts of the brain. Singer et al. (Singer et al., 2004) proved the activation of pain happens within the insula and anterior cingulate cortex, not only when an individual experiences pain but also when they observe another individual experiencing pain, thus suggesting a connected neural context for both personal experiences as well as those of others.

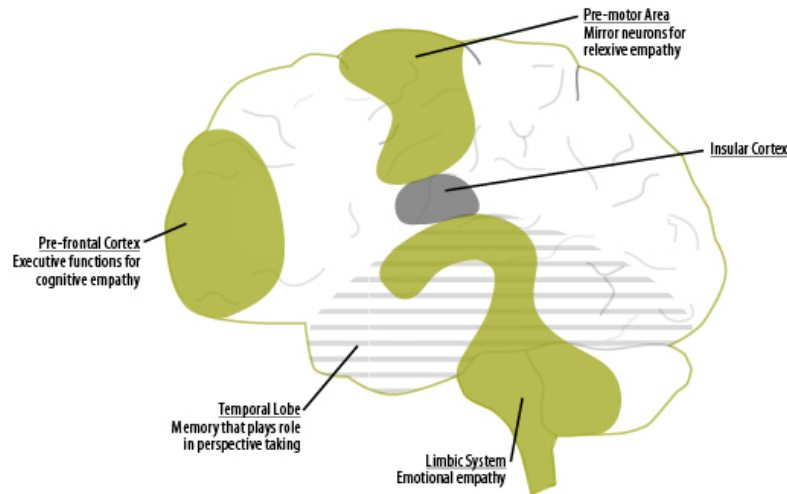


Figure 2.4. The Human Brain and Empathy.

2.4.2. Anterior Insula (AI): Emotional aspects of empathy are addressed by this region. When individuals feel emotions themselves or observe others experiencing emotions, the anterior insula is triggered.

2.4.3. Anterior Cingulate Cortex (ACC): This is driving the connections between both emotions and thoughts. It plays a critical role in affective empathy because it links emotional stimuli and motor responses, therefore contributing to compassion and a sense of distress when others suffer.

2.4.4. Medial Prefrontal Cortex (mPFC): This part of the brain links with cognitive empathy, or the understanding of another individual's frame of mind. The mPFC aids in the coming together of cognitive and affective information and is a fundamental aspect of the "theory of the mind" (Decety & Lamm, 2006).

2.4.5 Mirror Neuron System: The mirror neurons which activate while performing an action and observing another performing one, have been a significant milestone in the understanding empathy (Rizzolatti & Craighero, 2004). The neurons might facilitate the comprehension of others' behavior and intentions by simulating the observed actions and intentions, providing a neural system for empathetic behaviour (Foster et al., 2017)



Figure 2.5. The Mirror Neuron System.

2.4.6 Cognitive and Affective Empathy: “Cognitive empathy” (understanding others’ pain) and “affective empathy” (sharing others’ feelings) are looked at differently by Neuroscience. Multiple sections of the brain are activated in these two kinds of empathy (Decety & Jackson, 2004). Cognitive empathy is primarily linked to the medial prefrontal cortex and temporo- parietal junction, whilst affective empathy involves the anterior insula and anterior cingulate cortex (Decety & Lamm, 2006).

2.4.7 Genetic and Environmental influences: Neuroscientific research has found a connection amongst genetics and environmental factors with the neural basis of empathy. Studies (Warrier et al., 2018) proving that genetic variants related to neural development and neurotransmission can influence the capability for empathy, suggesting that there is biological reason for variance in empathetic ability.

2.4.8 Empathy in Psychopathology: Neuroscience research has also highlighted the lack of empathy in certain psychological conditions. Disorders like autism and psychopathy have an impact on empathetic communication and processing of emotions, due to abnormalities in brain systems (Blair, 2005).

2.4.9 Empathy and Emotion Regulation: Sections of the brain such as ventromedial prefrontal cortex (vmPFC) and orbitofrontal cortex (OFC) control emotional responses initiated by empathy. These areas help modulate the severity of emotional reactions, regulating the degree of emotional responses.

2.5.0 Neurochemical Modulators: Neurotransmitters and hormones such as oxytocin, serotonin and dopamine also play roles in neural pathways of empathy. For instance, empathy and trust are associated with oxytocin, this increases social bonding.

Empathetic behavior of healthcare workers links to patient wellbeing and satisfaction and studies in neurology also hypothesize that patient outcomes are positively impacted by empathy. The relationship between healthcare providers' empathy and positive health consequences for patients underscores the crucial role of empathy plays in the care of patients. **Figure 2.6** depicts the pathways for linking the empathetic relationship between patients and nurses, and healthcare outcomes (Hojat et al., 2023).

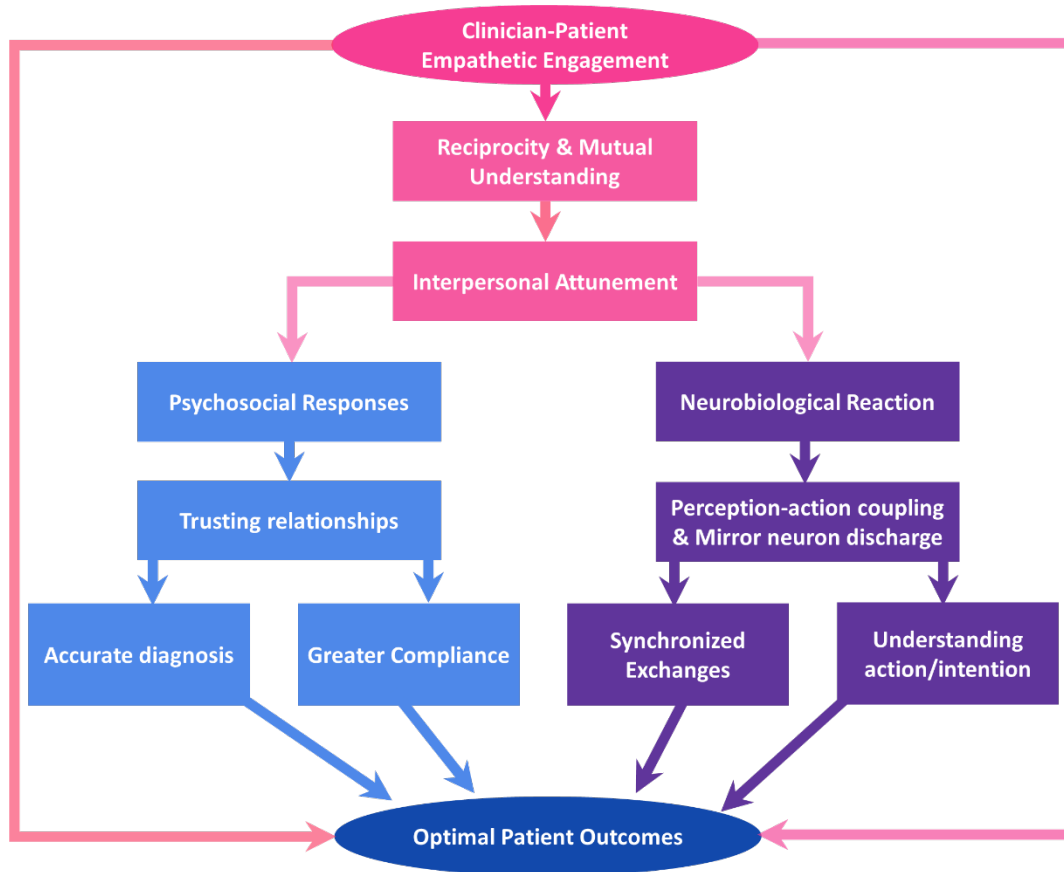


Figure 2.6. Pathways from Empathetic Engagement to Patient Outcomes.

The degree to which empathy is ingrained in neurobiology defines how deep is the ability to connect with others, and this influences not only personal relationships but also broader social behaviours. Specific to this research it was important to be aware of the neurobiological aspects that impact one's capacity to be empathetic as it has a bearing on a Nurse's inherent capability to practice empathy.

2.5 Empathy in Nurse-Patient Relationships

There are many dimensions of the nurse's role, and the clinical procedures they follow may vary by country, type of hospital, type of ward. However, there are some aspects that are common across all nursing professionals. A nurse is responsible for monitoring patients, administering medication in consultation with doctors, communicating with and educating patients (van Eede, 1977). In patient-

centered care, the nurse's role is primarily of collaboration with patients and their kin to provide support that is aligned to the requirements of each patient at each stage of treatment (Arko Jude, 2022), as represented in **Figure 2.7**.

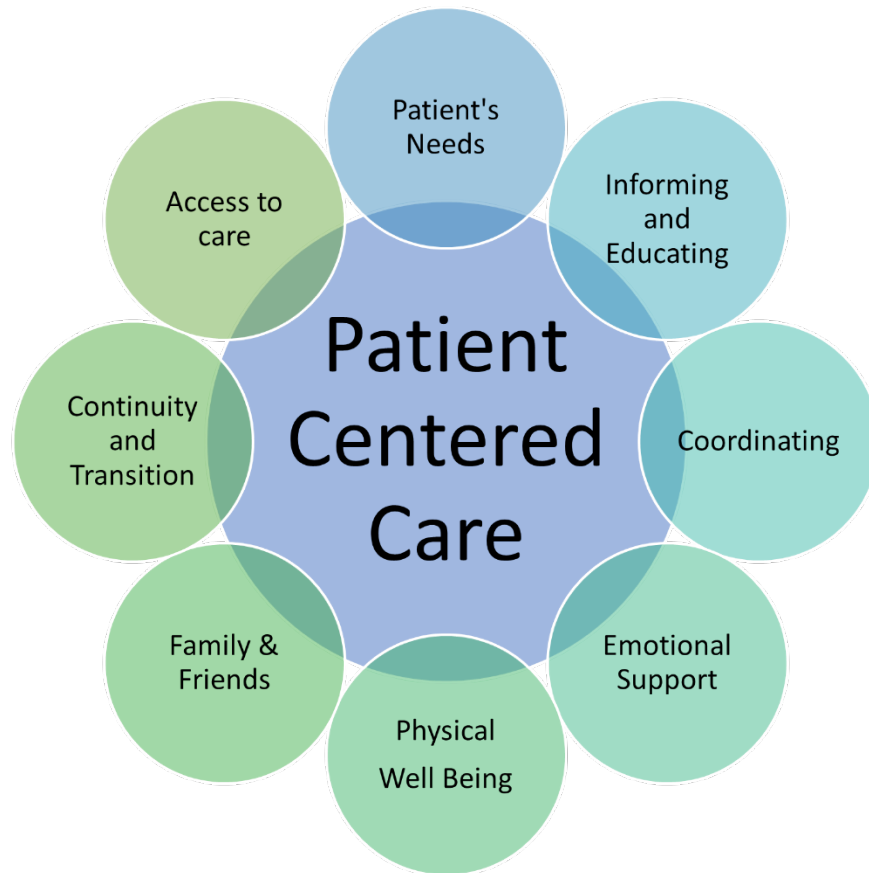


Figure 2.7. Patient Centered Care

Empathy, a critical attribute much needed in Nursing professionals, as they interact the most with patients and their families. Building hope and trust with patients is essential for establishing empathetic communication. Rutherford hypothesized that trust is an essential, though intangible, component for building meaningful relationships with patients (Rutherford, 2014) as represented in **Figure 2.8**.

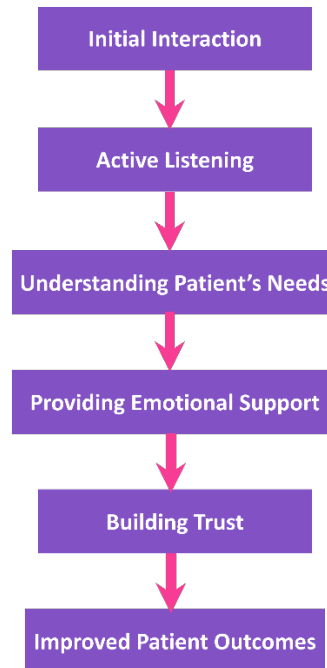


Figure 2.8. The Role of Active Listening, Trust in Improved Outcomes

Education, holistic empathetic nursing care and patient health are intricately correlated. Along with the physical ailments of a patient, in an integrated approach to healing, their psychological and social context are also considered. This helps nurses to focus on the recovery journey of the whole person rather than just the disease (Mead and Bower 2000). If the focus is only on the biological condition of a patient, without considering related aspects that impact the motivation of a patient, it may lead to negative health outcomes (Suhonen et al., 2022). **Figure 2.9** illustrates the patient's journey, and the way nurses can move from the initial patient orientation on their condition to working towards a patient and family centered approach, which improves overall outcomes (Sassen, 2023).

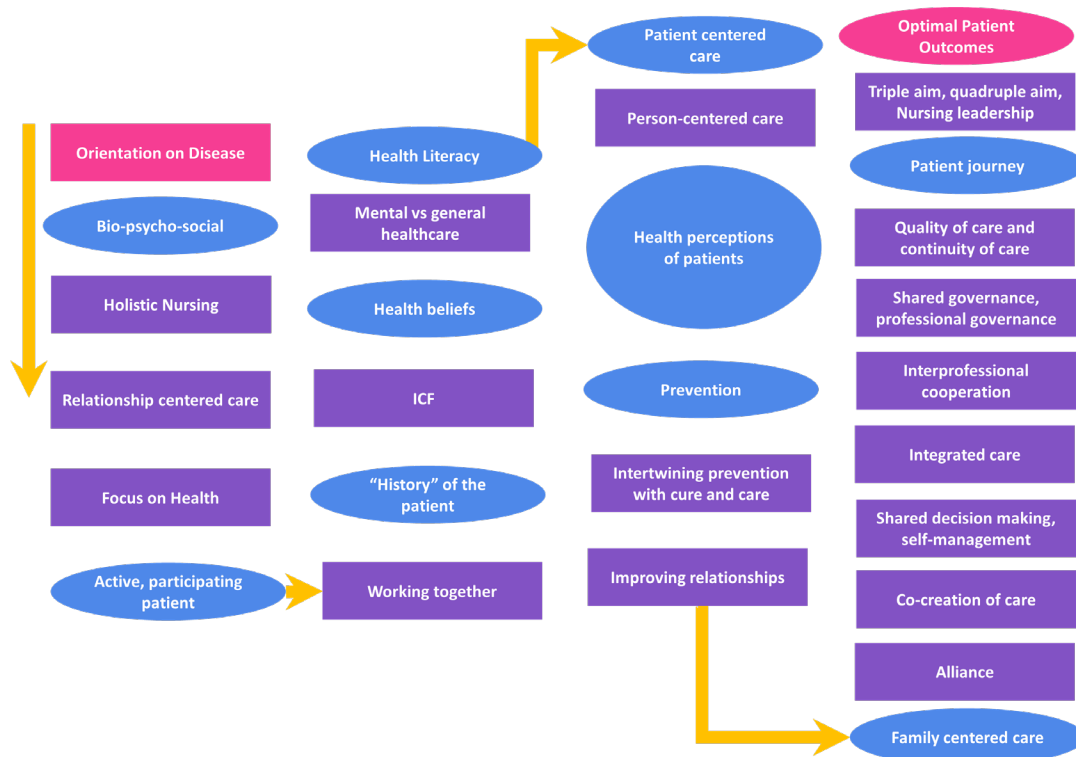


Figure 2.9. From an Orientation on Illness to Person-Centered Care with an Emphasis on improving Health.

Empathy’s critical role in patient-oriented care has been underscored in several studies (Hojat et al., 2023) (C. C. Yu et al., 2022). In a study on 17 papers, a positive correlation was found on empathy measures and outcomes if patient care (Snowdon et al., 2017).

Simultaneously, a correlation has been found between personal distress of nursing professionals and the care of patients in acute distressing scenarios such as cancer, indicating that the affective side of empathy could lead to personal distress of nurses (P. A. Hunt et al., 2017). Therefore, to avoid burnout the primary focus should be on nurses’ cognitive empathy, perspective taking rather than the emotional dimension of care or on sympathetic behaviours. (Chichra, 2019; P. A. Hunt et al., 2017; Wilkinson et al., 2017).

Using the JSE measurement scale, nurses' empathy across different wards was studied through cross-sectional research. This proved that while results of nurses across departments are similar, empathy scores were higher in more experienced or older nurses. In this study, the dimensions of "Compassionate Care", "Perspective Taking" and "Walking in Patient's Shoes" emerged as key factors (Ghaedi et al., 2020a).

Studies indicate that there is no correlation between empathy vis-a-vis educational level, and marital status (Babaii et al., 2021). With respect to gender and empathy, some researchers have observed more empathy in women than men (Hojat et al., 2002). This study examined how certain aspects such demographics, economics, culture, gender, age and experience that may influence a Nurse's ability to offer empathetic care to patients.

2.6 Barriers to Empathy in Indian Nursing Professionals

There are 3.41 million nurses in India – and the nurse to people ratio is 1.96 to 1000, whereas WHO norms prescribe a ratio 1.3 overall (Business Standard, 2022). Indian nurses experience multiple stress factors because the shortage of staff and time which at times reflects on their ability to foster empathetic relationships with patients. There are several barriers to practising empathy among Indian nurses as shown in **Figure 2.10**.

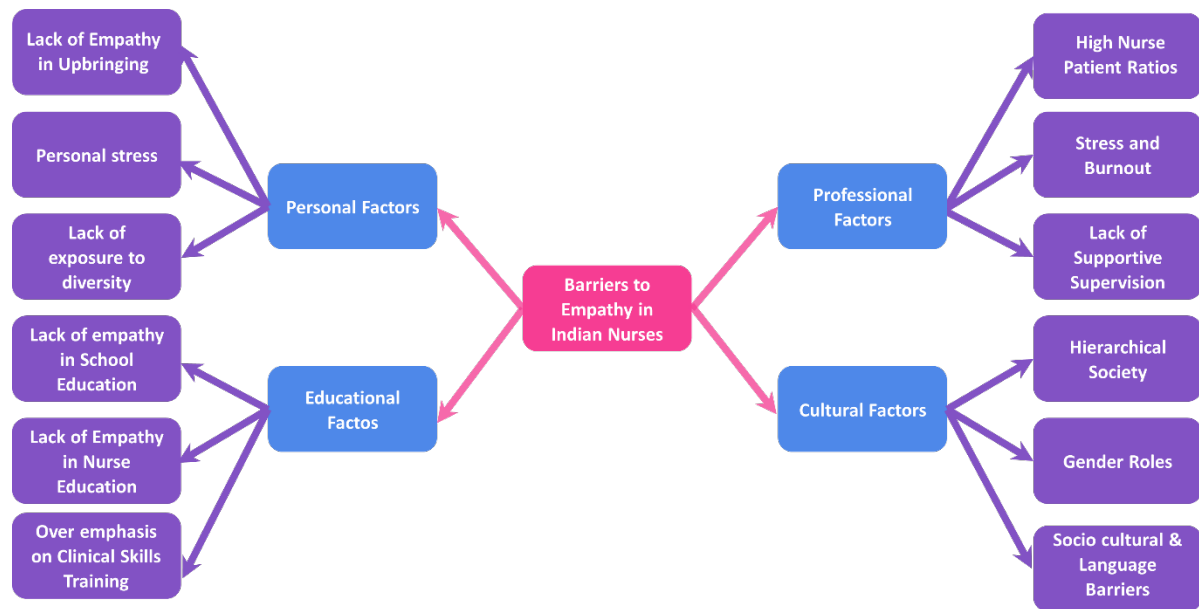


Figure 2.10. Barriers to Empathy in the Indian Nursing Context.

Some of the factors are as below:

1. **Education and Upbringing:** Due to economic diversity and non-supportive upbringing and schooling some nurses themselves are brought up in non-empathetic environments.
2. **Workload and Staffing Levels:** India has a skewed nurse to patient ratio of 1.96:1000 nurse ratio, as opposed to the WHO requirement of 1: 1000. High patient volumes and inadequate staffing leads to time constraints and stress, which prove a barrier for nurses to practice empathy with patients.
3. **Limited Resources:** Access to essential resources and equipment leads to frustration and poses challenges in providing empathetic care.
4. **Cultural and Linguistic Diversity:** India is a diverse country where there are people of diverse cultural backgrounds, and there are language challenges that can hinder effective communication and understanding, which may impact empathetic care (Maiti et al., 2012; Panda & Gupta, 2004; Qureshi, 2023)

5. **Lack of Training:** Insufficient training in empathy skills during nursing education contributes to a gap in the ability to connect emotionally with patients.
6. **Organisational Culture:** The culture within a hospital is a strong driver in building empathy and collaboration among healthcare workers. Hierarchical structures within the hospital may prioritize efficiencies over care, therefore clinical but non empathetic approaches to patient handling.

The hospital environment and patient condition are important influences on the nurses' ability to practice empathetic behavior. (Kuo et al., 2012b). Intense psychiatric conditions, or agitated behaviors of patients with mental illness may lead to bias, fear, insecurity, and burnout in some nurses (Lakshman, 2016). Additionally, most patients with complex, severe conditions are admitted to oncology, emergency wards or ICUs and, on the other hand, nurses in these departments who frequently tackle such patients face a higher degree of stress and this may hamper their ability to practice empathy (P. Hunt et al., 2019; McKnight-Chelius, 2017).

Moreover, Indian nurses are often also trying to balance personal and professional stress factors, including burnout, compassion fatigue, and emotional exhaustion, which can erode their capacity for empathy. The complex nature of the roles they perform, clubbed with society expectations and gender bias underscores these challenges, thus having a toll on nurses' well-being and resilience. As a result, nurses in India face several challenges and barriers in practicing empathy towards patients (Chichra, 2019). Additionally, the Indian Nursing curriculum includes soft skills training however there is no defined focus on empathy.

2.7 Existing Tools for Empathy Measurement in Healthcare

Despite empathy's crucial role patient well-being and positive health outcomes, empirical studies on empathy in the healthcare context are constrained partly because of a shortage of reliable tools to measure it (Fields et al., 2004a). It is typically measured by using a combination of self-filled tools and behavioral

measures to understand the underlying physiological and neurological processes driving compassion and care (Fields et al., 2004b).

There are differences in the purpose, target audience and assessment method of tools for empathy. The “Jefferson Scale of Empathy” (JSE) is the internationally accepted and most widely used survey tool created specifically to determine empathy of healthcare providers in relation to patient care (Hojat et al., 2001), (Montanari et al., 2015). The “Questionnaire of Cognitive and Affective Empathy” (QCAE) is another tool that assesses the sub-parts of empathy (cognitive and affective and their associated subcomponents} based on the social cognitive neuroscience approach on empathy and its underlying brain mechanisms (Ghaedi et al., 2020a). The “Consultation and Relational Empathy” (CARE) measure, captures the patient perspective based on their conversations with healthcare providers, and is focused more on the communicative and relational dimensions of empathy (Mercer et al., 2004). Further to this, the “Empathy Quotient” (EQ), designed for a broader audience, has been adapted to test healthcare worker’s emotional sensitivity (Baron-Cohen & Wheelwright, 2004). These tools are crucial in research and training, offering insights into the empathetic engagements of healthcare providers and their impact on clinical outcomes. “Interpersonal Reactivity Index” (IRI) is another empathy measurement tool which is applied on multiple components across healthcare professionals.

Table 2.1. Analysis Of Empathy Measurement Tools.

Scale for Empathy	Description	Target Audience	Type	Sources
“Jefferson Scale of Empathy” (JSE)	This scale assesses physicians' empathy in patient handling scenarios. Focuses on clinical abilities and care.	Physicians	Self-assessed	(Hojat et al., 2001)"The Jefferson Scale of Physician Empathy: Development and Preliminary Psychometric Data." Educational

				and Psychological Measurement
“Consultation and Relational Empathy” (CARE) Measure	Captures patients' perspective of clinicians' empathy during interactions. Focuses on the relational context.	Healthcare professionals	Assessed by patients	(Mercer et al., 2004) "The Consultation and Relational Empathy (CARE) Measure: Development and Preliminary Validation and Reliability." <i>Family Practice</i> .
“Interpersonal Reactivity Index” (IRI)	A multidimensional approach to evaluate affective and cognitive aspects of empathy.	General, applicable to all healthcare professionals	Self-assessed	(Davis, 1983) "A Multidimensional Approach to Individual Differences in Empathy." <i>JSAS Catalogue of selected documents in psychology</i> .
“Empathy Quotient” (EQ)	Designed to measure empathy in adults, focusing on the capacity to comprehend and respond to others' feelings.	General, including healthcare professionals	Self-assessed	(Baron-Cohen & Wheelwright, 2004) "The Empathy Quotient: An Investigation of Adults with Asperger Syndrome or High Functioning Autism, and Normal Sex Differences." <i>Journal of Autism and Developmental Disorders</i> .
“Patient-Practitioner Orientation Scale” (PPOS)	Assesses the orientation of healthcare practitioners towards sharing and caring aspects of patient care.	Healthcare practitioners	Self-assessed /Assessed by doctors	Krupat, E., et al. (2000). "The Patient-Practitioner Orientation Scale (PPOS): A Measure to Assess the Therapeutic

While these tools have a global reach, there are certain challenges in deploying them in the Indian Context.

The Jefferson Scale of Empathy (JSE) despite being the most globally recognized measure for empathy for healthcare workers, has the following limitations (Hojat et al., 2001):

1. **Self-reporting bias:** The JSE relies on self-reporting, which means respondents can answer questions in a manner that they feel is positive rather than capturing their actual attitude and behaviour.
2. **Limited scope:** The JSE primarily assesses “cognitive empathy”, or the comprehension of another’s perspective or emotions. It does not fully capture other dimensions of empathy, such as “emotional empathy” (the capacity to sense another individual's feelings) or compassionate behaviour (expressions, body language and actions towards care).
3. **Cultural and contextual differences:** The scale was created in a Western cultural context, therefore may not account for cultural nuances in the perception and expression of empathy. This could lead to a discrepancy in empathy levels among individuals from diverse states or countries with different dialects and cultural contexts (Hojat et al., 2002).
4. **Response variability:** The JSE survey items, as is the case with many other scales may be open to interpretation by respondents, leading to variability in responses even among individuals with similar levels of empathy.
5. **Limited predictive validity:** While the JSE can provide an assessment when the subject responded to the scale, its ability to predict actual empathic behaviours or patient outcomes is limited. It may not be accurate in predicting actual behaviours in real-world clinical settings.

6. **Potential for response bias over time:** When the JSE is administered longitudinally, respondents may become familiar with the scale and alter their responses to conform to perceived expectations rather than providing a measure of genuine changes in empathy levels.
7. **Inability to measure changes over time:** While the JSE is useful for measuring empathy at a certain point in time, it may not be sensitive enough to detect changes in empathy levels over time or in response to interventions aimed at improving empathy(Hojat & Gonnella, 2015).
8. **Limited applicability to non-physician healthcare professionals:** Since the JSE is primarily administered on medical students and doctors. its applicability to other healthcare professions (such as nursing, psychology, or social work) may be limited due to differences in training and job roles (Nunes et al., 2011) (Tavakol et al., 2012).

The Consultation and Relational Empathy (CARE) scale is a well-regarded tool used diverse health settings to evaluate the quality of empathy practiced in patient-clinician interactions. However, like other measurement tools, it has certain limitations. The identified limitations based on recent studies are outline below:

1. **Cultural Limitations:** The CARE measure has its' origins in a specific cultural context (UK) however will need proper adaptation and validation in different cultural settings. This issue has been tested and proven in the validation studies of the CARE measure in multiple countries, such as Iran, Korea, and Sweden (Mohammadi & Kamali, 2020).
2. **Specific Health Settings:** The applicability and relevance of CARE is variable across different health care settings. For instance, based on studies it has been observed that its use in specialized fields like surgery or gynecology may include challenges that are not addressed by the measure (Solaja et al., 2022).

3. **Measurement of Complex Constructs:** The CARE measure focuses primarily on the relationship aspects, and does not consider other key dimensions of empathy, such as cognitive or compassionate empathy, which might be crucial in certain scenarios (Bikker et al., 2017).
4. **Provider perspective:** While the CARE Measure is pivoted on the patient's perception of the consultation, it does not capture the healthcare provider's perspective or their own assessment of the interaction. Incorporating feedback from all stakeholders would reflect a more comprehensive understanding of the therapeutic relationship.

The **Interpersonal Reactivity Index (IRI)** is a psychological survey instrument used to evaluate an individual's capacity for empathy. Although it is used widely, there are certain limitations that the tool is associated with, which researchers and practitioners should consider (Batson, 2013; Cliffordson, 2001).

1. **Self-Report Bias:** The IRI, like many self-reported measures, relies on the honesty and accuracy with which individuals respond, since individuals might answer in the manner they perceive as acceptable to society rather than reflecting the real application of empathy on the job.
2. **Cultural Sensitivity:** The IRI was developed in western contexts and may not fully account for cultural variations in the way empathy is expressed or valued. This could lead to challenges when applied to populations with different cultural backgrounds.
3. **Dimensional Ambiguity:** IRI measures multiple empathy dimensions (such as “perspective-taking, empathic concern, personal distress, and fantasy”), but some studies have suggested that these subscales overlap in what they measure and may not be distinct.
4. **Limited Scope of Empathy:** The IRI primarily assesses “cognitive and emotional” aspects of empathy but may not adequately capture other components, such as compassionate or moral empathy, which may involve a readiness to help others or make moral judgments based on empathetic feelings.

5. **Age and Developmental Factors:** As IRI has been normed on adult subjects, it has limited applicability to children and adolescents whose empathetic abilities are still developing and might not perfectly align into the constructs defined by the IRI (Cliffordson, 2001).

These limitations suggest that while the IRI could be relevant for the assessment of empathy, it should be used in conjunction with other assessment methods for a more comprehensive understanding of empathy. Apart from this, the tool needs further validation to enhance its applicability across a wider population.

The Empathy Quotient (EQ) is another widely used self-reported scale for measuring empathy in adults, authored by researcher, Simon Baron-Cohen and other co-researchers at the Autism Research Centre, University of Cambridge. Despite its utility in multiple research and clinical scenarios, the EQ has certain limitations:

1. **Self-Report Bias:** Like other self-report scales, the EQ is subject to biases where individuals may fill it in ways that may make them look positive in the eyes of others, however, do not truly reflect their true feelings or behaviours. This can lead to skewed empathy scores that do not accurately reflect genuine empathic capabilities (Baron-Cohen & Wheelwright, 2004).
2. **Binary Gender Norms:** The EQ was initially validated with a binary understanding of gender, which may not accurately reflect the experiences and responses of non-binary or transgender individuals. This limitation can affect the generalizability and applicability of the test across diverse gender identities (Baron-Cohen, 2004).
3. **Cultural Bias:** The EQ was created and normalized largely on Western populations, and its validity has not been proven when administered in different cultural contexts. Cultural diversity in the way empathy is expressed and understood could vary the outcomes of such a measure (Dehghani et al., 2008).

4. **Dimensional Limitations:** The EQ primarily focuses on affective and cognitive aspects of empathy and may overlook other aspects such as compassionate or situational empathy. This suggests that the EQ might not fully and accurately capture the various facets of empathy (Lawrence et al., 2004).
5. **Specificity and Sensitivity:** While useful in identifying trends in empathy levels, the EQ may not be sufficiently sensitive or specific for use in as a diagnostic tool, particularly where there are borderline cases or in identifying differences between different types of challenges (Rogers et al., 2006).

The Patient-Practitioner Orientation Scale (PPOS) is a scale designed to assess the attitudes of healthcare practitioners and patients towards sharing of control and caring in the healthcare context (Street et al., 2003). While it has been useful in research and clinical practice, there are many limitations associated with the PPOS that are important to consider:

1. **Dimensional Overlap:** The PPOS has two sub-parts—sharing and caring—but studies have shown that these dimensions may not be entirely distinct. This overlap can complicate the interpretation of results, as it may be unclear whether responses reflect attitudes towards sharing control, caring, or a combination of both (Kravitz et al., 2002).
2. **Cultural Bias:** The PPOS was developed primarily in Western medical settings, which like other scales studied, could limit its applicability in other contexts. Cultural differences in patient-practitioner relationships, expectations, and communication styles can affect how questions are interpreted and answered, potentially skewing results (Harmsen, 2022).
3. **Response Bias:** As a self-report measure, the PPOS is subject to the usual biases associated with this method, such as self report bias. Healthcare providers may respond in a manner that aligns with idealized professional standards rather than actual practices or beliefs (Street et al., 2009).

4. **Adaptation to Modern Healthcare Practices:** The healthcare landscape has changed significantly since the PPOS was first developed, with increased emphasis on technology, telemedicine, and patient autonomy. The scale may not fully capture these modern dynamics or the evolving expectations of patients and practitioners (Beach et al., 2005).
5. **Limited Scope:** The PPOS focuses on attitudes toward shared decision-making and empathy but does not address other important aspects of trust, respect, and effective communication which are core to empathy. This limitation may necessitate the use of additional instruments to obtain a comprehensive understanding of these relationships (Levinson et al., 2010).

After a comprehensive research and analysis of the purpose, strengths and limitations of the existing tools with respect to the study of empathy, it was concluded that a new empathy scale should be developed for the aligned to this study which considered the multiple aspects of empathy and the cultural context and challenges specific to India.

2.8 Serious Games for Nursing Education

A game can be defined as structured play, for the purpose of entertainment, marketing, education or research, which includes a game objective or goal, game tools, game rules and game operations (Breuer & Bente, 2010; Djaouti et al., 2011; Silva, 2020). A simulation on the other hand accurately and realistically represents a scenario in an interactive form. A game is typically an abstracted or stylized version of a phenomenon (Crawford, 1984).

Ellis Bartholomeus in her book “Apply Play to Get Ahead of the Game” described the Magic Circle – a make-believe boundary created by a game rule in which the player experiences play (Bartholomeus, 2018; McDonald, 2019). Three elements are essential to a game – a player, interaction/play defined by rules, a toy or game which creates the magic circle which in turn fosters play. Game Designers

only construct a part of the magic circle, as the player is the one that completes it (Bartholomeus, 2018).

Researchers from multiple domains such as behavioral science, HCI and Game Design are increasingly drawing on diverse perspectives and domains to build design models, theories and technological interventions to drive behavioral change (Rapp, 2017a). Drawing inspiration from the video-game world, it has been concluded by multiple researchers that the inclusion of game elements can support behavior change processes and measurement (Rapp, 2017b; Robertson et al., 2021). Games not only provide a player with a safe environment or magic circle to take decisions, but they also adapt to the player's emotions and bring about an interplay between feelings such as frustration and joy felt during gameplay through built in challenges and rewards – and the term “affective gaming” has been coined on this basis (Ng & Khong, 2015). While playing games, there are underlying behavioral changes taking place within the players, and these manifest as facial expressions, body movements and emotions which influence the gameplay. Since it has been determined that empathy includes cognitive, affective and behavioral attributes (Hojat et al., 2002), it is surmised that games would be an appropriate intervention to build all aspects of empathy in Indian Nurses (Boctor, 2013; Muhamad & Kim, 2020).

Game goals, structural constructs and the user experience of a game contribute to the creation of a multi- dimensional game typology (Aarseth et al., 2003). To arrive at game design principles and a process relevant to a specific game type that would be relevant to empathy building, it was first critical to explore the essence of games and various genres they are classified into. The mind map shown in **Figure 2.11**, describes the genres of games including Video Games, Board Games, Card Games, Serious Games and Outdoor Games, these are further divided into subcategories based on their goal, mechanics and the user experience they support (Pedersen, 2003).

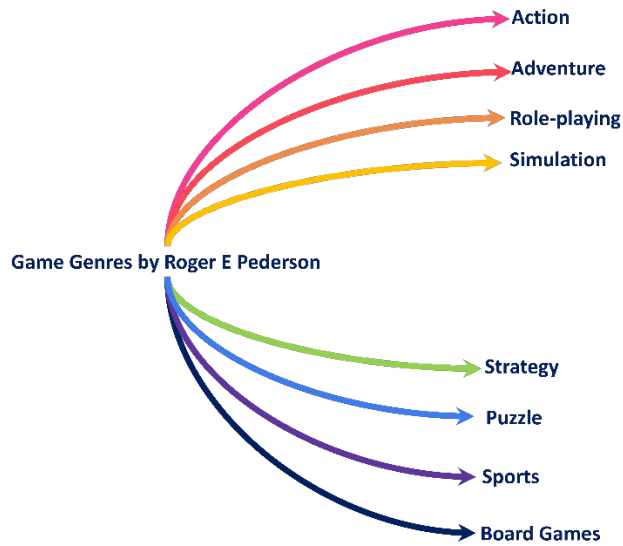


Figure 2.11. Mind-Map of Game Taxonomy (Pedersen, 2003).

Serious or applied games are those designed for a purpose (Laamarti et al., 2014). They imbibe motivational levers inherent in video game design – such as competition, rewards, challenges, levels. They are also deployed in varied game formats, physical interactions through board games or through digitally generated avatars and 2D or 3D environments, to engage participants in working through boring or complex tasks (Aarseth et al., 2003; Nguyen & Bavelier, 2023).

Serious games serve a range of user needs such as education, training, assessment, recruitment, knowledge management, innovation and scientific research (Sawyer & Smith, 2008). They engage players through narrative gameplay and through the experience, educate or disseminate information. **Table 2.2.** summarizes various user needs addressed by serious games. While serious games have immense potential to address diverse user needs, the context and audience for games requires careful selection for them to be successful (Sawyer & Smith, 2008).

Table 2.2. Ben Sawyer and Peter Smith Taxonomy of Needs for Serious Games.

	Games for Health	AdvergAMES	Games for Training	Games for Education	Science & Research	Production	Games as work
Govt & NGO	Public Health	Political Games	Employee Training	Inform Public	Data Collection and Planning	Strategic & Public Policy	Public Diplomacy Research
Healthcare	Rehab & Wellness	Recruitment & Propaganda	Soldier Training	School Education	Wargames/ Planning	Weapon Research	Command & Control
MARCOM	Advertising Treatment	Advertising Products	Product Use	Product Information	Opinion Research	Machinima	Research
Education	Inform about diseases and risks	Social issue Games	Train Teachers & Workforce	Learning	Computer Science	Constructivist P2P learning	Distance Learning
Corporate	Employee Health & Wellness	Customer Education and Awareness	Employee Training	Continuing Education	Advertising and visualisation	Strategic Planning	Command and control
Industry	Occupational Safety	Sales and Recruitment	Employee Training	Workforce Education	Process and Optimisation Simulation	Nano Biotech Design	Command and Control

Tony Bates, in his book “Teaching in a Digital Age”, (Carr, 2022) shared excerpts from the “Practical Design Guide for Serious Game-based learning” developed by the “Digital Education Strategies Team at G Raymond Chang School for Continuing Education”. The methodology that was included in the design guide was adapted from the Design, Play, and Experience (DPE) Framework (Winn, 2011) talked about the following three phases:

- 1. Pre-production:** during which collaborative working between cross functional members of the team leads to the creation of a game prototype.
- 2. Production:** is where elements of the game are created and programmed.
- 3. Post-production:** this is the compilation and testing phase before it is given to learners.

“The Digital Education Strategies” team additionally built on the Design, Play and Experience approach to identify 4 core components:

- 1. Learning,** the subject matter to be learned by players while playing the game and their learning outcomes that can be measured.
- 2. Storytelling,** which is the back story of the game inclusive of the character design, setting, and the overall game goals.

3. **Gameplay** encapsulates the player interactions with the game, or in the case of a multiplayer game, with other players.
4. **User Experience** is the player's journey during game interaction and his or her emotions during this interaction.

These components are captured in the Tony Bates Serious Games Methodology as represented in **Figure 2.12**.

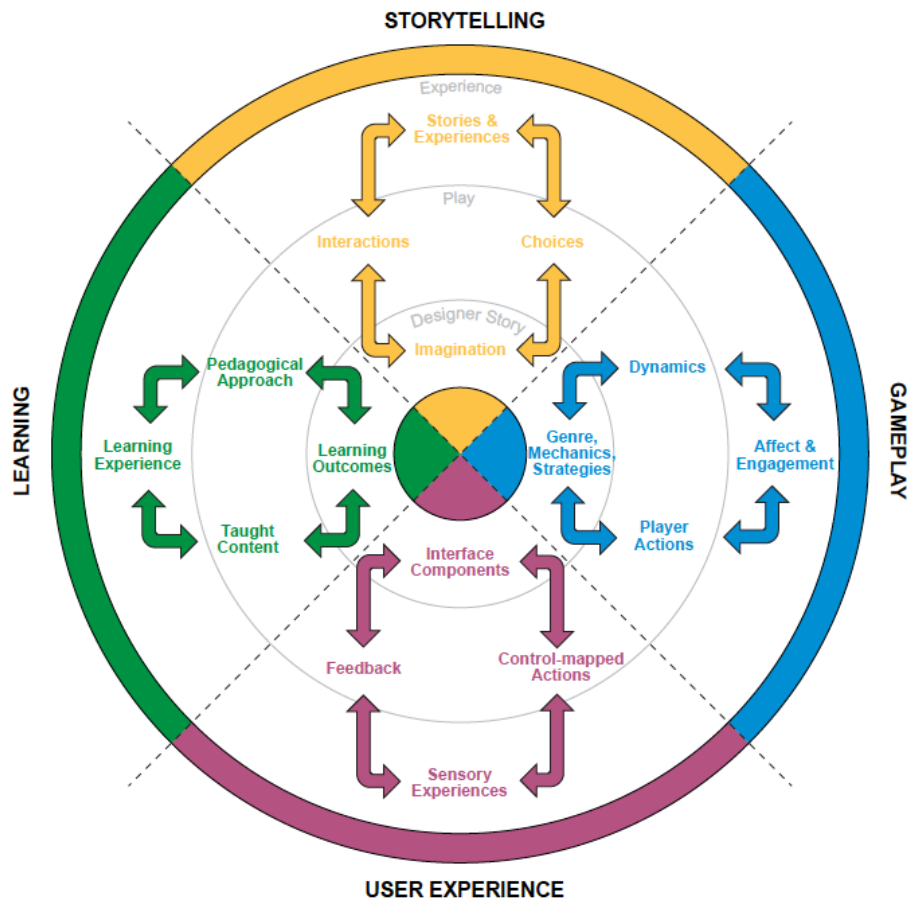


Figure 2.12. Tony Bates Serious Games Methodology Digital Education Strategies 2018 (Carr, 2022).

Serious games have a strong applicability in the healthcare context and are adaptable to meet several training requirements of stakeholders through the patient

treatment journey. Serious games are non-threatening and engaging, therefore effective for teaching difficult concepts. Visuals, audio and text aid the scaffolding of the learning through the game (Lu, 2013; Robertson et al., 2021; Thompson et al., 2010).

The perceptions of nursing students on factors such as interface design, content, were studied, along with their perspectives on usability, and future usage of serious games (Johnson et al., 2022). Two simulation courses were administered to nurses: one focused on home healthcare and the other in the context of medico-surgical wards. The primary focus was to build “clinical reasoning and decision-making skills in nursing students” through the simulations. The simulations were pilot tested on 249 second year nursing students. The home healthcare simulation course was liked by more students. However, the students experiencing both medical-surgical and home healthcare simulations felt video based serious games are an appropriate medium for nursing education.

Serious games or Game-based learning (GBL) offer innovative and engaging platforms for building soft skills, clinical reasoning skills and evidence-based knowledge in the context of nurse education (Johnsen et al., 2018a). A meta-analysis on 26 papers concluded that serious games could address 4 essential nursing competencies including procedural, health assessment, communication and clinical reasoning skills (Sipiyaruk et al., 2018; Tan et al., 2017).

The Constructivist Theory (Cetin-Dindar, 2016; Mainka et al., 2005), Benner's novice to expert theory (Munjas, 1985) and Ericsson's concept of deliberate practice (Macnamara & Maitra, 2019), underscore the value of practice in real world contexts. These three theories reinforce the importance of learning by doing and the value of practice. GBL encourages repetitive practice, allowing learner control and a range of levelled, real world scenarios. This form of learning is apt for nurses given the importance of the duties they need to perform in the real hospital context (Munjas, 1985).

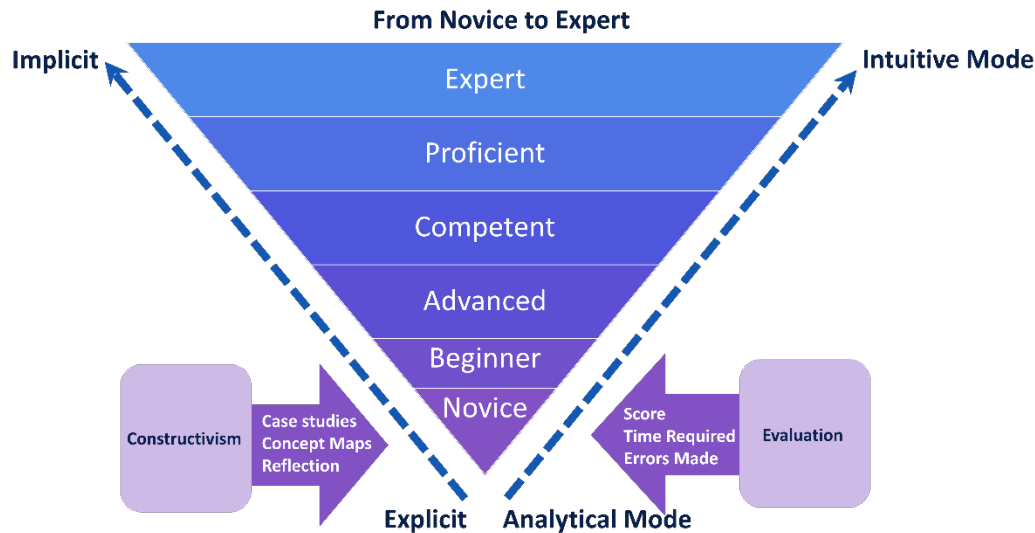


Figure 2.13. Benner's Novice to Expert Theory (Hassani et al. 2017).

By simulating diverse patient scenarios, nurses can practice perspective-taking in the nurse-patient interaction, emotional intelligence and communication skills that are all needed for adopting empathetic behavior with patients. These immersive experiences allow nurses to take on multiple viewpoints, confront their own biases and practice empathetic responses in a safe and supportive environment, thereby “bridging the gap between theoretical knowledge and real-world” application of empathy. There is still a need for deeper empirical studies on the effectiveness of knowledge transfer into the actual clinical setting (Encarnação, 2010).

Scenario based gaming formats also allow for real time feedback that drive learners to make accurate decisions and follow proper procedures (Elverdam & Aarseth, 2007).

The following images, **Figure 2.14 a and b**, highlight examples from Texas AM University (Hendrix Lindsey, 2020) and Eagle Gate College (Eagle Gate College, 2023) represent physical and digital simulations and games for nurses with realistic challenges where learners can practice clinical skills and soft skills such as decision making and effective communication.

Digital simulations were particularly relevant during COVID19 and in situations where a significant volume of students needed to learn from different locations. Additionally, they were faster to update and track effectiveness on specially for soft skill development.



(a)



(b)

Figure 2.14. Simulation based training on clinical skills could be Physical or Digital.

Vital Signs by Breakaway Games (Breakaway Games, 2020), shown in **Figure 2.5.**, simulates the tension and chaos of a hospital's Emergency Department and enables learners to handle complex trauma cases that come in. The learner faces challenges such as packed examination rooms, tough decision-making, the need for triage, checking reports and administering the right treatment for each patient in short timeframes. Natural disruptions such as phone calls, and administrative work are built in to add stress and pressure.

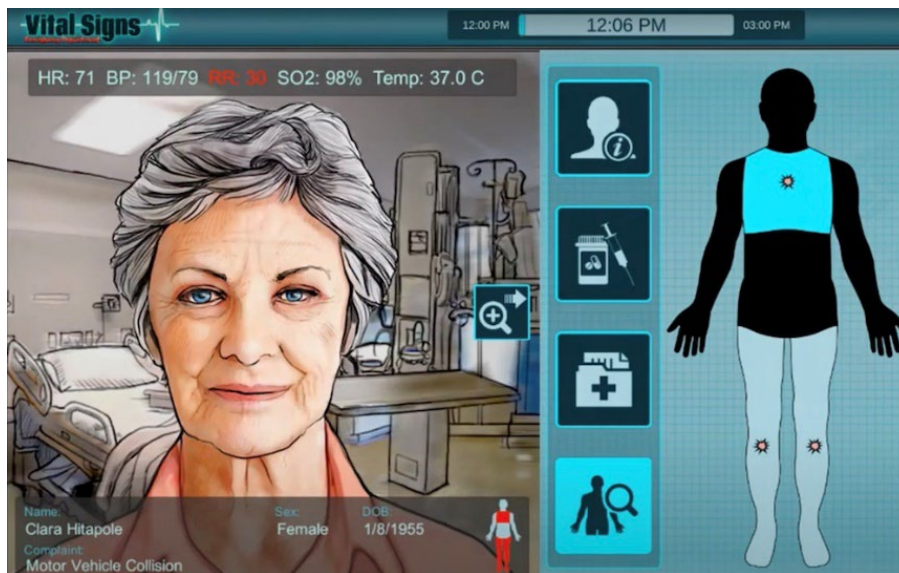


Figure 2.15. Vital Signs by Breakaway Games.

Games can include motivational elements that enable active participation of learners even for complex subjects, therefore they are found appropriate as a platform for the education of healthcare professionals such as nurses (Graafland & Schijven, 2018). While researchers have concluded that games are an effective method for learning, a blended approach to instruction will enhance effectiveness. The pre-game activities could include offline lectures and game orientation. During the gameplay it is critical to include content scaffolding and technical assistance to learners. De-briefing sessions at post-game stage are essential in order to ensure a smooth transition into real life contexts (Bado, 2022).

2.9 Neuroscientific basis for building empathy through Game Based Learning

This section addresses insights from the neuroscience of games to explore the brain sections that they affect and their applicability in building empathy.

2.9.1 Engagement of Empathy related brain areas:

Video games such as role-playing games activate parts of the brain that relate to empathy such as the anterior insula, anterior cingulate cortex and prefrontal cortex. These games simulate scenarios that necessitate understanding and reacting to the emotions and perspectives of others, thereby stimulating these areas and potentially enhancing empathetic ability (Decety & Jackson, 2004).

2.9.2 Mirror Neurons and Imitation: Games that involve mimicking or understanding character actions may engage the mirror neuron system, crucial for empathy. This engagement helps players grasp the intentions and emotions of others, both within the game and in real-world interactions (Rizzolatti & Craighero, 2004).

2.9.3 Game-Based Learning Strategies to Foster Empathy:

Role-Playing Games (RPGs): Assuming roles of characters from diverse backgrounds and challenges allows players to experience situations from new perspectives, deepening understanding and emotional connections (Belman & Flanagan, 2009).

Narrative-Driven Games: Games with strong emotional narratives can evoke feelings and foster a deeper understanding of diverse human experiences, reinforcing cognitive and emotional empathy skills (Gee, 2003)

Cooperative Games: Games requiring players to collaborate to achieve common goals, promote social bonding and improve empathy. This cooperative gameplay encourages effective communication and mutual support (Zadra & Clore, 2011).

2.9.4 Research and Outcomes in Game-Based Empathy Training:

Empirical Studies: Studies have begun to examine how specific games affect empathy and associated neural activity. (Lim & Reeves, 2010) found that

immersive VR environments enhance social and cognitive empathy by allowing players to experience life from another's perspective.

Longitudinal Effects: Long-term engagement with empathy-focused games may lead to lasting changes in the plasticity of the brain related to empathy and interpersonal perception, though further research is needed to map these effects accurately (Meyer et al., 2013).

2.9.5 Challenges and Considerations:

Individual Differences: The effectiveness of game-based empathy training varies based on neurobiology, experiences, and openness to empathic experiences. Personalization of gaming experiences is key (Kral et al., 2018)

Balancing Entertainment and Education: The challenge lies in designing games that are both engaging and educationally effective, integrating narrative elements, realistic scenarios, and meaningful social interactions (Prensky, 2001).

Based on the study of the neuroscientific basis of games, it is concluded that there is a synergy between the parts of the brain that activate during empathetic communication and those during gameplay. Therefore, games are an appropriate tool for empathy building.

2.10 Virtual Reality and Empathy

Virtual Reality (VR) can be defined as a digital platform that generates a simulated three-dimensional (3D) environment akin to reality (Sisto et al., 2002). VR presents a compelling interface that enables the player to engage with the digital environment seamlessly (Sisto et al., 2002). Studies have been conducted which explore immersive storytelling and the development and testing of VR experiences including the theory of flow, presence and embodiment (McDonough, 2022; Perez-Marcos, 2018; Slater, 2018). The results imply that there is a correlation between user traits and the user experience in specific VR experiences, and these influence the degree of immersion of users in the VR (Lee et al., 2020). Users are not only influenced by technological features, however, have a deeper engagement based on

the VR narrative structure and the depth of their influence over the story pathways (Chen & Teh, 2013).

VR can recreate environments and relationships experienced in the physical world and enable repetitive practice in a safe setting therefore it is found to be appropriate for learning and skill building for healthcare workers (Dean et al., 2020). Medical students can learn anatomy, infection control and surgery in a risk-free environment. Complex surgeries can be conducted on a patient avatar, and this can help in confidence and skill-building among medical students and novice doctors without bringing harm to the patient (Steenstra & Erkoyuncu, 2014). VR has been used for multiple applications in the healthcare domain from Training to Diagnosis to Patient Education and Treatment (Javaid & Haleem, 2020). **Table 2.3.** summarizes the major applications for VR in the Healthcare Segment, **Table 2.4.** features some examples of simulations created for doctors, nurses and care givers.

Table 2.3 Applications of VR for Healthcare.

Training	Diagnosis	Patient Support	Treatment	Medical Marketing
Learning Anatomy, Infection Control.	Medical problems replicated in VR.	Awareness of impending treatment through VR Experiences.	Doctors can plan treatment/surgery in a safe environment.	VR may be used for demonstrating the action of a drug at a cellular level, in the human body to doctors
Building of clinical and surgical skills in a safe environment	Medical students can input a patient's vital signs and identify the condition so as to decide the next line of treatment within the VR environment.	Physical Rehabilitation and Pain Management	Gives a visual experience remotely during a robotic surgery	Can demonstrate the features of medical devices
Building leadership, empathy and communication skills		Management of Phobias		

Table 2.4. Examples of VR for Healthcare.

VR Intervention	Company Name and Purpose	Description
	Virtual Knee Surgery by Osso VR(Cevallos et al., 2022)	VR used for the treatment of a fracture by Surgeons
	Military Medical VR Training by SIM (Malone et al., 2022; Xie et al., 2021)	Immersive scenarios to prioritize war injuries, emergency response, rescue operations for severely injured.
	VR Training for Nurses by SIMX (Malone et al., 2022)	This includes 150 simulations in up to 97 settings and customizable patient interactions.
	Soft skills training by immerse for working professionals (Bequiri, 2019)	This VR focusses on building an emotional connection to drive positive outcomes in the workplace. Specially for diversity and inclusion training
	Analytics based on Soft skills training by immerse for working professionals(Bequiri, 2019)	The VR provides analytics and measurable data on learner performance on softs kills. This data is not only useful for providing areas for improvement for the learners but also drawing organisational attention to critical issues

	End of Life Conversations by Embodied labs(McDonough, 2022)	Care givers walk the patient's shoes and visualize the end-of- life experience and important decisions that are taken during that phase.
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To fully harness the power of VR in healthcare, hardware requires careful selection, based on its relevance to the task or skill. Some of the VR devices that are used by healthcare professionals include VR controllers, a stylus-like controller for surgical equipment and haptic gloves (Allgaier et al., 2022). VR experiences are typically distinguished by how immersive they are (Chiquet et al., 2023). Low-immersion VR systems use images with lower fidelity to reality and they may be experienced on a regular desktop via a keyboard or mouse or a phone embedded in a Google Cardboard. However, high-fidelity VR completely engages the user in a hyper-realistic world using advanced VR headsets and the interactivity is largely based on tracking of the head and body movements along with voice and gaze (Chiquet et al., 2023)[14]. **Figure 2.16** highlights the different modes of interaction in a VR environment.

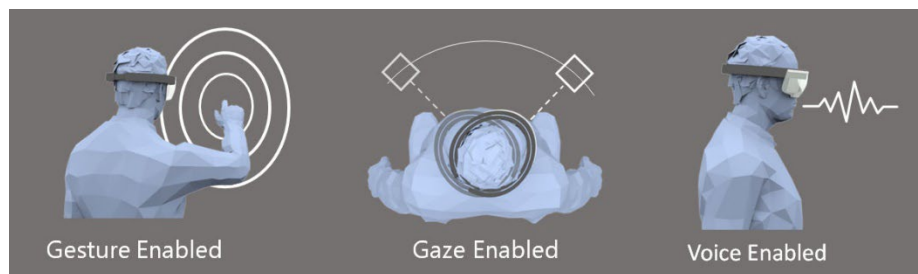


Figure 2.16. Multimodal User Interactions in VR.

As technology is transforming, users are also becoming more discerning, designers need to keep their focus on enhancing user engagement and experience keeping their goals at the center (Mohan, 2022). VR is known to drive learning, build memory capacity and enable decision making. Because of its visually rich and immersive nature, Studies have proven that VR-based enables an increase in

learner's span of attention by 100% and improve assessment results by 30%. (Elmqaddem, 2019).

2.10.1 ` Devices for VR and their impact on immersion

Immersion in VR is significantly driven by the fidelity of the experience and access to the appropriate technology, which is also a decision governed by the cost of VR. If VR based training is to be deployed to a greater population of learners with budget limitations, the phone enabled Google cardboard or Procus or Utopia device would be appropriate to use (Mohan, 2022). Whereas simulations created for surgeons, or emergency training which involve a high degree of accuracy, fidelity, and sensory motor skills, would require costlier but more immersive headsets such as HTC Vive Pro 2, Oculus Rift, Meta Quest or an Apple Vision. To successfully use VR in healthcare simulations and games, the technology should be selected carefully based on different functionalities (Mohan, 2022). The standard devices used for medical training and procedures are VR controllers, stylus and data gloves. The cognitive load, latency causing motion sickness and usability of the devices need to be evaluated and selected for different procedures (Allgaier et al., 2022; Yatsuta, 2023). **Figure 2.17.** demonstrates how surgeons in a cardiology center in Israel collaboratively perform non-invasive testing and plan surgery using VR headsets (Sheba Global, 2020).



Figure 2.17. Mixed Reality (MR) Being used for non-invasive testing.

Table 2.5. highlights the available devices vs the experience for the users of VR and AR.

Table 2.5. The Reality Matrix of hardware for experiencing AR and VR.

IMMERSIVE	HTC Vive Pro 2	Magic Leap
	Apple Vision	Microsoft Hololens
	Oculus Quest	Meta Quest Pro
AMBIENT	Google Cardboard	Phone
	Procus Go	Tablet
	Utopia 360 Headset	Data Goggle
VIRTUAL REALITY		AUGMENTED REALITY

2.10.2 Design Guidelines for VR

While the power of VR in building imaginary worlds for users to explore is established, ill-designed experiences may lack the degree of immersion required and cause unintended consequences such as motion sickness, which is a well-known side effect of VR experiences (Akiduki et al., 2003; Munafo et al., 2017). There are 5 design guidelines that have a critical impact on the virtual experience (Bowman & McMahan, 2007; Stadler et al., 2023) as outlined below.

- 1. Perceptual Design** The film language and cinematics used in VR is significantly different from conventional films where audiences are led by the way in which the film is crafted. In VR, visual or auditory attraction points would need to be created to drive users attention and lead them in the intended sequence within the plot (ÇATAK et al., 2020).
- 2. Spatial Design and Relative scale** in the context of VR a critical role in building immersion and influencing the user's senses. Spaces that are small

and claustrophobic might invoke a sense of user discomfort. A feeling of smallness is invoked by large and open environments however this provides a sense of comfort to the user. In both cases spatial fidelity to the real world is essential for the user to integrate in the virtual world (ÇATAK et al., 2020) .

3. **Sound Design** is an essential element in the VR experience. Audio, especially when used binaurally to give a sense of the location of the action or event that is driving the sound plays an important role in storytelling. The spatial environment also becomes more immersive with the appropriate use of surround sound. Indoor and outdoor sounds would be designed differently from each other (ÇATAK et al., 2020).
4. **Interaction Design** would need to be intuitive and easily fit the player mental models. For instance, cause vs effect interactions must be consistent through levels in VR games. While all games need to consider consistency, VR games become difficult to play if there is no consistency in interactions. VR being a full-body experience, it can be disorienting for players if the interaction logic changes significantly across levels (ÇATAK et al., 2020).
5. **Navigational Design** The navigation design should be established for the VR experience should be decided at inception of the design process basis the prior experience that the user has with the medium. First time users might find difficulty in navigating with hand controllers or walking through the environment, therefore the movement would need to be limited to complete a task. New users are also prone to motion sickness therefore the navigation gradually needs to transition from a basic to an advance level in their case (ÇATAK et al., 2020).

The development of high-fidelity experiences and life-like human characters in VR has been known to be time consuming and costly, involving specialized resources. however in February 11, 2021, Epic Games revealed an early glimpse of the MetaHuman Creator, an application that enables even a layman to create a customized hyper realistic digital human, which is rigged, textured and has

hair and clothes, in minutes following an intuitive process (Fang et al., 2021b). These have proved useful in the process of game development for this research. Figure 2.18 demonstrates the hyper-realistic characters available for customization on MetaHuman Creator.



Figure 2.18. Realistic easy to customize 3D characters from MetaHuman Creator.

VR has globally been used to strengthen various segments of healthcare training; a few examples are included in **Table 2**. It can be used for learning and practicing clinical and surgical procedures. Surgeons treat a patient when they are unconscious or numb due to anesthesia, however the overall well-being of the patient in a state of consciousness is in the hands of the nurses. In addition to learning clinical skills effectively, nursing students also need to learn how to address their patients' psychological and emotional aspects (Dean et al., 2020).

VR based simulations and games are widely used and have high applicability in nurse education, as they offer risk free and experiential learning (Plotzky et al., 2021). VR-based games and simulations offer safe environments for nurses to practice clinical and soft skills repetitively in a variety of complexity levels. This enables them to reduce the time to competence for the job they are training for and helps avoid risk of failure on the job (Barnabè et al., 2017; Steenstra

& Erkoyuncu, 2014). Plotzky et al, in a study of Twenty-two papers, found that there is significant variety in the use cases for VR simulations in nurse education – these include training in procedural skills, emergency response, soft skills and psychomotor skills. Among these studies, VR was found to be an appropriate medium foster empathy by simulating life from the perspective of a dementia patient (Plotzky et al., 2021). Some studies hypothesize that VR enables nurses to walk in the shoes of patients and enables nurses to experience what patients go through and can transform their empathy skills (Eric B Bauman, 2013). VR has the ability to impact the future of the nursing profession through immersive training, however clinicians, patients and educators need to partner with the technology companies that create these experiences to make them more relevant and accurate. (Dean et al., 2020; King et al., 2018).



Figure 2.19. A nurse engaging in a VR Simulation using an HTC Vive Headset.

2.11 Synthesis of Review of Literature

The review of existing global research on empathy in nurses underscored its critical role in strengthening nurse-patient relationships and influencing clinical outcomes. Studies consistently show that empathy enhances patient satisfaction, adherence to treatment, and psychological well-being (Mercer & Reynolds, 2002).

However, research also identifies barriers to empathy in Indian Nurses, including burnout, workload pressures, and emotional exhaustion (Chichra, 2019).

In William Chopik's study on empathy levels across 63 countries, it was determined that the cultural dimensions of empathetic behaviour correlate with the development of a country economically, people's access to education and their standard of living (Chopik et al., 2017). According to this study, India was at an average level in terms of empathy ranking 35 overall vs US on a rank of 7. A similar lens could be applied to hospitals with access to different levels of economic support, resources and amenities (Dr Ranamjith PV, 2018). This indicates the need for initiatives to improve empathy levels in the country.

At the same time measurement of empathy in the Indian context remains a challenge, as globally recognized scales may have some limitations (Batson, 2013; Cliffordson, 2001; Hojat & Gonnella, 2015). They often show variations in results in different cultures and are also primarily self-reported assessments which can produce subjective or inconsistent results. Therefore, there is a need to develop a scale that considers Indian context and challenges. The literature also points towards the context-dependent nature of empathy, with variations across nursing specialties, patient populations, and healthcare settings (J. Yu & Kirk, 2008). Despite these challenges, ongoing research advocates for integrating empathy training into nursing curricula and workplace interventions to foster better, patient-centered care.

Research has proven that games and immersive environments such as VR affect empathy and associated neural activity. (Lim & Reeves, 2010) and are known to enhance social and cognitive empathy by allowing players to experience life from another's perspective. Additionally, the neurological study of empathy and games has proven that empathy-focused games may lead to lasting changes in the plasticity of the brain related to empathy and interpersonal perception (Meyer et al., 2013). However, there are limited studies in the area of games for empathy in the Indian nursing context.

Based on the review of literature it was concluded that there is a need to understand and to capture relevant baseline data on empathy in Indian nurses through longitudinal, mixed-method approaches and to explore the efficacy of VR and game based learning in improving the level of empathy in the context of Indian Nurses. The analysis of the literature review helped to identify the research gap, research questions and hypothesis which formed the basis for this investigative study.

CHAPTER 3: AIM, OBJECTIVES AND HYPOTHESIS

3.1 Overview

The review of literature affirmed there are limited studies in the context of empathy in Indian nurses in comparison to the rest of the world. Nurses in India face challenges in practicing empathetic behavior due to their upbringing in non-empathetic environments, shortage of resources, cultural differences, lack of training and hospital culture. It was also understood that VR and GBL could be appropriate tools to build empathy in Indian nurses as they provide engagement and immersion into learning clinical and soft skills. VR is also proven to be a platform that allows the nurses to in get into a patient's shoes and seeing the world from their point of view. A study of the neuroscience aspect of games helped determine that user response to games is also associated with similar parts of the brain that are impacted when one practices empathy. Therefore, GBL was an appropriate medium to test for the building of empathy skills among nurses. This section revisits the objective of this research defined in its inception, and breaks it down into sub-objectives, research gaps and research questions.

3.2 Aim and Objectives

Aim: To assess the Effectiveness of Immersive Media and Game Based Learning in building empathy among Nursing Professionals in India.

Objectives:

RO1. To develop a reliable scale to assess the baseline empathy score of Indian Nursing Professionals.

RO2. To design immersive game prototypes (2D photographic, 3D VR, 360 VR) for Indian Nursing Professionals to build and practice empathetic skills with patients.

RO3. To develop a reliable learner feedback form to assess the comparative effectiveness of the game prototypes.

RO4. To assess effectiveness of immersive media and game-based learning in building empathy among Nursing Professionals

3.3 Hypothesis

The review of literature highlighted the need for effective, culturally and contextually relevant mechanisms for training Indian Nurses on empathy. Traditional methods of empathy training, such as lectures, role-play, and case studies, were found to be passive, less engaging, and unable to fully simulate real-world emotional contexts (Batson et al., 1997). The higher engagement and sensory immersion of VR suggest that it may be more effective than traditional methods in teaching empathy due to its immersive nature and its ability to walk in another's shoes (Bailenson, 2018; Dean et al., 2020). The inherent motivational aspects of games would enable repetitive play and practice and enable nurses to achieve a mastery level in the desired subject (Munjas, 1985). This helped to arrive at the hypothesis that **“Virtual Reality based games are more effective than other approaches in building empathy in Indian Nurses.”** This research is focused on testing the efficacy of this hypothesis.

To address the objectives mentioned in **Section 3.2**, the research Gap and questions have been identified in **Figure 3.0**.

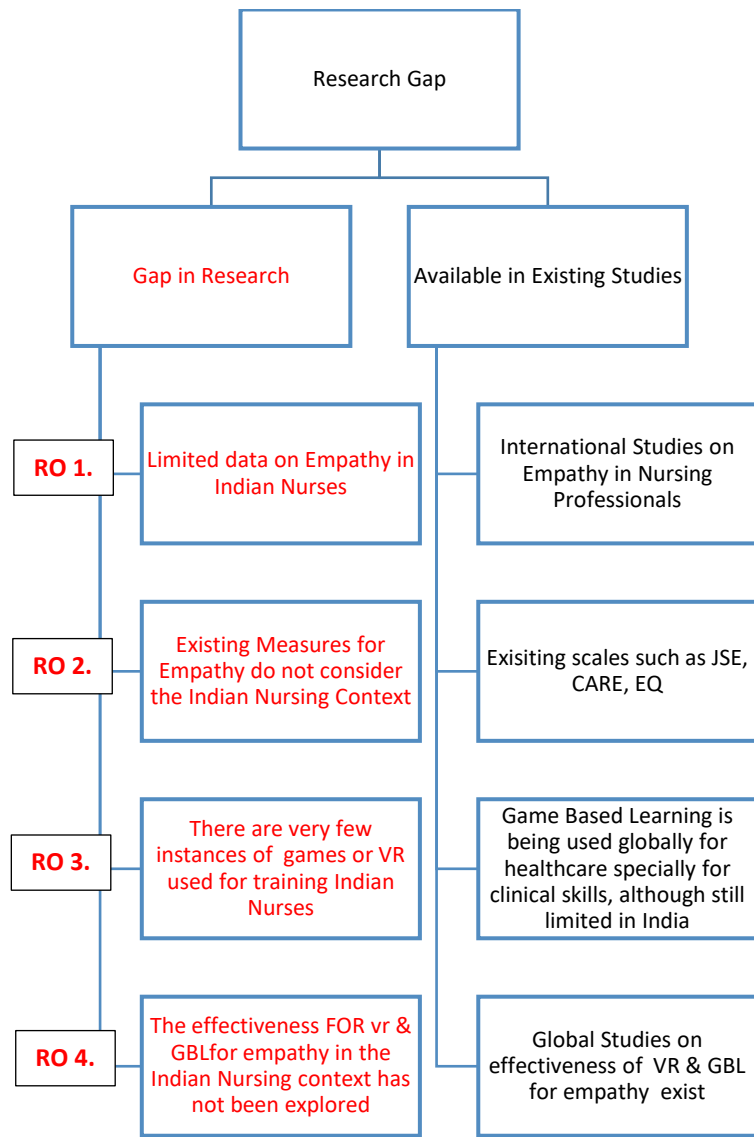


Figure 3.1. Research Gap.

Table 3.1. Research Gap and Questions.

Research Gap	Research Questions
1. There is limited data on the current level of empathy in Indian Nurses.	What is the current state of empathy in the interaction between nurses and patients in the Indian hospital scenario?
2. The measures for empathy do not consider the Indian Nursing context	What are the factors that affect empathy in the Indian context?
3. There are limited usage of digital media and VR and Game based learning GBL for training Indian Nurses	What is the motivation and perceived learnability of Indian Nurses in GBL?
4. Effectiveness for VR and GBL has not been explored for creating empathy in Indian nurses.	How would one measure the efficacy of VR and GBL in building empathy in Indian Nurses?

3.4. Validation process and tools for the research

The validation process and data analysis tools that have been used in this research are detailed out in **Chapters 4, 5, 6 and 7**. **Chapter 7** includes Table 7.1. which summarizes the interventions used for each Research Objective, sample population and statistical analysis technique. The limitations of the methods used are further highlighted in **Chapter 8**.

CHAPTER 4: DESIGN OF NEW EMPATHY SCALE AND LEARNER FEEDBACK FORM

4.1 Overview

To build a game intervention that could improve the empathy score of Indian Nurses, it was first critical to measure the baseline empathy score and then the impact on it after playing the game. To assess the empathy score of Indian Nurses there was a need to develop an empathy scale which considered the Indian cultural context, economic fabric and workplace challenges. While several scales were studied and analysed as covered in the literature review in **Section 2.6**, they did not address cultural nuances of Indian Nurses and Indian Hospitals.

There was also a need to develop a learner feedback form aligned to VR and GBL which is aligned to the Indian Nursing context. This section addresses the process followed for developing the Empathy Scale and the Learner Feedback Form used in this research.

4.2 Development of an Empathy Scale for the Indian Nursing Context

To initiate the development of an Empathy Scale for Indian nurses it was first important to understand the cultural and behavioral context of the target population and to gather inputs from experts in diverse domains including nursing. Five experts including a behavioral scientist, a human factors expert, a doctor, a psychologist and a nursing professional (10 years and above experience, and mean age, 37 years) were interviewed to capture key requirements from an empathy scale and a thematic analysis was conducted to derive factors and keywords related to empathy. Five themes emerged from conversations where different experts had their independent perspective.

The table and mind map summarize the findings and thematic analysis. These inputs became the basis for defining the keywords and survey questions for the empathy scale.

Table 4.1. Thematic Analysis.

Item	Themes	Sub-Themes	Key Expert Insights
1	Personal Background and Development of Empathy	1.Family Background and Early Experiences 2.Education and Professional Training	Empathy is influenced by upbringing, with early exposure to caregiving shaping emotional engagement. Many nurses in India come from rural backgrounds, or lower economic strata backgrounds, where caregiving roles are often integral to family responsibilities. Nurse education in India emphasizes clinical knowledge over soft skills
2	Stress Factors Affecting Empathy	Workload and Systemic Pressure, Emotional Exhaustion and Burnout	Shortage of resources and skewed nurse patient ratio lead to high workloads and stress. The emotional exhaustion reduces the ability of Indian Nurses to engage empathetically.
3	Cultural Factors Shaping Empathy	Hierarchical Authority and Communication, Cultural Norms Around Caregiving	Cultural norms and hierarchies in Indian healthcare affect how openly empathy can be expressed. Nurses are often expected to defer to doctors and administrators, which may limit their ability to express empathy openly. Empathy may be shaped by cultural norms that emphasize

		collective well-being and familial care, especially in rural areas.
4	Motivation to Practice Empathy	Healthcare professionals are motivated by both internal values and external rewards such as recognition. Empathy and compassion is often not given as much importance in healthcare setups where clinical outcomes and productivity are recognised and rewarded over patient-centred care.
	Intrinsic Motivation (Values and Beliefs), Extrinsic Motivation (Recognition and Rewards)	
5	Empathy as a Learned and Dynamic Skill	Experiential learning and regular training help professionals develop and sustain empathy over time. Nurses develop empathy by interacting with diverse patients and observing mentors who model compassionate behavior.
	Experiential Learning, Continuous Development	



Figure 4.1. Mind map on Key Themes from Focus Group

A set of survey items and keywords were also selected from JSE scale. 30 survey questions were created, including eight from JSE, rated on a 7-point Likert scale). These were divided into 8 factors.

The scale included an informed consent form, and also captured the age, gender, educational level, marital status, state where the nurses came from, salary bracket, and specialization. It captured data on the background of the nurse and included 30 items on the upbringing of the nurse, empathy experienced during their education, and stress factors as typically experienced in Indian Hospitals due to shortage of resources, time, manpower and training. The negative experiences the nurse faced at different stages could also lead to stress on the job and therefore conflicts with patients. The empathy scale developed is included in **Table 4.1**. Eight questions, shortlisted based on the discussion with the experts, were included based

on the JSE (**APPENDIX C**) which have been mentioned as “Existing”, whereas new questions are labelled as “Newly added”.

Pilot testing on nurses was done by random sampling via online links on mobiles to 50 nurses (Mean $\pm$ SD=33.91 $\pm$ 9.646; male=47.4%, female=52.6%). The nurses ranged from 19 to 51 years old, belonged to Delhi, Uttar Pradesh, Uttarakhand, Maharashtra, Punjab, Assam, Bihar, Karnataka, Kerala, Andhra Pradesh, Rajasthan, Tamil Nadu, and Haryana and were associated with Govt, Autonomous, Private hospitals, and Universities. Their qualifications ranged from B.Sc, M. Sc and Ph.D.

Factor analysis (principal component analysis, using 50 iterations and Varimax Rotation Matrix, minimum coefficient value = 0.50) was performed to find correlations between factors and prioritize the items and the empathy scale was then standardized and statistically found to be reliable at Cronbach’s Alpha > 0.70. The results and detailed analysis of the same are included in **Section 7.2**.



Jefferson Scale of Empathy

Physician/Health Professions (HP - version)

Instructions: Using a ball-point pen, please indicate the extent of your agreement or disagreement with each of the following statements by marking the appropriate circle to the right of each statement.

Please use the following 7-point scale (a higher number on the scale indicates more agreement):
Mark one and only one response for each statement.

1 — 2 — 3 — 4 — 5 — 6 — 7
Strongly Disagree Strongly Agree

	1	2	3	4	5	6	7
1. My understanding of how my patients and their families feel does not influence medical or surgical treatment.	☐	☐	☐	☐	☐	☐	☐
2. My patients feel better when I understand their feelings.	☐	☐	☐	☐	☐	☐	☐
3. It is difficult for me to view things from my patients' perspectives.	☐	☐	☐	☐	☐	☐	☐
4. I consider understanding my patients' body language as important as verbal communication in caring for patients' relationships.	☐	☐	☐	☐	☐	☐	☐
5. I have a good sense of humor that I think contributes to a better clinical outcome.	☐	☐	☐	☐	☐	☐	☐
6. Because people are different, it is difficult for me to see things from my patients' perspectives.	☐	☐	☐	☐	☐	☐	☐
7. I try not to pay attention to my patients' emotions in history taking or in asking about their physical health.	☐	☐	☐	☐	☐	☐	☐
8. Attentiveness to my patients' personal experiences does not influence treatment outcomes.	☐	☐	☐	☐	☐	☐	☐
9. I try to imagine myself in my patients' shoes when providing care to them.	☐	☐	☐	☐	☐	☐	☐
10. My patients value my understanding of their feelings, which is therapeutic in its own right.	☐	☐	☐	☐	☐	☐	☐
11. Patients' illnesses can be cured only by medical or surgical treatment, therefore, emotional ties to my patients do not have a significant influence on medical or surgical outcomes.	☐	☐	☐	☐	☐	☐	☐
12. Asking patients about what is happening in their personal lives is not helpful in understanding their physical complaints.	☐	☐	☐	☐	☐	☐	☐
13. I try to understand what is going on in my patients' minds by paying attention to their non-verbal cues and body language.	☐	☐	☐	☐	☐	☐	☐
14. I believe that emotion has no place in the treatment of medical illness.	☐	☐	☐	☐	☐	☐	☐
15. Empathy is a therapeutic skill without which success in treatment is limited.	☐	☐	☐	☐	☐	☐	☐
16. An important component of the relationship with my patients is my understanding of their emotional status, as well as that of their families.	☐	☐	☐	☐	☐	☐	☐
17. I try to think like my patients in order to render better care.	☐	☐	☐	☐	☐	☐	☐
18. I do not allow myself to be influenced by strong personal bonds between my patients and their family members.	☐	☐	☐	☐	☐	☐	☐
19. I do not enjoy reading non-medical literature or the arts.	☐	☐	☐	☐	☐	☐	☐
20. I believe that empathy is an important therapeutic factor in medical or surgical treatment.	☐	☐	☐	☐	☐	☐	☐



OE0

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Figure 4.2. Jefferson Scale of Empathy

Table 4.2. New Empathy Tool for Indian Nurses (“Existing” items were drawn from Jefferson Scale of Empathy, “Newly Added” were created as a part of this study)

S No.	Item	Construct	Type
1	My family gives importance to my feelings in the various contexts of my life	IEENV	Newly added
2	My family has been empathetic towards me since my childhood	IEENV	Newly added
3	My teachers in school understood my feelings	IEENV	Newly added
4	I believe in listening to another person and give importance to their words	COGP	Newly added
5	I believe that entering another person’s shoes is an important part of communication during treatment.	EMPMO	Newly added
6	My nursing education taught me how to be empathetic with patients	INSRES	Newly added
7	I feel motivated to come to my job as a nurse each day	EMPMO	Existing
8	Conflicts at home, work and lack of time stresses me	EMO	Newly added
9	When I am stressed, I may lose my patience with a patient and may not listen completely	NA	Newly added
10	I am stressed because of lack of resources at my work place	INSRES	Newly added
11	I extend immediate help to a patient during therapy without any hesitation	COGP	Newly added
12	I often have conflicts with patients	COGN	Newly added
13	Empathy is a therapeutic skill without which patient care cannot happen	COGP	Newly added
14	I believe in making strong bonds with patients and their family members	NA	Newly added
15	I believe being sympathetic with patients is exhausting for me	COGN	Newly added
16	Patients’ body language helps me understand what is going on in their minds	COGP	Newly added
17	I try not to focus on the patient’s mood while taking history of a patient	COGN	Newly added
18	I feel I should ask patients about their personal lives to understand them better	COGP	Newly added

19	If a patient is disturbed, I immediately try to understand what is bothering them verbally and through body language.	COGP	Newly added
20	I believe practicing empathy can help my patients feel better	COGP	Newly added
21	I find it easy to give bad news to a patient or their family	COGP	
22	I believe I am more empathetic than I was 5 years ago	EMO	Newly added
23	I feel satisfied when I am empathetic with the patient during therapy	EMO	Newly added
24	A nurse's understanding of the emotional status of his/her patients, as well as that of their families is one of the important aspects of the nurse – patient relationship	EMO	Existing
25	I believe that patients feel better when nurses understand their feelings	NA	Existing
26	Attention to patients' emotions is not important in-patient interview	COGN	Existing
27	Nurse's emotional connect with their patients do not have a significant influence in treatment outcomes	EMO	Existing

Constructs in this table:

IEENV: Individual Empathetic Environment, **INSRES:** Individual Stress Related to Resources; **EMPMO:** Empathy related to motivation; **COGN:** Cognitive Negative; **COGP:** Cognitive Positive; **EMO:** Emotional Factors **NA:** Factors not found reliable/relevant

The 30-item questionnaire was classified into 6 constructs/factors which considered the Indian nursing context, to enable ease of statistical analysis of data gathered. These constructs are described and interpreted in **Table 4.2**. While all newly added questions are included keeping the Indian context in mind, some questions have a deeper correlation. Specifically questions 1, 2 and 3 were added keeping in mind the Indian context where the lack of empathy faced during the upbringing or through the educational system influence the empathy of nurses. Question 6 is included as the curriculum for Indian Nurses includes soft skills but with no specific focus on empathy. Questions 8,9 and 10 refer to typical stress factors mentioned by nurses in India during the focus group. Question 12 is frequent in hospitals where nurses are stressed due to an overload of patients due to the skewed nurse patient

ratio. Question 18 is typical of the Indian context where people do not respect personal boundaries and ask more personal questions.

Table 4.3. Constructs in the New Empathy Scale

Factors in Empathy Scale	Description	Interpretation on a 7-point Likert Scale
IEENV: Individual Empathetic Environment	The nurse's environment, including where they have grown up in and live in – and empathy of people around including family, teachers, colleagues.	4 questions in the scale – to be interpreted positively
INSRES: Individual Stress Related to Resources	Shortage of resources such as less nurses, less equipment, less time.	2 questions– to be interpreted reverse coded
EMPMO: Empathy related to motivation	Motivation of the nurse to take care of the patient through empathy.	2 questions – to be interpreted positively
COGN: Cognitive Negative	If the nurse has a negative attitude towards practising empathy.	5 questions – to be interpreted reverse coded
COGP: Cognitive Positive	If the nurse has a positive attitude towards practising empathy.	8 questions – to be interpreted positively

EMO:	If the nurse has a good EQ and is	4 questions - – to be interpreted
Emotional	able to exhibit the right amount of	positively
Factors	care.	

The factors that were negative were reverse coded before the final statistical analysis. The correlation between these factors can be found in **Section 7.2**.

After the new empathy scale was pilot tested and tested for reliability, it has been used for pre and post empathy tests on the Indian Nurses through the course of this study.

4.3 Creation of the Learner Feedback Form

A learner feedback form was created as an adaption to the nursing context based on an existing form described in the “Heuristic Evaluation Of Virtual Reality Applications,” *Interacting with Computers*, (Sutcliffe & Gault, 2004). The items were reworded to a language the nurses in India would understand and contexts that they would be able to relate to. **Table 4.3** captures the factors in the original form and **Table 4.4** is the adaptation aligned to the Indian Nursing context created through this study.

Table 4.4 VR Heuristic Evaluation Form.

.	Survey Items
1.	Natural Engagement
2.	Compatible with the user’s action
3.	Natural expressions of action
4.	Close coordination
5.	Realistic Feedback
6.	Faithful Viewpoints
7.	Navigation and Orientation Support
8.	Clear Entry and Exit points

9. Consistent Departures
 10. Support for learning
 11. Clear Turn Taking
 12. Sense of Presence
-

The form captured sociodemographic data and included a 12-item survey that addressed aspects such as relatability to context, engagement and immersion, usability and perceived learnability. The scale was based on a 7-point Likert scale.

The game and learner feedback form were tested on 60 nurses from different wards. (male=50%, female=50%). The nurses ranged from 18 to 40 years old, belonged to ten different states in India including Himachal Pradesh, Haryana, Rajasthan, Uttar Pradesh, Uttarakhand, Andhra Pradesh, Tamil Nadu, Himachal Pradesh, West Bengal, Punjab. Their qualifications included a Bachelor of Science (B.Sc.) in Nursing, Master of Science (M.Sc.) in Nursing and Doctor of Philosophy (Ph.D.) in Nursing. They were associated with the Gynecology, Emergency, Cardiology and Oncology wards to ensure diversity.

Table 4.5. Learner Feedback Form.

Item No.	Survey Question	Factor
1.	The content is very close to the real clinical scenario.	Relatable to the Context
2.	I found the scenario similar to my daily work as a nurse.	
3.	I found the feedback on my decisions easy to relate to and actionable.	
4.	I found it easy to walk through the scenario.	Usability
5.	I found the instructions in the scenario easy to follow.	
6.	I found the entry and exit points clear in the scenario.	
7.	I will use game-based learning again for learning.	

8.	I felt like I am physically present in the scenario.	Engagement and Immersion
9.	I found the scenario engaging.	
10.	I found the look and feel close to a real hospital setting.	
11	I found the scenario a good learning experience.	Perceived Learnability
12	I will remember what I learnt in this scenario and use it in my routine patient care.	



Figure 4.3. Nurses Testing the Game

The nurses were seated in quiet enclosed spaces within the hospital such as the conference room, the nurses' resting rooms, and training rooms. Instructions were textually and verbally given to each nurse on how to access the game on each of their mobiles. 3-4 nurses were tested simultaneously. The time taken by the nurses ranged 10-15 minutes each. This was followed by administering the learner feedback form digitally on their mobile phones, which took an additional 5 minutes per nurse.

The learner feedback form had four factors – relatability to the context, usability, engagement and immersion, and perceived learnability. The form was statistically found to be reliable at Cronbach's Alpha 0.904 overall, and the first

three factors of context specificity, engagement, immersion, and usability were found to be at Cronbach Alpha > 0.70 . The fourth factor, perceived learnability, only had two related survey questions and therefore were tested for reliability through Pearson Correlation and also found to be >0.5 and therefore reliable. The detailed results and analysis are captured in **Section 7.4** of this thesis. The learner feedback form was then take forward for gathering post-game feedback from nurses who tested each of the three interventions.

CHAPTER 5: DESIGN OF THREE GAME INTERVENTIONS

5.1 Overview

Amidst the surge of the digital revolution, game technology has also evolved to deliver more realism through higher resolutions, more immersive experiences and gesture-based interactions, each format or medium offering a unique experience to players. Each medium is known for its unique strengths and challenges with respect to engagement and immersion, usability. By examining these differences, developers and researchers can tailor gaming experiences and enhance the overall appeal and effectiveness to suit different audiences. Through this study, three types of game formats had been evaluated relative to each other – 2D Photographic, 360 Live Action and 3D VR. This chapter addresses the factors that were examined in comparing these formats and the process to design and develop them.

5.2 Comparative analysis between 2D Photographic, 360 Live Action and 3D VR

This section contrasts the three game formats that were created and studied for the purpose of this research.

Engagement and Immersion

2D games on mobile, although limited to smaller interfaces on flat screens, still offer compelling experiences and possibilities of storytelling. However, they do not offer the same level of presence as VR or 360-degree formats due to their lack of spatial depth and interactivity (McMahan et al., 2012). 3D VR offers a unique immersive experience to players as they navigate through an interactive 3D environment, a feeling of presence is created. Studies have proven that VR's ability to track head and body movements and provide stereoscopic visuals significantly enhances user immersion compared to traditional gaming formats (Slater & Wilbur, 1997). On the other hand, 360 – degree live action video offers

a different kind of immersion. It allows users to look in any direction within a real-world environment captured by omnidirectional cameras and offers very realistic experiences which are easier for players to relate to than 3D generated avatars and environments (Taylor & Layland, 2019).

Usability and Interaction

2D photographic games are often narrative based with simple interactions or puzzle-solving. They engage users through compelling stories and detailed artwork but lack the physical interactivity that VR offers, or the visual navigation offered by 360-degree videos. However, this format can still be highly engaging for users who prefer ease of use narrative storytelling over and above immersive environments (Adams, 2013).

The three different media also differ with respect to the usability and amount of interactivity offered to the player. 3D VR based games can be made to be highly interactive, allowing players to manipulate elements around, and move around in order to interact with the virtual spaces in a way that replicates what their real-world actions would have been. This high degree of interactivity and is known to enable user engagement and can lead to longer and more satisfying interactive sessions for the player (Bowman & McMahan, 2007). Although 360-degree live-action games offer the highest visual fidelity and panoramic views, they generally have limited interactivity. Users can look around and are offered a rich visual experience, however, their ability to interact with the environment is constrained compared to VR. This medium offers more of a rich visual experience rather than an intense gameplay experience (Mateer, 2017).

Accessibility and Practicality

There are differences in the technological access to such formats and the practicality of usage. 2D games are most easily accessible on mobile devices and computers, therefore making them easy to develop, use and distribute, making them practical for casual users (Schrader & Bastiaens, 2012). 360-degree live

action games are also accessible since they can be experienced on standard screens with a less immersive effect. They can be deployed on a larger range of platforms such as smartphones, tablets, PCs, VR headsets, therefore more accessible and easier for players to relate to. On the other hand, 3D VR requires specialized hardware such as headsets and controllers which are costly and cumbersome to use for some users. Additionally, due to latency issues and a lag between the real environment and the VR they some players can also experience motion sickness and giddiness (LaViola Jr, 2000).

5.3 Design Process followed for the three Game Formats

To do a comparative study on game formats for training Indian Nurses, three types of game interventions were created and tested, including 2D photographic on mobile, 360-Degree live action on a desktop and 3D Virtual Reality (VR). All three interventions were created based on the same scenario of a trainee nurse interacting with a head nurse and a patient who has just been detected with Stage 3 cancer. The goal was to understand their unique contributions to the gaming experience under the dimensions of usability, engagement and immersion, context specificity, perceived learnability, catering to different user preferences and contexts.

To design a game that nurses could relate to, be engaged with and practice empathy with, the IDEO Design Thinking Process was followed (Dam, 2022; Shé et al., 2022). Design thinking has been defined as a “process that embodies empathetic design of solutions and iterations of ideation and innovation while engaging in problem-solving”. This methodology was conceptualized by Stanford Design School and later practiced and popularized by IDEO (Brown, 2021). This involves a five-stage iterative process as represented in **Figure 5.1**.

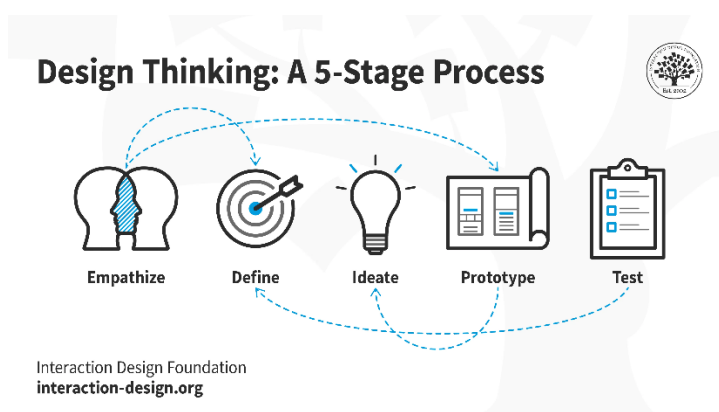


Figure 5.1. The Phases of the IDEO Design Thinking Methodology.

The IDEO Design Process was adapted to the nursing context to design, and pilot test the game in the following sequence, as represented in **Figure 5.2**.

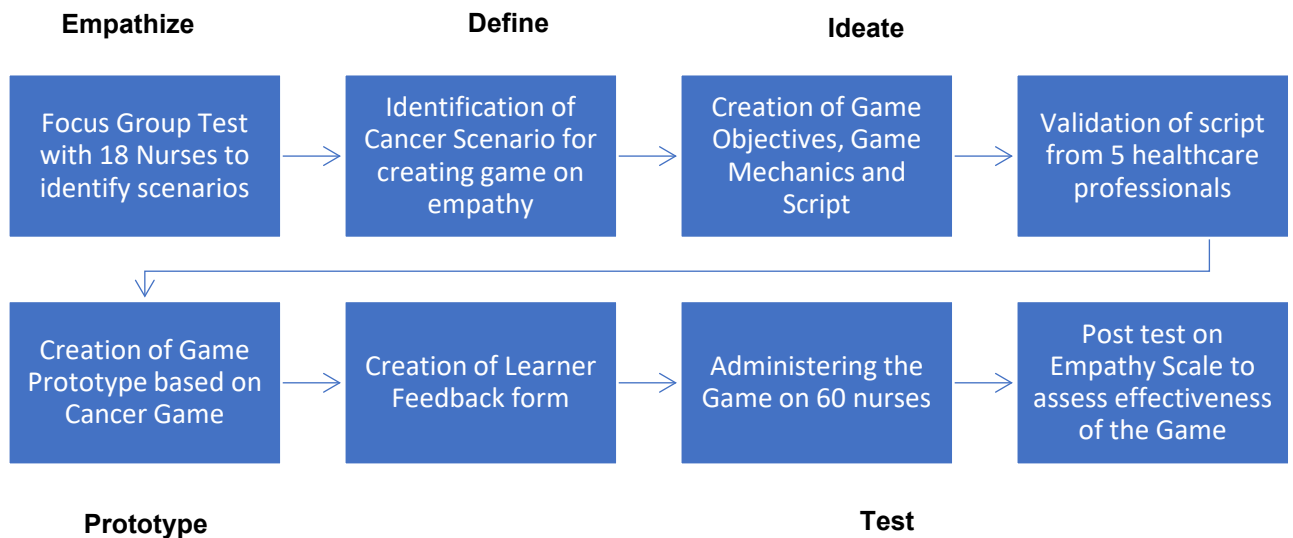


Figure 5.2. Interpretation of the IDEO Design Thinking Methodology for this study.

5.4 Empathizing with Indian Nurses (Focus Group Discussion)

A focus group was conducted with 18 Indian nurses from diverse backgrounds in terms of age, gender, marital status, state to identify barriers to empathy. The nurses were 11 F and 7 M and ranged from 19 - 46 years old, the discussion was conducted in a closed conference room in AIIMS Rishikesh. The steps followed were as below:

1. **Brief:** After seeking their consent to participate in the research, nurses were provided a brief on the objectives of the study: “To identify potential barriers to empathy and to identify scenarios where empathy was needed in nurse-patient interactions.”
2. **Warm up Session:** There was a round of introductions, and the nurses were asked easy questions to make them relax.
3. **Key research questions:** The nurses were asked questions on their socio-demographic background, education and motivation to take up nursing as a profession. They were then asked what they felt was empathy’s role in nurse patient interactions and what the barriers to practising empathy were. The nurses were then asked to identify scenarios in which they felt empathy was needed in their interactions with different types of patients in diverse wards. The conversations with patients were recounted by the nurses and documented.
4. The focus group with nurses followed the Turn-Taking & Interaction Analysis method (Gheduzzi et al., 2022; Lin et al., 2023). In this dialogue, nurses shared multiple scenarios where they had practised empathy with patients of diverse conditions. The nurses built on each other’s experiences with their own and in some cases acted as informal mentors to each other in the scenarios.
5. As scenarios were discussed, nurses were asked to rate the complexity of the empathetic interaction with the patient in each case as high, medium and low.
6. **Conclusion:** The key points were summarised, and a confirmation was sought from the nurses.

The focus group with Nurses helped to identify potential scenarios and stories for nurses to practice empathy, which could potentially become a basis for defining the plot of the game for empathy (**Table 5.1**).

Table 5.1. Scenarios for practicing Empathy in the Nurse-Patient interaction.

Complexity	Setting	Scenario
Low	Hospital Reception	Registration of a distraught patient with family and guidance to the appropriate ward
Low	General Ward	Calming patient who is in pain with a broken limb
Medium	Pediatrics Ward	Getting a minor patient to understand their condition and take medication
Medium	Obst & Gynae Ward	Breaking bad news to a father and mother who have just lost their baby
Medium	Cancer Patient	Informing a patient that he/she has just been detected with cancer
High	Emergency unit	Admitting patient who is in pain after an accident, soothing family
High	ICU	Understanding condition of patient with myocardial infarction and deciding course of action

The scenario of the cancer patient and the nurse was identified as the context to take forward into the three prototypes built for the purpose of this study. This was considering the high prevalence of cancer in India, and its increasing incidence due to lifestyle changes, environmental factors and aging populations, it has become a significant public health concern in the country (Mallath et al., 2014). Nurses often encounter patients in this condition and often face the difficult challenge of breaking bad news, counselling the patient and family (Sedaghati Kesbakhi et al., 2017). The empathy skills applied and learnt in a cancer scenario are transferable to multiple critical scenarios such as delivering bad news or managing chronic illnesses (Back et al., 2009). The remaining scenarios would be taken up in the next phase as this research through a Virtual Hospital, as described in Section 8.6 of this thesis.

A stepwise framework that healthcare professionals use to break bad news was also studied to create a framework for the scenario, called the SPIKES

protocol (De Sousa et al., 2017; Marschollek et al., 2019), which formed the basis for the script for the scenario.

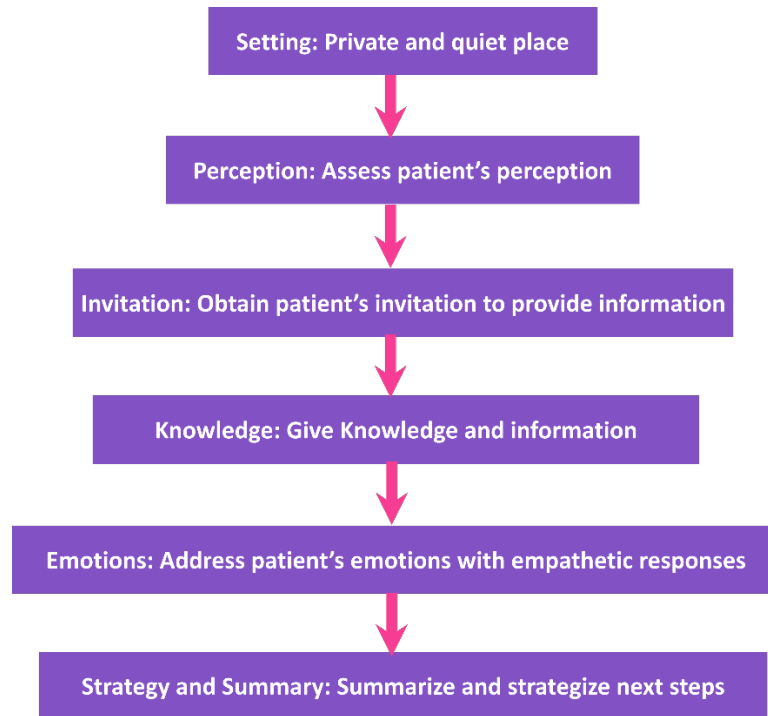


Figure 5.3. SPIKES protocol for breaking bad news.

A nonlinear script was created based on the interaction between the trainee nurse, head nurse and patient. The original flow is created by a senior nurse based on a typical conversation that nurses have with a cancer patient. The alternate pathways were defined based on the personas that emerged through the focus group discussions with the nurses and literature review. The entire script was further validated by senior doctors and nurses for accuracy. The script is included in **APPENDIX D** of this thesis and the non-linearity and conversation flow is represented in **Figure 5.9** and **5.10**.

Problem Definition and Empathy Mapping

While there are multiple barriers to empathy, training was identified as a key area which could have a pivotal influence on attitudes and behaviors of nurses as well as have a long-term impact on patient outcomes and organizational culture (Hussein

Yassein Hussein & Samir Abd El-Aziz Elsaïad, 2021). Inspired by what is experienced in the video game world, this research focused on how game-based learning could positively influence nurses' attitude and behavior and support them in practicing more empathetic communication with patients (Johnsen et al., 2018b; Perez-Marcos, 2018; Thompson et al., 2010).

As established during the literature review of this study, empathy has three essential components as mentioned in **Figure 2.2.** – cognitive, affective and behavioral. In the nurse-to-patient interaction, the cognitive and behavioral aspects of empathy are critical to practice, whereas practicing the affective component may lead to burnout (Hunt et al., 2017; Wilkinson et al., 2017). Asking the right questions and using the correct words with patients to understand their pain is critical in guiding them in their journey to recovery. Therefore, the primary game goal was to create a nurse -patient conversation that would enable improvement in the cognitive empathy nurses practiced with patients.

Based on the literature review and thematic analysis of the focus group discussion, five nurse personas (Jansen et al., 2020; Negley & Smith, 2019; Nielsen et al., 2022) had been identified in the context of their approach to patient interaction.

Table 5.2. Nurse Personas in Patient Interactions.

Nurse Persona	Behavior Traits	Impact on Patients	Reference
Empathetic Nurse	- Actively listens to patient concerns - Demonstrates compassion - Builds rapport and trust	- Increases trust and emotional well-being - Improves treatment adherence and satisfaction	(Mercer & Reynolds, 2002)
Impatient Nurse	- Rushes through tasks - Easily frustrated - Minimal communication	- Patients feel unheard or anxious - Decreased trust and compliance with care	(Haskard Zolnierek & Dimatteo, 2009)

Nurse Persona	Behavior Traits	Impact on Patients	Reference
Sympathetic Nurse	- Provides reassurance - Recognizes patients' emotions - Offers hope and encouragement -Tends to be over-involved or may burnout.	- Reduces distress - Enhances emotional support, but may lack deeper engagement	(Dean et al., 2020; Wilkinson et al., 2017)
Detached Nurse	- Focuses on clinical tasks - Maintains emotional distance	- Care perceived as competent but impersonal - May be suitable for critical situations	(Bullock, 2003)
Advocate Nurse	- Acts as a voice for the patient - Collaborates with healthcare team	- Patients feel empowered and respected - Improved advocacy for patient needs	(Bu & Jezewski, 2007)

For the purpose of this study the first three, the Empathetic Nurse, Impatient Nurse and Sympathetic Nurse, were included in this scenario. Further scenarios could include other personas based on the patient condition and severity of the illness. Empathy Mapping (Gibbons, 2018; Hampshire et al., 2022; Leigh Brown, 2018) was conducted to identify what nurses in India Think, Feel, Say and Do. Three potential nurse personas were defined: the impatient nurse, the sympathetic nurse, and the empathetic nurse and an Empathy Map was created (**Figure 5.4.**) to understand the nurses better.

Think		Feel	
I do not have time	I need more resources	I feel motivated to do my work well	I feel my family does not understand my choice of work
I want to do my duty well	I believe empathy will help my patient's recovery	I feel sorry for this patient	Sometimes I lose patience when patients do not understand
Say		Do	
I do not have time please hurry up	I feel so sorry for you	I may scold the patient	I may not give enough time to the patient
I would like to understand your condition better	As a family member of the patient, this is how you can support them.	I may get emotionally involved with the patient's condition.	I may spend time to understand the patient's condition

Figure 5.4. Empathy Map for Indian Nursing Professionals.

Ideation for the Game on Empathy

Based on the focus group discussion, the cancer scenario was selected as the narrative for the game intervention, where a patient has just been detected with Stage 3 cancer. Brainstorming was conducted with a diverse group, including nurses, doctors, UX specialists and Game Designers, to evolve the game mechanics, rubrics and scenario design. The objective was to design a game that nurses could relate to which could help them understand the questions to ask a patient in order to understand their pain. This would also enable them to use the correct behaviors and statements to help them on their journey to recovery.

A scenario was constructed in which the learner gets into the shoes of the nurse who has an interaction with the head nurse and then the patient with cancer. The nurse's goal was to console the patient and help them in adopting the correct line of treatment.

Prototype

A script and storyboard were created to define the nurse-patient interaction in the game (**APPENDIX: D**). The first draft was shared by a senior nurse based on actual empathetic conversations with patients with cancer. Post that, additional dialogue trees were created representing two other nurse personas including the impatient nurse, the sympathetic nurse and the empathetic nurse. The script was further validated by five senior experts including two doctors and three senior nurses. A further description of the three personas was created to strengthen the visual representation of the scenarios.

The impatient nurse: Due to a shortage of time and stress factors, some nurses may not give enough time to listen and understand the patient's condition better.



Figure 5.5. The impatient nurse persona (AI Generated).

The sympathetic nurse: Some nurses get too involved with the patient's condition and become sympathetic. Sympathy will not address the patient's problem and will also lead to burnout of the nurses.



Figure 5.6. The sympathetic nurse persona (AI Generated).



Figure 5.7. The empathetic nurse persona (AI Generated).

The empathetic nurse: Some nurses prioritize and make time for empathetic conversations with patients. They ask the right questions, listen calmly, and are able to understand patient needs and support them on their path to recovery.

5.5 Intervention 1 (Photographic Game based learning)

This is a narrative driven, photographic role-playing-game (RPG) based on the conversation between a trainee nurse and a breast cancer patient. The scenario for this game was selected from the contexts identified through the focus group discussion where-in empathetic conversations are needed with patients. The scenario was selected because it was generic and did not need specialist knowledge to complete, and because it required an effective use of empathetic communication skills to navigate and complete the game. **Figure 5.8** demonstrates the process followed to create this game prototype.

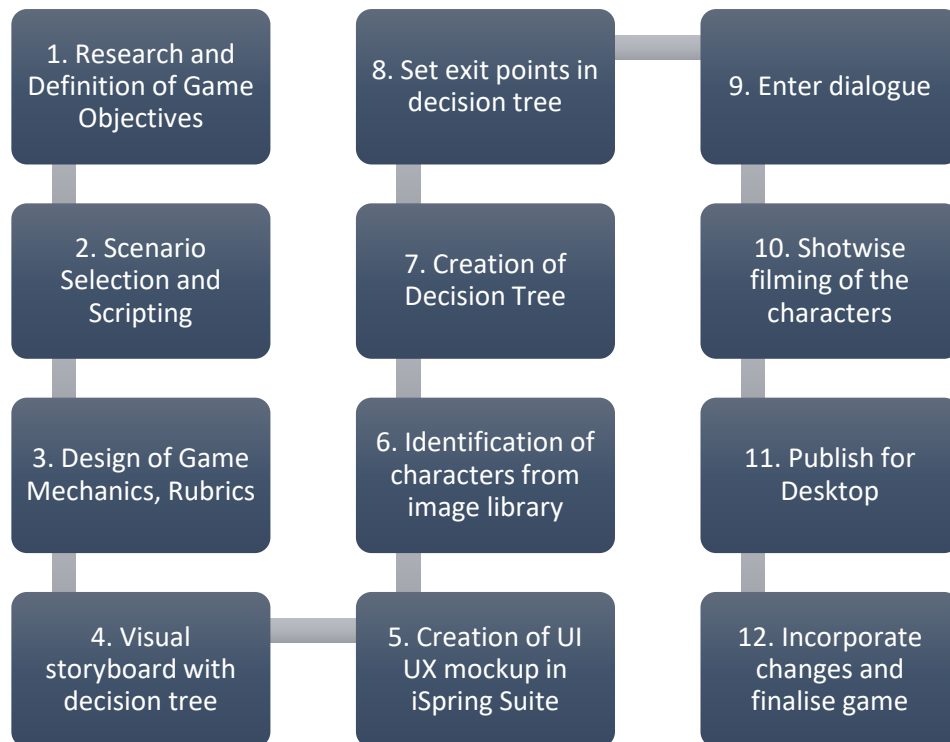


Figure 5.8. Process for 2D Photographic Game Creation.

Game Concept:

Set in the oncology ward of a busy government hospital in India, the game includes three primary characters with dialogue - the trainee nurse, the head nurse and the newly appointed trainee nurse. There was also a secondary character, the husband

of the patient in ward, who did not have any dialogue, however needed to be present to bring more realism to the scenario. The game is visualised as a narrative-driven, text-based RPG designed to build empathy in Indian nurses.

The learner gets into the shoes of the trainee nurse and interacts with the head nurse first, receives a brief that a patient has been detected with stage 3 breast cancer, and would require support and guidance on her next line of treatment. The conversation options are presented in a textual form, and the learners would need to select the dialogue that they find the most intuitive. The dialogues are created by keeping in mind the three personas mentioned in **Section 2.4.:** a. the impatient nurse b. the sympathetic nurse c. the empathetic nurse. The game focuses on empathy, communication skills, and compassionate care, offering a realistic glimpse into the daily challenges and rewards of nursing.

Game Mechanics:

On starting the game, after assuming the role of the nurse the player would be taken through to different pathways, which would either allow them to score more points or lose points. If they made the wrong choices, they were exited from the game and compelled to try again. The game included negative scoring if incorrect choices were made. If they made the correct choices, they could earn a positive empathy score and score up to 100% overall if they get all answers correct.

Figures 5.9. and 5.10. reflect the nonlinear pathways through the game narrative. The learner always has three choices of dialogue based on the three nurse personas, and he or she would progress through the game based on the choice that they make. The choices in blue are the correct ones, the ones in orange are the ones that are incorrect, and red represents when the learner is thrown out of the game and asked to replay the game from the beginning.

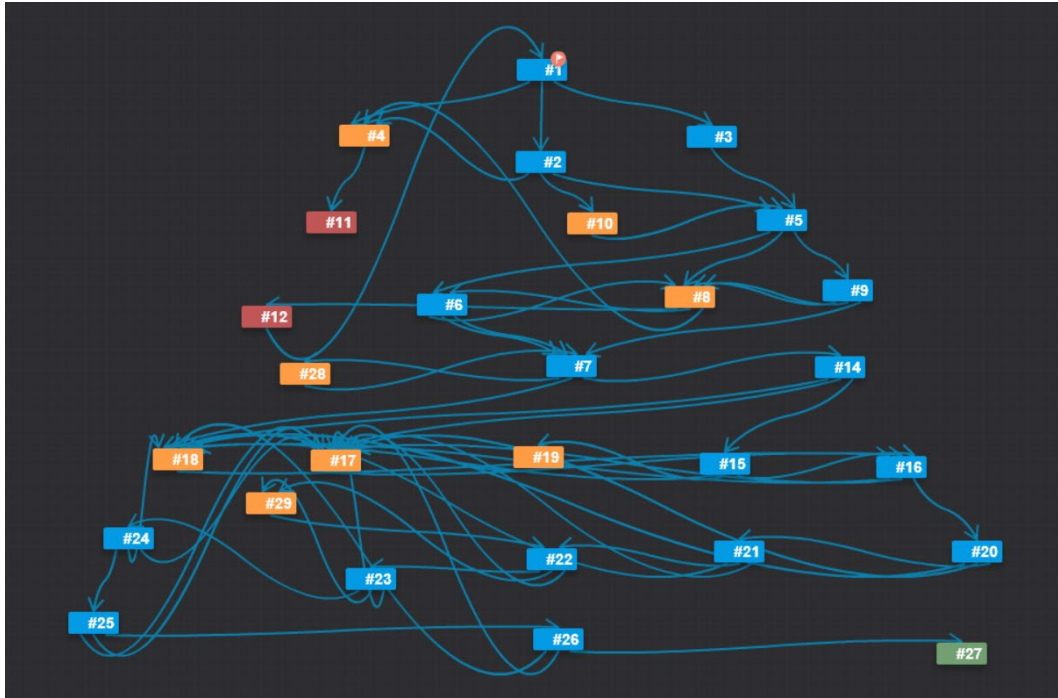


Figure 5.9. Pathways for dialogue choices by the nurse.



Figure 5.10. Choice of dialogues for the nurse, zoom in view.

The following were key features of the game:

1. **Interactive Conversations:** Players navigate through dialogues with the head nurse and the patient. Choices made during conversations affect the story's progression, teaching the player about the impact of their words and actions.

2. **Empathy Meter:** A dynamic empathy meter tracks the player's empathy levels based on their interactions and choice of dialogue.
3. **Decision Points:** Critical junctures where the player must make decisions regarding patient care, handling emotions, and professional conduct, simulating real-life nursing scenarios.
4. **Learning Nuggets:** Brief, informative segments providing the learners feedback on their action are interspersed in the game.
5. **Outcome Variability:** Multiple endings subject to the learner's choices, emphasizing the importance of empathy and effective communication in nursing.

Features to enhance the player engagement with the game:

- **Realistic Dialogue:** Realistic, contextual and culturally sensitive conversations that are based on daily experiences of Indian nurses created in consultation with stakeholders such as nurses, doctors and HCI experts.
- **Character Depth:** Richly developed characters, including the compassionate head nurse as a mentor and the vulnerable patient, creating emotionally engaging interactions.
- **Reflective Learning:** Encourages self-reflection and empathy, offering a safe space with the freedom to fail for players to understand the emotional complexities of patient care.

The simulation was created using iSpring Conversation Simulation tool and iSpring image library. This game does not have audio and can be played on the Smart Phone or on the desktop screen with keyboard and mouse interaction.

The link to the game is <https://agamagar.github.io/portfolio/HospitalVR>

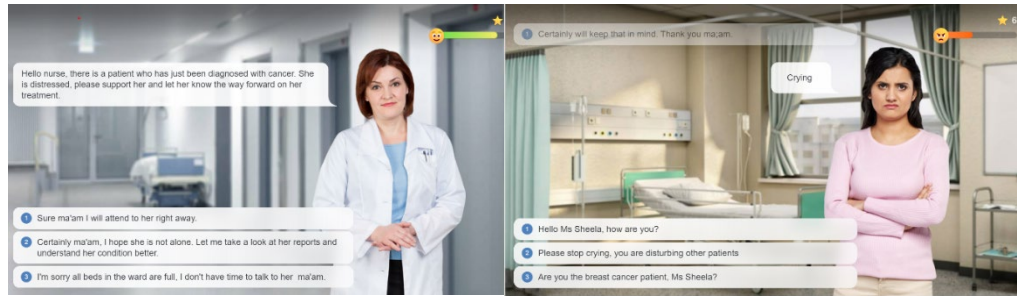


Figure 5.11. Images of 2D Photographic Intervention showing the head nurse and the patient.

5.6 Intervention 2 (360 Live Action):

For the 360 Live Action game intervention, the workflow involved the production of multiple 360-degree videos with the same dialogue as game intervention 1. These videos were strategically designed in a way that they could be seamlessly assembled into a comprehensive learning experience. Moreover, the discrete nature of these videos allowed for their activation based on the learner's responses.

This game prototype followed the same cancer scenario, game concept, mechanics, script as game intervention 1, however, it is filmed with live actors using an insta360 ONE Action Camera (5.7k 360 Capture). The footage is edited using 3D Vista, and Spatial audio is used to make the scenario more realistic. The simulation can be viewed by the learner using the desktop. The learners can be teleported to move to different sections of the ward through the navigation system. In this intervention the expressions of the actors are clearly visible, and the learners can navigate freely.

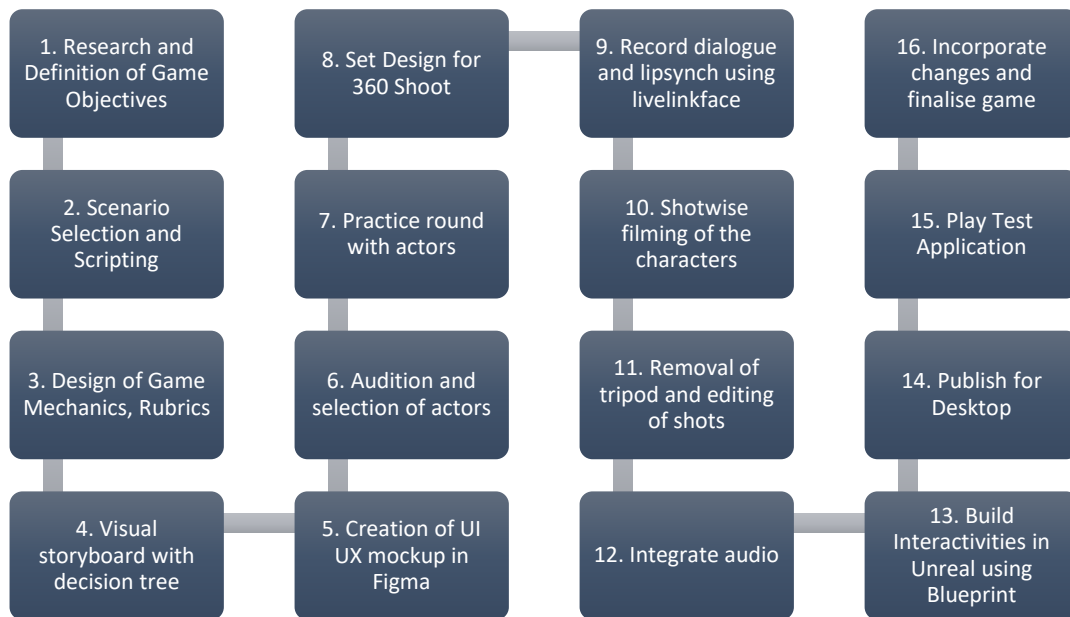


Figure 5.12. Process for 360 Live Action Game Creation.

The initial exploration included Unreal Engine and Adobe After Effects as platforms for constructing a learning model compatible with Windows and macOS-based devices. The user interface (UI) was created within Adobe After Effects; however, it was not suitable for creating a standalone interactive application. Conversely, Unreal Engine, despite its ability to transpose the blue-print framework to multiple media types, posed limitations in rendering 360-degree video content effectively. Given these considerations, alternative solutions were explored, resulting in the selection of 3DVista due to its rendering capabilities for 360 videos. The focus was to develop a self-contained interactive application using this software.

The film was shot in an environment set up as a private ward in a hospital. The actors for the nurse and head nurse in the hospital wore scrubs and lab coats to make them appear authentic. The patient and the husband of the patient were the other two characters in the film. A rehearsal was done before beginning the shoot as shown in **Figure 5.13**. The game can be played on the following link:

<https://youtu.be/AJnt0Zsrzh8> .



Figure 5.13. Rehearsal and Planning for 360 Live Action Video.

5.7 Intervention 3: (3D VR)

This is a 3D VR enabled game based on the same script and structural framework as game interventions 1 and 2. The characters used in this intervention are MetaHumans (Fang et al., 2021a; Giuliana, 2022) integrated in Unreal Game Engine 5.1. MetaHumans Creator (MHC), launched by Epic Games in February 2021, made available to the public in April 2021, is known for its ability to create High Fidelity Human Characters. These characters are a result of a research project which aimed to create highly realistic characters and reduce production costs for film, animation and game companies. The perceived advantage for this research was that we could design our own hyper realistic, rigged characters rapidly with limited time and resources. There were also some challenges, as MetaHumans were

newly launched and not many developers were familiar with them. While I did have the option of using Unity 3D and creating 3D models in Maya or Blender, I opted for MetaHumans as a further area for research as a part of this project.

There were specific criteria that were established for the choice of technology and process for VR:

1. The application should exhibit seamless performance during testing.
2. The application must encompass essential e-learning components, including scoring, conversation trees, and instructional elements.
3. The application should adhere to established heuristics.
4. The characters within the application must be endowed with the capability to emulate human facial movements.

Figure 5.14. describes the workflow followed for the 3D VR Game Design followed to address these criteria.

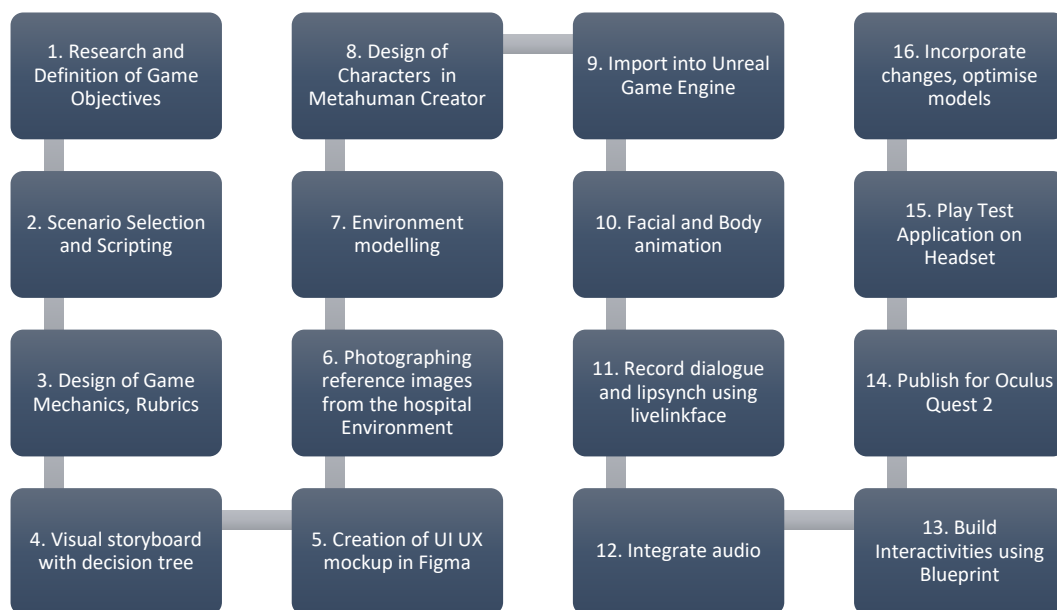


Figure 5.14. 3D VR Game Design and Development Process.

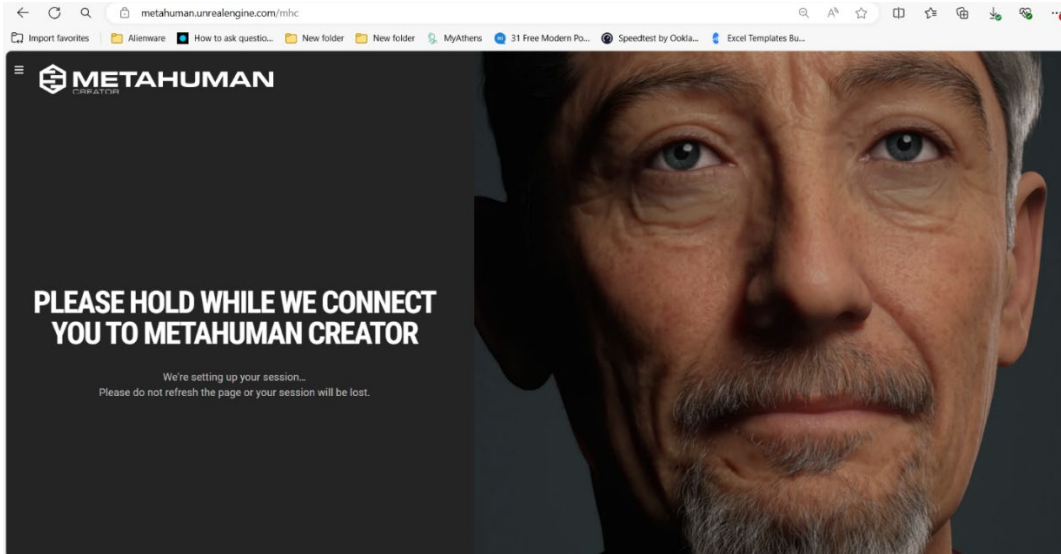


Figure 5.15. MetaHuman Creator – a Rapid Generation Tool for High Fidelity Avatars.

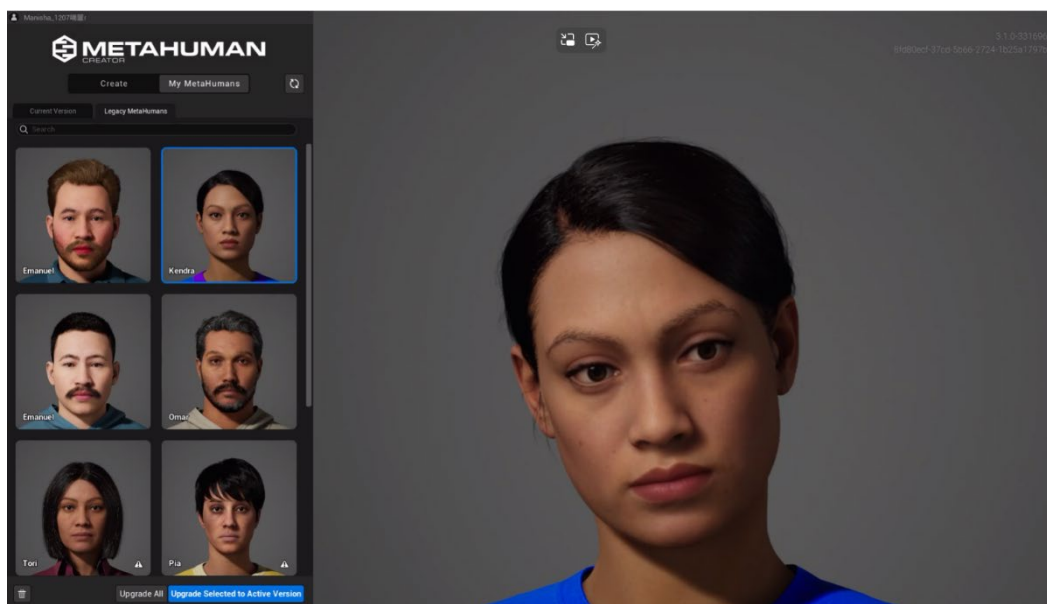


Figure 5.16. MetaHuman Nurse Character.

The MHC allowed for easy customization of character features, complexion, hair, expressions and offered a collection of body movements which made them easier to use for the game prototypes. Three characters were created – the head nurse, the patient and the patient’s husband. Although it was also possible to customise the clothes to some extent, the nurse’s uniform needed to be recreated in Blender and then mapped onto the avatar. There were some challenges in

mapping the new clothes and retaining the movement at the same time, therefore we had to use the existing clothes that were available in MHC and modify the colours to make them look like hospital scrubs.

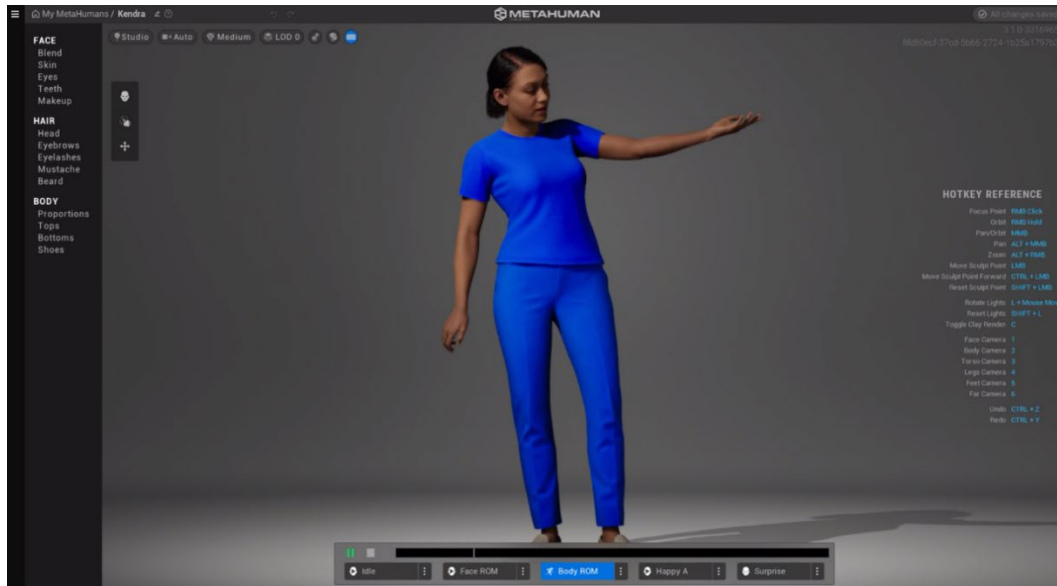


Figure 5.17. Nurse MetaHuman Character in Scrubs.

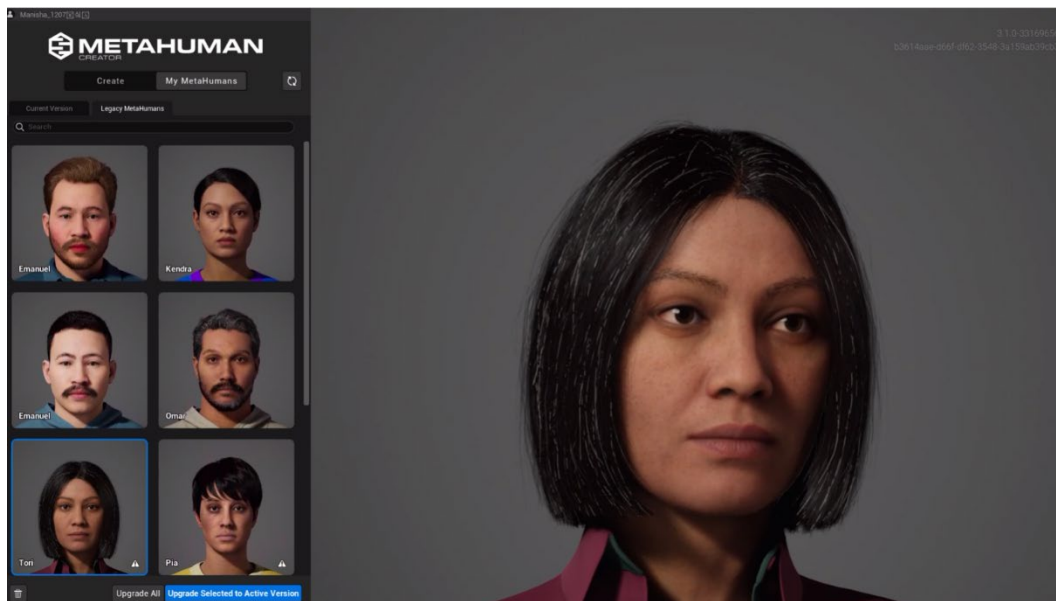


Figure 5.18. Cancer Patient MetaHuman Character.

It was possible to make the skin texture of the patient dull and rough to make her look unwell and age the patient by bringing in touches of grey hair. There

were limitations in terms of the hairstyles available, and one had to choose from the existing set. There were multiple readily available animated expressions such as sadness, fear, and anger which were appropriate for the patient character.



Figure 5.19. Cancer Patient MetaHuman Character – Smile.

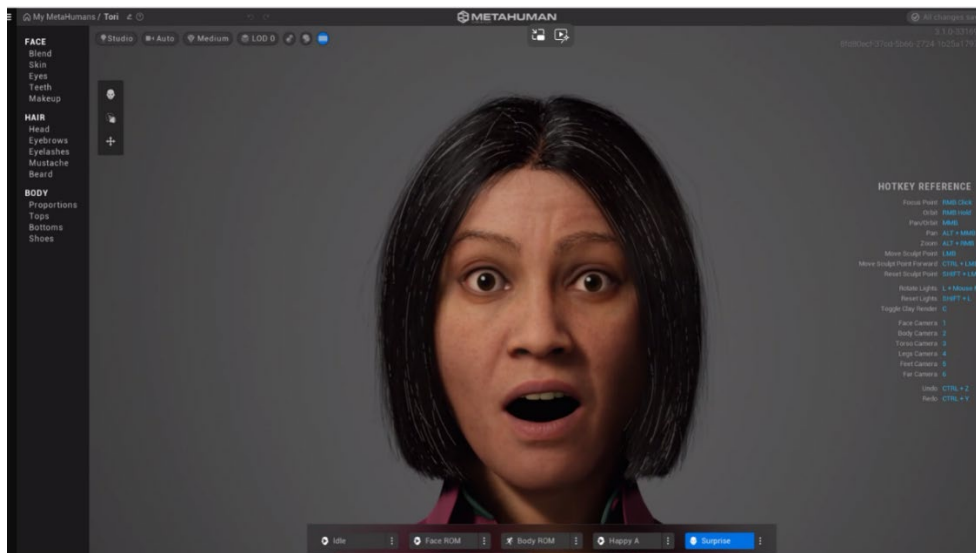


Figure 5.20. Cancer Patient MetaHuman Character – Surprise.

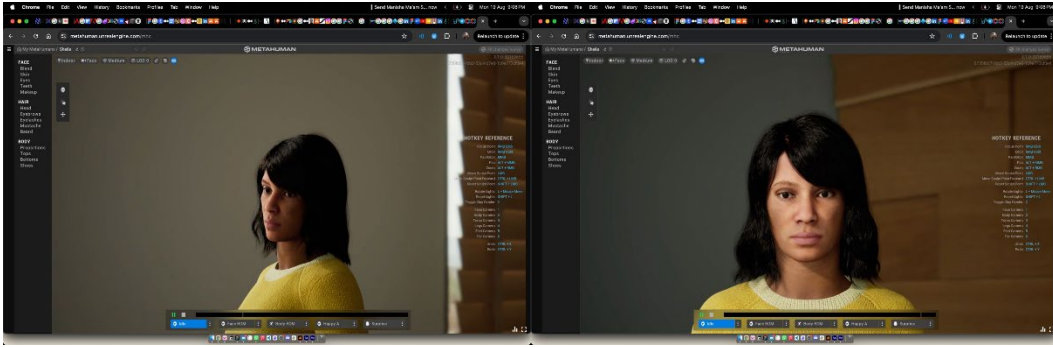


Figure 5.21. The patient with modified facial features and hair

As the patient was not looking Indian, the features were worked on further and the complexion was made rougher and the body was made thinner, assuming a person who is unwell. The hair was also changed to make her look more unkempt and unwell.

Although one could choose from a specific wardrobe and change colours and customize, there were limitations in terms of types of clothes available. For instance, there were no readily available Indian clothes or Hospital Clothes for the patient to wear, so we used the readily available clothes and kept her covered with a hospital bed sheet.

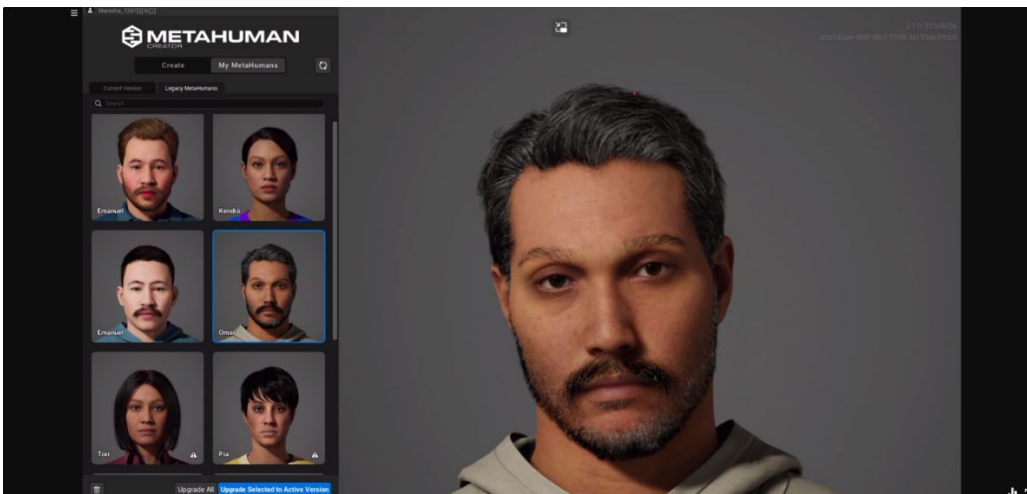


Figure 5.22. Husband of Patient MetaHuman Character.

The husband character was also created using MHC as shown in **Figure 5.22.** and **5.23.** There was customization done to facial features and complexion of

an existing character to make him look more Indian and in his forties. Though he had no dialogue, he had to maintain a sad and stressed expression throughout.



Figure 5.23. Husband of Cancer Patient MetaHuman Character – Body Movement.

The 3D environment was created using a combination of Blender and Unreal Game Engine. Photo references were taken from the real hospital environment to inspire the spaces, furniture, lighting, colors and elements in the hospital as shown in **Figure 5.24**. There were challenges taking photo references in the hospital. It had to be done with special permission from the hospital management.



Figure 5.24. Photographic Reference Images from the Hospital.



Figure 5.25. 3D Model of the Hospital Created in Blender.

The animation has been created using motion capture files imported from Mixamo and Deepmotion and Spatial Audio has been used for the dialogue. The prototype played a significant role in defining the structural framework of the project, while the storyboarding exercise facilitated the finalization of the conversation flow in consultation with various stakeholders and advisors. As the MetaHumans along with the backgrounds were heavy, the source files were stored in a CPU and the otherwise wireless Oculus Quest 2 needed to be connected to the CPU by a wire to run the game application smoothly.

Given the multidimensional nature of the user interface, which involved auditory, visual, and spatial modalities, we constructed a rudimentary interaction prototype in Figma to understand and evaluate the UI's functionality (**Figure 5.26**). This prototype was subsequently imported into Unreal Engine to ensure compatibility with the VR platform (**Figure 5.27**). This phase presented several challenges that had to be surmounted.

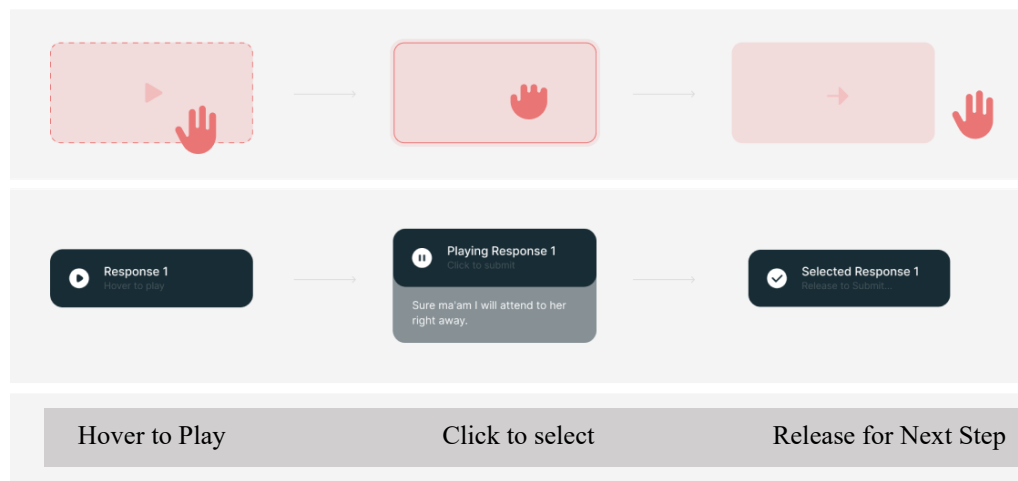


Figure 5.26. Navigation System of 3D VR Game.



Figure 5.27. 3D VR Environment with UI.

The next stage of development was the animation phase with MetaHumans. This involved two distinct aspects: facial animation and body motion capture. In the case of body motion capture, initial attempts utilizing motion-capture suits and video-to-mocap pose/motion generators yielded unsatisfactory results. Consequently, the decision was made to use Presto Mocap from Maximo, a solution that offered greater customization of animations to align with the rhythm and pace of the dialogues. Regarding facial animations, we explored various options, including mocap presets and facial video-to-mocap generators, all of which failed to deliver convincing outcomes. Subsequent research revealed that Unreal Engine offered a viable solution called "LiveLink," allowing us to simultaneously record actors' facial expressions and dialogues, resulting in a cohesive facial animation file for each dialogue. This worked effectively, though not without its unique challenges. A significant learning was that the Face Link function was designed to work directly with our metahumans, recording dialogue in real-time; however, this integration caused the application to crash. Consequently, the decision was taken to use the LiveLink application to record mocap data and audio separately, and later integrate them within the Unreal Engine platform.

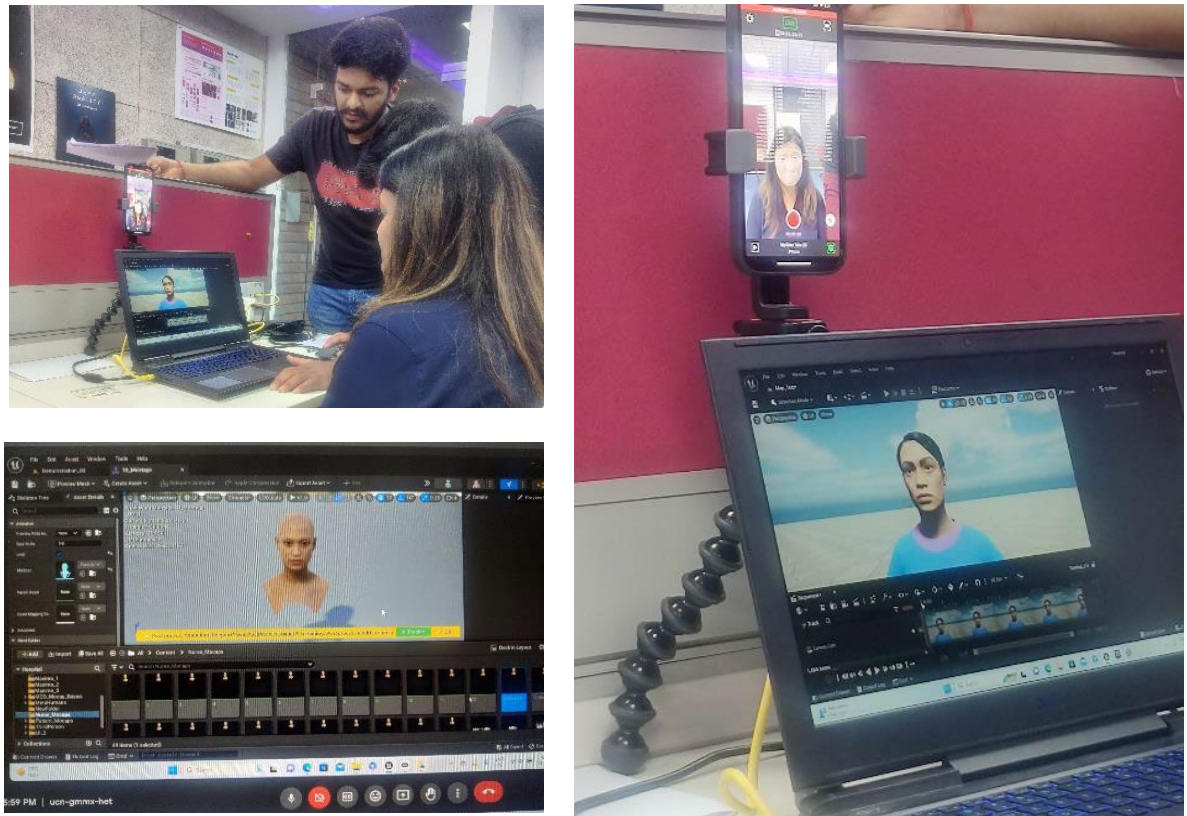


Figure 5.28. Recording Dialogue and Expressions on Livelink face.

The dialogues and expressions of all the characters were recorded using live actors and Livelink face. There was a need to exaggerate facial expressions and do a few retakes before the appropriate expression appeared on the MetaHuman characters within Unreal Game Engine. The same voice overs were also used for the 360 Live Action Characters in Intervention 2.

Further to this, the characters were placed in the 3D hospital environment and lights were placed strategically to bring out the depth and shadows effectively. The elements had to be optimized in the room to keep the applications as light as possible. The images in **Figure 5.33 to 5.35** show the experiments in terms of lighting and placement of objects and characters in the environment.



Figure 5.29. 3D Environment of the Ward.



Figure 5.30. 3D Environment of the Hospital Corridor.



Figure 5.31. Positioning of Characters in 3D environment.



Figure 5.32. Testing of the VR Application by Senior Nursing Faculty.



Figure 5.33. Interactivity in the Game Developed using Blueprint, Unreal Game Engine.

The flow and interactivity of the game was created using Blueprint, Unreal Game Engine's Visual Scripting Language. This being a visual language is easier for non-programmers to learn and adapt to in a short period of time.

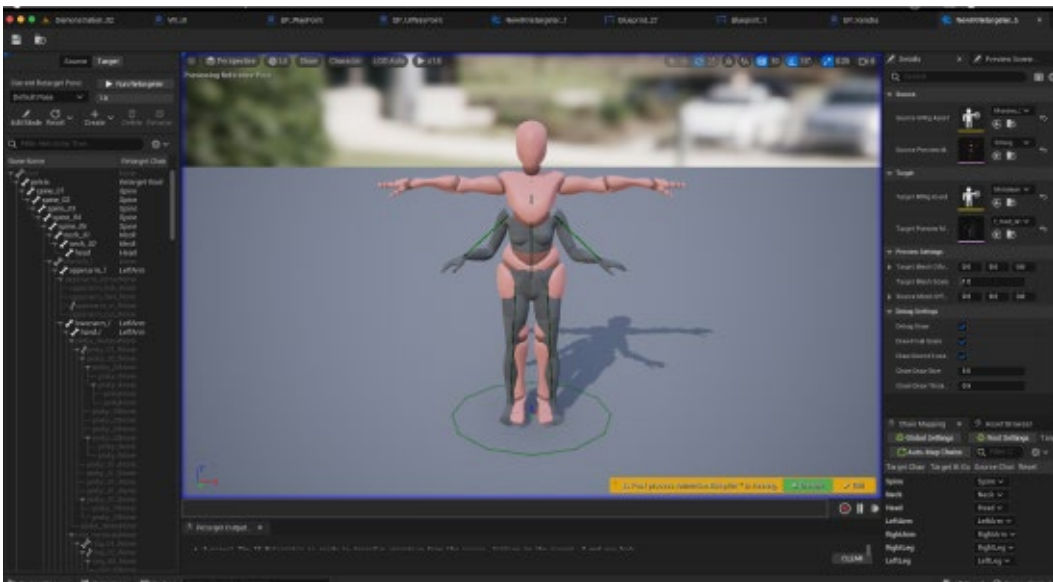


Figure 5.34. Rigging of Characters in Unreal Engine.

Manual Rigging of the characters needed to be done in Unreal Engine as the MetaHuman characters did not easily adapt to the motion capture files from Maximo and Deepmotion.

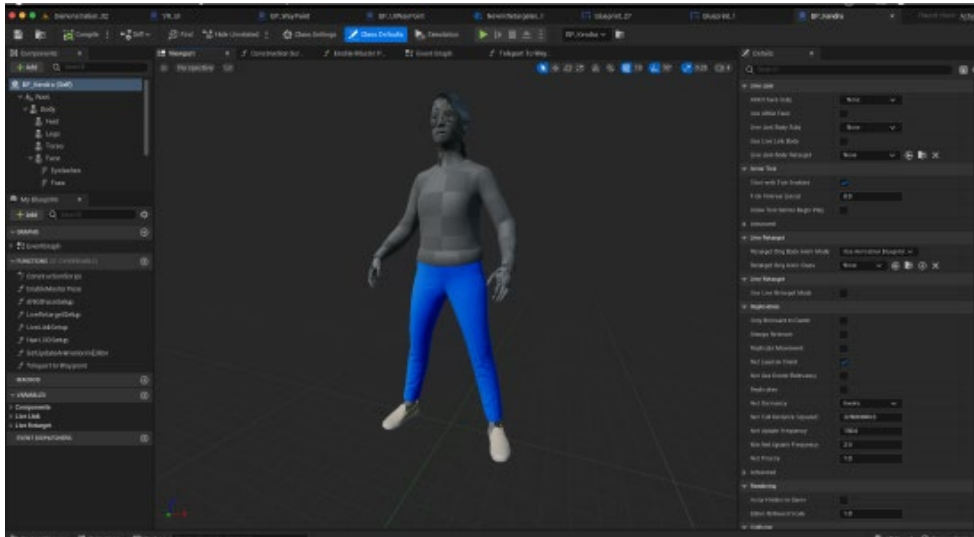


Figure 5.35. Clothes of Characters in Blender and Unreal Engine.

The 3D VR game overall required significant experimentation as MetaHumans were newly launched and there were very few developers who could guide us as we faced challenges. There were multiple insights from this research that can be shared with other developers that plan to use MetaHumans for game development.

At the end of this phase the three game interventions, 2D Photographic on Mobile, 360 Live Action on the desktop and 3D VR on Oculus Quest 2 were completed for testing and data collection on nursing professionals.

CHAPTER 6: MATERIAL AND METHODS

6.1 Overview

This chapter addresses the research design, sample selection, instruments, interventions and procedures used for collecting data based on the four objectives defined in **Chapter 3**. The measurement instruments for this study included a New Empathy Scale and a Learner Feedback form which were specially created for this study and described in **Chapter 4** of this thesis. The mixed methods approach was used in this research – which included quantitative and qualitative data collection methods to comprehensively assess the impact of three game interventions on the target population of Indian Nurses. While validation of the New Empathy Scale created was done with participants across the country, the testing of the three game interventions were carried out on nurses from the oncology, cardiology, emergency and obstetrics and gynaecology departments of AIIMS Rishikesh. Ethical clearance from the Research Review Board of AIIMS was received prior to the data collection on the nurses after a detailed presentation on the research proposal which included the objectives, sampling, proposed research plan and value of this research.

There were three games designed especially for this research in 2D photographic, 360 Live Action and 3D VR formats, the design and development process for these is described in **Chapter 5** of this thesis. The Empathy scale was administered before and after to test for the improvement while playing the games. A post intervention learner feedback form was also administered to gather the feedback on the nurses on the three game interventions. The test data gathered was analysed using various statistical methods for the quantitative components and a thematic analysis was conducted with the qualitative data from interviews and focus groups with nurses and the findings of the same are reflected in **Chapter 7** of this thesis.

6.2 Study setting

The research on nurses was conducted in four departments of AIIMS, Rishikesh including the Emergency, Obstetrics and Gynaecology, Oncology and Cardiology wards. The administration of the survey forms and game interventions happened in the seminar rooms, nurses' stations and wards of the different departments and a conscious effort was made to ensure that nurses were not disturbed from the care of patients by identifying their free time on the Rosters, an example of which is shown in **Figure 6.1**.

Nursing Cadre Duty Roster	Total 8:00 AM Total 8:00 PM		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180	181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210	211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260	261	262	263	264	265	266	267	268	269	270	271	272	273	274	275	276	277	278	279	280	281	282	283	284	285	286	287	288	289	290	291	292	293	294	295	296	297	298	299	300	301	302	303	304	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319	320	321	322	323	324	325	326	327	328	329	330	331	332	333	334	335	336	337	338	339	340	341	342	343	344	345	346	347	348	349	350	351	352	353	354	355	356	357	358	359	360	361	362	363	364	365	366	367	368	369	370	371	372	373	374	375	376	377	378	379	380	381	382	383	384	385	386	387	388	389	390	391	392	393	394	395	396	397	398	399	400	401	402	403	404	405	406	407	408	409	410	411	412	413	414	415	416	417	418	419	420	421	422	423	424	425	426	427	428	429	430	431	432	433	434	435	436	437	438	439	440	441	442	443	444	445	446	447	448	449	450	451	452	453	454	455	456	457	458	459	460	461	462	463	464	465	466	467	468	469	470	471	472	473	474	475	476	477	478	479	480	481	482	483	484	485	486	487	488	489	490	491	492	493	494	495	496	497	498	499	500	501	502	503	504	505	506	507	508	509	510	511	512	513	514	515	516	517	518	519	520	521	522	523	524	525	526	527	528	529	530	531	532	533	534	535	536	537	538	539	540	541	542	543	544	545	546	547	548	549	550	551	552	553	554	555	556	557	558	559	560	561	562	563	564	565	566	567	568	569	570	571	572	573	574	575	576	577	578	579	580	581	582	583	584	585	586	587	588	589	590	591	592	593	594	595	596	597	598	599	600	601	602	603	604	605	606	607	608	609	610	611	612	613	614	615	616	617	618	619	620	621	622	623	624	625	626	627	628	629	630	631	632	633	634	635	636	637	638	639	640	641	642	643	644	645	646	647	648	649	650	651	652	653	654	655	656	657	658	659	660	661	662	663	664	665	666	667	668	669	670	671	672	673	674	675	676	677	678	679	680	681	682	683	684	685	686	687	688	689	690	691	692	693	694	695	696	697	698	699	700	701	702	703	704	705	706	707	708	709	710	711	712	713	714	715	716	717	718	719	720	721	722	723	724	725	726	727	728	729	730	731	732	733	734	735	736	737	738	739	740	741	742	743	744	745	746	747	748	749	750	751	752	753	754	755	756	757	758	759	760	761	762	763	764	765	766	767	768	769	770	771	772	773	774	775	776	777	778	779	780	781	782	783	784	785	786	787	788	789	790	791	792	793	794	795	796	797	798	799	800	801	802	803	804	805	806	807	808	809	810	811	812	813	814	815	816	817	818	819	820	821	822	823	824	825	826	827	828	829	830	831	832	833	834	835	836	837	838	839	840	841	842	843	844	845	846	847	848	849	850	851	852	853	854	855	856	857	858	859	860	861	862	863	864	865	866	867	868	869	870	871	872	873	874	875	876	877	878	879	880	881	882	883	884	885	886	887	888	889	890	891	892	893	894	895	896	897	898	899	900	901	902	903	904	905	906	907	908	909	910	911	912	913	914	915	916	917	918	919	920	921	922	923	924	925	926	927	928	929	930	931	932	933	934	935	936	937	938	939	940	941	942	943	944	945	946	947	948	949	950	951	952	953	954	955	956	957	958	959	960	961	962	963	964	965	966	967	968	969	970	971	972	973	974	975	976	977	978	979	980	981	982	983	984	985	986	987	988	989	990	991	992	993	994	995	996	997	998	999	1000	1001	1002	1003	1004	1005	1006	1007	1008	1009	1010	1011	1012	1013	1014	1015	1016	1017	1018	1019	1020	1021	1022	1023	1024	1025	1026	1027	1028	1029	1030	1031	1032	1033	1034	1035	1036	1037	1038	1039	1040	1041	1042	1043	1044	1045	1046	1047	1048	1049	1050	1051	1052	1053	1054	1055	1056	1057	1058	1059	1060	1061	1062	1063	1064	1065	1066	1067	1068	1069	1070	1071	1072	1073	1074	1075	1076	1077	1078	1079	1080	1081	1082	1083	1084	1085	1086	1087	1088	1089	1090	1091	1092	1093	1094	1095	1096	1097	1098	1099	1100	1101	1102	1103	1104	1105	1106	1107	1108	1109	1110	1111	1112	1113	1114	1115	1116	1117	1118	1119	1120	1121	1122	1123	1124	1125	1126	1127	1128	1129	1130	1131	1132	1133	1134	1135	1136	1137	1138	1139	1140	1141	1142	1143	1144	1145	1146	1147	1148	1149	1150	1151	1152	1153	1154	1155	1156	1157	1158	1159	1160	1161	1162	1163	1164	1165	1166	1167	1168	1169	1170	1171	1172	1173	1174	1175	1176	1177	1178	1179	1180	1181	1182	1183	1184	1185	1186	1187	1188	1189	1190	1191	1192	1193	1194	1195	1196	1197	1198	1199	1200	1201	1202	1203	1204	1205	1206	1207	1208	1209	1210	1211	1212	1213	1214	1215	1216	1217	1218	1219	1220	122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Figure 6.1. Roster of nurses to identify available slots for testing.

Intervention 1 was tested on mobile devices of nurses and intervention 2 on personal computers and laptops. For Intervention 3 an Oculus Quest 2, was used to experience the 3D VR environment. The weight of the device is 503 g. It has a resolution of 1440 x 1600 pixels and has a 110-degree field of view. There is an inbuilt speaker system for audio. The interaction with the VR environment is with two hand controllers. **Figure 6.2** demonstrates the postures while using the VR and 360 applications and **Figure 6.3** demonstrates all three applications in use.

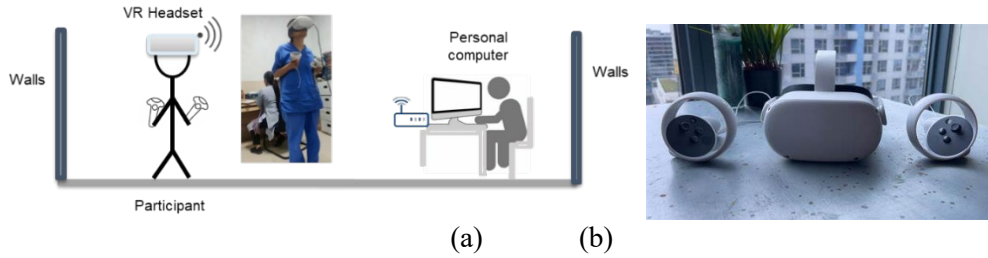
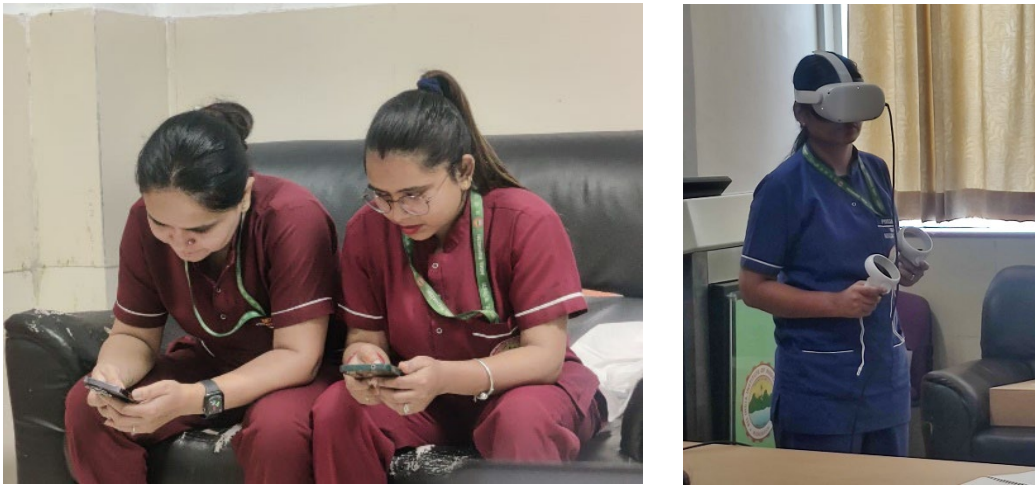
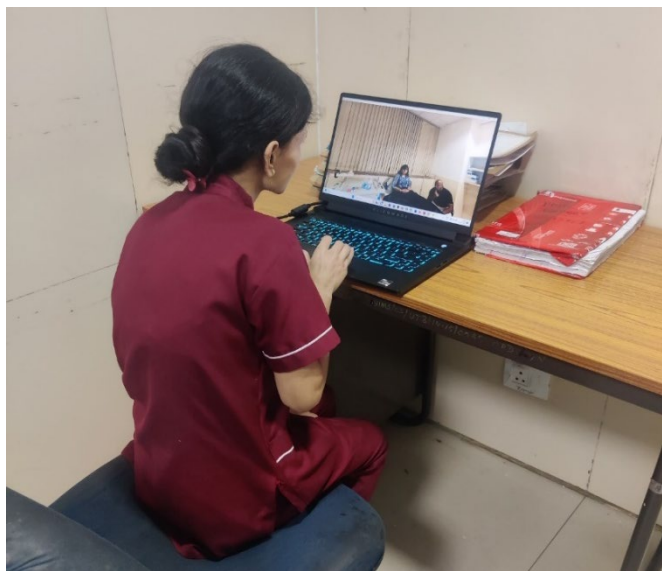


Figure 6.2. (a) Experiment setup (b) VR headset- Oculus Quest 2.



(a) (b)



(c)

Figure 6.3. Data collection in in nurse's stations in the wards (a) 2D Photographic on mobile (b) 3D VR on Oculus Quest 2 (c) 360 Live Action on Desktop.

6.3 Study population

Indian nursing students and professionals between the ages of 19 to 55 were considered for this study, including men and women.

6.4 Sample Size and Sampling Technique

For the reliability testing of the empathy scale and pilot testing 50 nurses was conducted on a sample size of 50 nurses.

Post ethical clearance, 180 nurses from the Oncology, Obstetrics and Gynecology, Emergency and Cardiology Wards of AIIMS Rishikesh were tested via stratified random sampling considering different experience levels and specializations of nurses. The unit selection was done by purposive sampling technique. Total enumeration sampling was used in calculating the sample size. The total nurses working in all the units were 208. This was done by using G Power software (version 3.1.9.7) by keeping following parameters: Effect size = 0.25 Type I error (alpha) = 0.05 Power (1-beta error prob) = 0.80 Number of groups = 4 Obtained Total Sample Size = 180.

6.5 Study Design

The mixed method was adopted for this research, as both qualitative and quantitative methods were followed to gather data and information to support the design of the instruments as well as to gather and analyze test results.

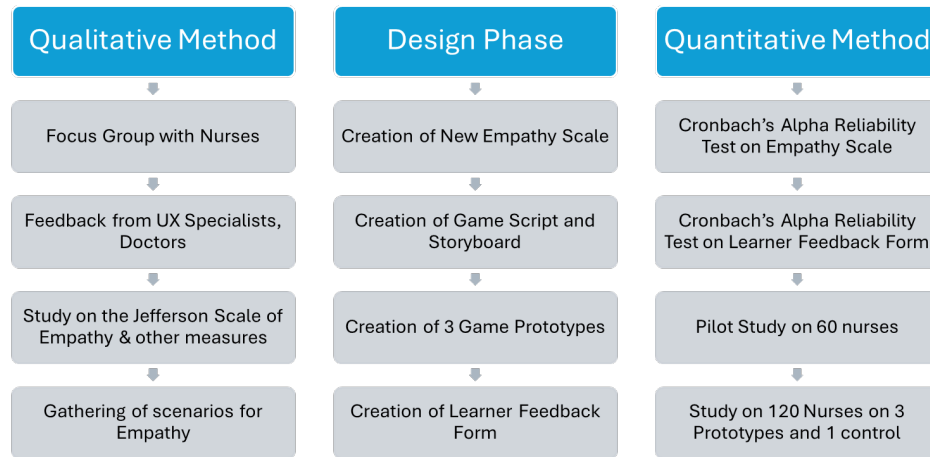


Figure 6.4. Mixed method including qualitative and quantitative approaches.

To achieve the overall objective of evaluating “The effectiveness of Immersive Media and GBL in building empathy among Nursing Professionals in India”, a four-step methodology was followed aligned to the four Research Objectives (RO) outlined in **Section 3.1**. It was important to first determine the baseline empathy score of Indian Nurses. While there are several tools for empathy measurement in healthcare professionals, as outlined in **Section 2.6**, they do not consider the socio-demographic context or workplace the challenges of Indian Nurses. A 30-factor empathy scale was designed based on a 7-point Likert Scale for assessing the empathy level of Indian Nurses. The reliability test was conducted based on the data gathered on the pilot test of this scale, and it was found to be Cronbach’s Alpha >0.70 therefore reliable. The process for developing this scale is described in **Section 4.1**. and the detailed analysis of test results is available in **Section 7.2**

A focus group was conducted with 18 Nurses to ascertain barriers to empathy as well as scenarios where empathy was followed in the nurse-patient interaction. This was followed by the Design of 3 game interventions (2D Photographic, 360 Live Action and 3D VR) using the IDEO design methodology. This methodology is further detailed out in **Section 4.2**. The reason for developing three types of interventions was to do a comparative study between media types and platforms and study the impact they have on nurse’s motivation to learn soft skills such as empathy from them as well as their relative impact on empathy scores.

To measure the learner's engagement with the game-based learning interventions, a learner feedback form was created. This form was aligned to heuristics for VR and GBL and aligned to the context of nursing professionals and practice. The process for creation, the considerations for this form and the reliability test for this form are further described in section **Section 4.3**. A pilot test was conducted on 60 nurses to determine their feedback on usability, engagement and immersion, alignment to context and perceived learnability.

This was followed by the testing of the three game interventions and one control on a population of 120 nurses from AIIMS Rishikesh. The Randomized Control Trial (RCT) method was deployed for data collection for this research. The independent variable was the three game prototypes created and the dependent variable was the learner feedback and the overall impact on empathy of the nurses. The unit selection was done by purposive sampling and selection of nurses for testing from the oncology, emergency, OBG and Cardiology wards was done by random sampling. This is further described in **Section 4.4**. **Figure 6.5** summarizes the process of Data Collection with nurses at AIIMS Rishikesh. The nurses were first asked to fill the empathy scale prior to administering the intervention. They then played the game and were administered the learner feedback form to gather feedback. After 7 days they were again administered the empathy scale to gather the change in score.

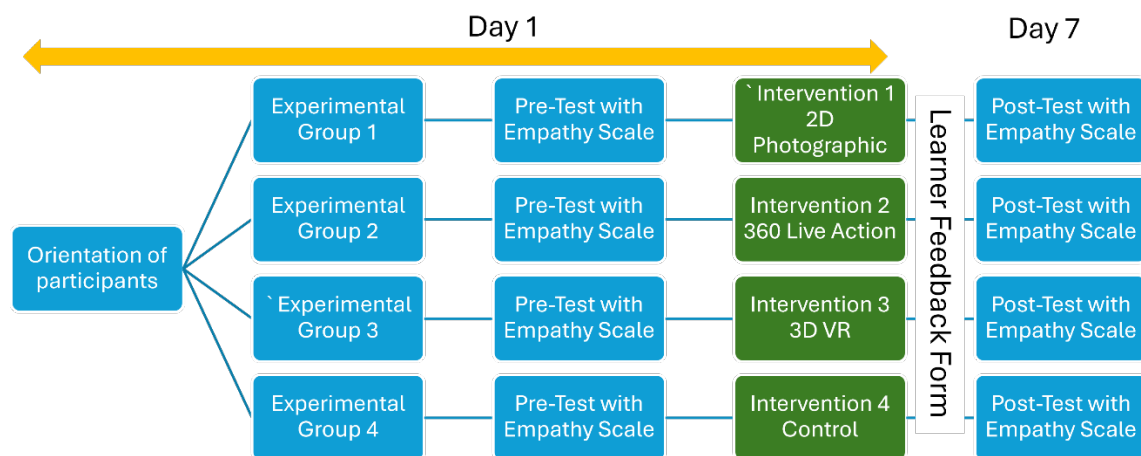


Figure 6.5. Process for Data Collection.



The first ten minutes were spent briefing the nurses and making them relaxed and comfortable with the game formats as shown in **Figure 6.6**. All three game interventions were administered to nurses through random sampling.

Figure 6.6. Orientation and briefing of nurses on Game Interventions.



Figure 6.7. Nurses were immersed in the 3D VR Game.

The nurses were immersed while playing the games, and their postures while playing the game interventions were observed as shown in **Figure 6.7**. The mobile platform was the easiest to use and required minimal support. The desktop application of 360 Live Action was also relatively easier for the nurses who were familiar with computers. For many the VR experience was a new one, many opted for it due to the novelty of the experience.

6.6 Inclusion and Exclusion Criteria

The sample would be restricted only to Indian nurses located in Indian hospitals.

6.7 Randomization

Allocation of nurses to different groups was done by simple random sampling keeping a balanced allocation of 1:1:1:1 for all four groups (2D photographic, 360 Live Action, 3D VR, Control).

6.8 Allocation Concealment

The identity of the nurses would be concealed and kept confidential in the test result to keep it neutral.

6.9 Blinding

The survey instruments and game prototypes were administered to nurses without them being told they were specifically for building empathy. This was to minimize self-report bias and enable nurses to make intuitive and natural selections of options presented to them.

6.10 Intervention

Independent variable: e-learning via three interventions

1. 2D Photographic on phone
2. 360-degree live action on desktop
3. 3D VR on Oculus Quest 2

Dependent Variable:

1. Empathy among nurses as tested with the empathy scale
2. User-friendliness, Context Specificity, Engagement and Immersion, Perceived Learnability

6.11 Outcome measurements

Improvement in empathy score on the cognitive, affective and motivational domain were tested. Comparative learner feedback and effectiveness of three types of games interventions (2D Photographic, 360 Live Action and 3D VR) would be measured and analyzed.

6.12 Tools & Data collection Methods

The instrument used for baselining the empathy score was the New Empathy Scale and the specially created Learner Feedback Form was used to gather nurses' feedback on the learning. These were administered through google forms to the nurses on their mobiles.



Figure 6.8. Testing of VR Game in Nurse's Stations and Seminar Rooms.

6.13 Ethical Considerations

A detailed research proposal was presented in front of the Research Review Board of AIIMS Rishikesh, and approval was received before conducting the tests. A consent form was signed by all participants of this study.

These tests were administered in strict alignment with all ethical regulations to ensure that participants were safe throughout. No subject that was tested was harmed physically, mentally, or emotionally. The rights and dignity of participants were protected throughout the testing process. Participation in this research was

entirely voluntary, and subjects had the right to withdraw at any time without penalty.

6.14 Statistical Tools Used

Different statistical tools were used to analyze data at each stage. The findings of these statistical analysis is reflected in the Results section in **Chapter 7** of this thesis.

Table 6.1. Statistical Tools used.

S.No.	Purpose	Statistical tool
1.	Reliability Test of New Empathy Scale	Cronbach's Alpha and Pearson Correlation
2.	Inter-relationship between Factors in New Empathy Scale	Varimax with Kaiser Normalization
3.	Reliability Test of Learner Feedback Form	Cronbach's Alpha and Pearson Correlation
4.	Test of Normality of data	Shapiro-Wilk and Kolmogorov-Smirnov ^a
5.	Testing the hypothesis during pilot study of the game.	Chi-Square Test
6.	Comparison of pre and post empathy test of pilot.	Wilcoxon Signed Rank Test
7.	Relative comparison and ranking of learner feedback on three game prototypes.	Kruskal Wallis and Mann Whitney Tests
8.	Ranking of pre and post empathy survey feedback on three game prototypes	Kruskal Wallis and Mann Whitney Tests
9.	Gender-wise comparison on mean rank of feedback game prototypes	Mann Whitney Test

The first phase of pilot testing and data collection for the reliability test for the empathy scale happened over a month. The testing of the game interventions with pre and post empathy tests and learner feedback took place over two months at AIIMS Risikesh. **Chapter 7** addresses statistical analysis of the results based on the testing of the game interventions.

CHAPTER 7: RESULTS

7.1 Overview

Aligned with the four ROs identified, and four research questions outlined for this study in **Chapter 3**, trials were conducted and the analysis of data was carried out in various statistical methods as reflected in **Table 7.1**. This chapter includes a summary of the findings from the trials carried out during the process of testing the reliability of the measurement instruments - the New Empathy Scale and the Learner Feedback Form; and pilot testing of the game-based approach on a wider population of nurses. The following sections present detailed statistics and interpretations of the results based on the study population of nurses from the Emergency, Oncology, Cardiology, and Gynecology departments of AIIMS Rishikesh.

Table 7.1. Correlation of Research questions to Statistical Analysis Conducted.

S. No.	Research Question	Intervention	No. of Nurses Tested	Result Analysis
1.	What is the current state of empathy in the interaction between nurses and patients in the Indian hospital scenario?	Creation and Reliability testing of New Empathy Scale.	50	Cronbach Alpha > 0.70, therefore reliable.
2.	What are the factors that affect empathy in Indian Nurses?	Identification and Analysis of factors in the New Empathy Scale.	50	A correlation between empathy scale factors was established through Rotational Component Analysis by Varimax with Kaiser Normalization.
3.	What is the motivation and perceived learnability of Indian Nurses in GBL?	1. Creation and reliability testing of Learner feedback form 2. Pilot testing of the Game.	60	1. Cronbach Alpha > 0.70 therefore Reliable. Fourth Factor was >0.50 by Pearson Correlation. The factors were Usability, Engagement and Immersion,

				Contextual Alignment, Perceived learnability.
				2. Pilot testing of the 2D photographic game intervention and Chi Square Test done.
				3. Wilcoxon Signed Rank Test for pre post empathy comparison.
4.	How would one measure the efficacy of VR and GBL in building empathy in Indian Nurses?	Creation of 3 games, learner feedback form administered, pre- post empathy scale administered.	120	1.Non-Parametric Kruskal Wallis and Mann-Whitney tests conducted on learner feedback results – mobile based intervention scored highest. 2.Kruskal Wallis and Mann-Whitney tests on pre and post empathy scale proved that though 2D photographic ranked highest, some factors of empathy score were higher with 3D VR and 360 VR 3, Gender wise differences in response to the game-based intervention. Female nurses had a greater preference for the game.

7.2 Reliability of the New Empathy Scale

The new empathy scale (presented in **Section 4.2**) is a 30-item scale which addresses cognitive, affective, and motivational aspects of empathy on a 7-point Likert scale. The instrument includes 8 items from JSE, and the remaining items were newly created aligned with the Indian nursing context. To assess the internal consistency and reliability of the new empathy scale, Cronbach's Alpha (α) was calculated based on data collected through a pilot test with Indian Nurses. The pilot test was administered via online links on mobiles to 50 nurses (Mage $\pm$ SD=33.91 $\pm$ 9.646; male=47.4%, female=52.6%). The nursing professionals ranged

from 19 to 51 years old, belonged to Delhi, Uttar Pradesh, Uttarakhand, Rajasthan, Haryana, Maharashtra, Punjab, Assam, Bihar, Kerala, Karnataka, Andhra Pradesh and Tamil Nadu, and were associated with Govt, Private, Autonomous hospitals and Universities. Their educational qualifications ranged from B.Sc, M.Sc and Ph.D.

Reliability Statistics	
Cronbach's Alpha	N of Items
.788	30

Figure 7.1. Reliability of 30 item New Empathy Scale.

A summary of all 30 Items as tested and analysed through Cronbach's Alpha, was proven to be .788 cumulatively therefore the scale or Alpha > 0.70 as shown in **Figure 7.1**, which is considered reliable overall (Nunnally, 1967; Peterson, 1994). The Cronbach's Alpha of 0.788 is comparable to previous studies that have evaluated the reliability of empathy scales such as JSE at .80 (Mudri et al., 2024) as tested in healthcare professionals, particularly nurses and medical students. This suggests that the items within the questionnaire are sufficiently correlated and could be used as a consistent and reliable method of testing empathy in Indian Nurses.

Individual factors were also statistically analyzed to test for reliability. The factors pertaining to empathy in the nurse's personal environment pertaining to family and education (IEENV) were found to be at 0.78; Cognitive factors that were positive pertaining to the nurse's belief that listening is important, as is the observation of body language and the importance of empathetic behavior (COGP) was at 0.94, the motivation for practicing empathetic behavior, (EMPMO) was analyzed through Pearson Correlation was >50 which is considered reliable. The criticality of the emotional aspects related to empathetic behavior (EMO) based on analysis came out to be 0.72. Aspects such as shortage of time and resources, factors due to stress and home and work which were cognitively negative (COGN) were analyzed at 0.88.

7.3 Correlation between 8 Factors of New Empathy Scale

The 50 nurses responded to questions of the New Empathy Scale on a 7-point Likert scale where the 1 was “Strongly Disagree”, and 7 was “Strongly Agree”. Analysis of the results, with 11 iterations using Varimax with Kaiser Normalization, established the rating and correlations across the 8 factors of the Empathy Scale. Out of the 30 items, based on the responses, 17 items were shortlisted from the New Empathy scale as more critical to empathy from the perception of the sample of nurses tested.

Table 7.2. Rotated Component Matrix for New Empathy Scale.

Items	Factors								
	COGP	PAF	COGN	MOTIV	PC	IEENV	WP	NAF	IAT
1. Patients' body language helps me understand what is going on in their minds	.840								
2. I extend immediate help to a patient during therapy without any hesitation	.829								
3. I believe practicing empathy can help my patients feel better	.703								
4. I believe in listening to another person and give importance to their words	.702								
5. A nurse's understanding of the emotional status of his/her patients, as well as that of their families is one of the important aspects of the nurse – patient relationship		.795							
6. I believe that patients feel better when nurses understand their feelings		.784							
7. I feel satisfied when I am empathetic with the patient during therapy		.731							
8. Attentiveness of patients' personal experiences does not influence treatment outcomes			.903						
9. Attention to patients' emotions is not important in-patient interview			.892						
10. I feel motivated to come to my job as a nurse each day				.876					
11. My nursing education taught me how to be empathetic with patients				.865					
12. Because people are different, it is important to see things from patients' perspective					.727				
13. My teachers in school understood my feelings						.870			
14. My family has been empathetic towards me since my childhood						.728			
15. I am stressed because of lack of resources at my work place							.831		
16. I find it easy to give bad news to a patient or their family								.805	
17. A nurse's sense of humour contributes to a better clinical outcome									.70

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 11 iterations.

COGP: Cognitive Positive; COGN: Cognitive Negative; PAF: Positive Affect; NAF: Negative Affect; MOTIV: Motivation; PC: Personalized Care; IEENV: Individual Empathetic Environment of Nurses
WP: Work Pressure; IATTI: Individual Attitude of Nurses

In **Table 7.1.**, the positive response to items 13 and 14, at .870 and .720 respectively, reconfirms that the nurses believe that the IEENV in terms of the empathy experienced during the nurse's upbringing, or their education has a strong correlation with their ability to practice empathy. Items 1 to 4 under Factor 1, COGP, include the positive mindset of the nurses in practicing empathetic behaviour with patients including listening, observing the body language of the patient and understanding of the positive influence of empathy while caring for

patients. These came out to be .840, .829, .703, .703 under COGP, thus proving that nurses understand the importance of empathy and have a positive mindset towards being sensitive to patient's needs. Items 8 and 9 under Cognitive Negative (COGN), at 876, .865 respectively, when analyzed after reverse coding, showed that nurses understood that it was important to understand the patient's personal experience and feelings during perspective taking to help them better in their recovery journey. Items 10 and 11 reflect the fact that the nurses are motivated to come to work, and their nursing education highlighted the importance of practicing empathetic behavior. Item 12 at .726, reflects that nurses understand that each patient is unique and there is a need for Personalized Care (PC). Items 5,6 and 7 are at .795, .784, .735 respectively, under Positive Affective (PAF) represent importance of understanding the emotions and feelings of patients towards practicing empathy and underscores the sense of satisfaction that nurses get from practicing empathetic behavior with their patients. Items 15 and 16 at .831, .805 respectively, clearly identify that Indian nurses feel stressed in the workplace and experience a resource shortage at the workplace. A sense of humor in patient interactions which in the JSR survey items, may not considered as critical a factor as others in by nurses in India is at .703, and may be adopted basis the individual style or approach of the nurse.

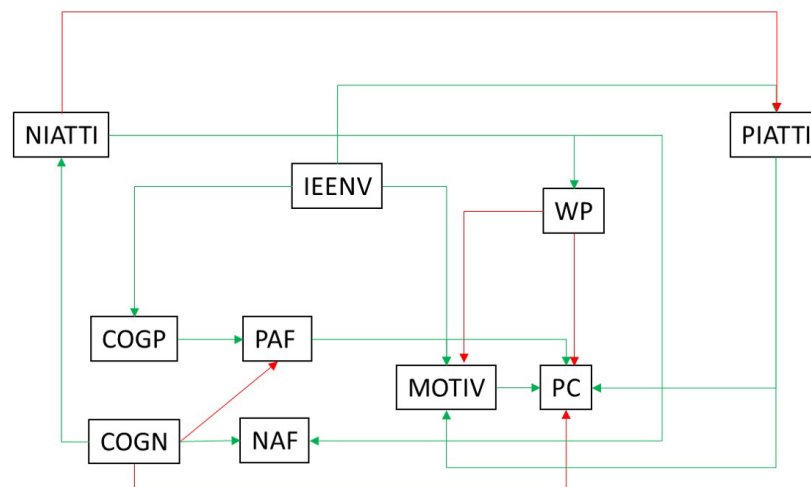


Figure 7.2. Correlation between Factors in Empathy.

Figure 7.3 represents the positive (green arrow) and negative (red arrow) relationship between factors. The upbringing of the nurse in an empathetic environment (IEENV) positively influences the positive mindset towards empathy (COGP) of the nurses and their motivation (MOTIV) to practice empathy. WP or Workplace Pressures impact the motivation (MOTIV) of nurses and the personal care (PC) that they can offer. The negative attitude towards practicing empathetic behavior (COGN) also impacts the nurse's ability to practice empathy.

7.4 Reliability of the Learner Feedback form

The Learner Feedback form (presented in **APPENDIX A**) is based on four factors -Usability, Relatability to the Context, Engagement and Immersion and Perceived Learnability. Based on a pilot reliability study conducted on 60 nurses the first three factors were found to be Cronbach's Alpha > 0.70. The fourth Factor was >0.50 by Pearson Correlation Test therefore reliable. All factors in the form were found reliable.

Table 7.3. Reliability Statistics of Four factors of Learner Feedback form.

Survey Question	Factor	Reliability Test	Reliability Statistics
The content is very close to the real clinical scenario I found the scenario similar to my daily work as a nurse. I found the feedback on my decisions easy to relate to and actionable.	Relatable to the Context	Cronbach Alpha	.706
I found it easy to walk through the scenario. I found the instructions in the scenario easy to follow I found the entry and exit points clear in the scenario.	Usability	Cronbach Alpha	.780
I will use game-based learning again for learning I felt like I am physically present in the scenario. I found the scenario engaging. I found the look and feel close to a real hospital setting.	Engagement and Immersion	Cronbach Alpha	.716
I found the scenario a good learning experience.			.836

I will remember what I learnt in this scenario and use it in my routine patient care.	Perceived Learnability	Pearson Correlation
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According to George (2020), Cronbach's Alpha is considered significant within the range of 0.7 to 0.99, indicating a high degree of internal consistency when $\alpha > 0.7$ (Lachenbruch & Cohen, 1989). In this study, Cronbach's Alpha values were assessed across three factors—relatability to the context, usability, and engagement & immersion—along with the Pearson correlation coefficient (r) in relation to perceived learnability. The results suggest that the learner feedback form is a valid and reliable instrument for gathering learner insights in future research.

The findings indicate that Cronbach's Alpha for the first three factors—relatability to the context ($\alpha = 0.706$), usability ($\alpha = 0.780$), and engagement ($\alpha = 0.716$)—falls within the acceptable range ($0.7 \leq \alpha \leq 0.99$), confirming their reliability. Additionally, for the fourth factor, a Pearson correlation of $r = 0.836$ with a significance level of $p < 0.05$ demonstrates a statistically significant and positive correlation. Thus, the overall analysis confirms that the Learner Feedback Form is both statistically reliable and valid.

Given the >0.70 Cronbach's Alpha values across three factors (relatability to the context, usability, engagement & immersion) and Pearson Correlation above 0.80 with regard to perceived learnability, the learner feedback form can be considered a valid and reliable instrument for collecting learner insights in future studies. However, further research using test-retest reliability and factor analysis could provide deeper insights into its construct validity.

7.5 Pilot Study on 60 nurses based on 2D photographic Intervention

The game was tested on the 60 nurses, and a 12-item learner feedback form based on a 7-point Likert scale was administered as a post-test.

Table 7.4: Test of Normality of Learner Feedback Data.

Kolmogorov-Smirnov ^a			Shapiro-Wilk		
Sc	df	Sig.	Statistic	df	Sig.

Context Specificity	.229	60	<.001	.831	60	<.001
Usability	.234	60	<.001	.731	60	<.001
Engagement & Immersion	.176	60	<.001	.852	60	<.001
Perceived Learnability	.310	60	<.001	.709	60	<.001

Data is <.05 therefore not following normal distribution.

The Kolmogorov-Smirnov^a and Shapiro Wilk test was performed, and as shown in **Table 7.3**, the value of data was found to be 0.001 (p<0.05) and not found to be following normal distribution; therefore, a non-parametric test – Chi-Square test was performed to test the hypothesis that game-based learning is an effective tool to teach empathy to Indian Nurses.

The Kolmogorov-Smirnov (KS) test and the Shapiro-Wilk (SW) test are normality tests that assess whether a given dataset follows a normal (Gaussian) distribution (Ghasemi & Zahediasl, 2012). These tests are critical in determining the appropriate statistical analysis methods, as parametric tests require normally distributed data, while non-parametric tests do not. The Chi-Square (χ^2) test is a non-parametric statistical test used to determine whether there is a significant association between categorical variables (Pearson, 1900).

Table 7.5: Chi Square Test based on Learner Feedback Results.

	Context Specificity	Usability	Engagement & Immersion	Perceived Learnability
Chi-Square	66.600 ^a	92.533 ^b	63.500 ^c	113.333 ^d
df	8	10	12	7
Asymp. Sig.	<.001	<.001	<.001	<.001

a. 0 cells (0.0%) have expected frequencies less than 5. The minimum expected cell frequency is 6.7.

b. 0 cells (0.0%) have expected frequencies less than 5. The minimum expected cell frequency is 5.5.

c. 13 cells (100.0%) have expected frequencies less than 5. The minimum expected cell frequency is 4.6.

d. 0 cells (0.0%) have expected frequencies less than 5. The minimum expected cell frequency is 7.5.

The Chi-Square test as reflected in **Table 7.4**, showed a statistically significant result (p <.001) along the dimensions of contextual specificity, engagement and immersion, usability, and perceived learnability. It was found that 85% of the nurses had rated the game >5.5 on Contextual Specificity, 86.67% of nurses had rated the game >5.5 on engagement and immersion, and 85% of nurses had rated the game at >5.5 on Usability and 81% nurses had rated the game >5.5 on perceived

learnability (Fig.7). It was concluded that this population felt that the game prototype was found to be effective in all four dimensions.

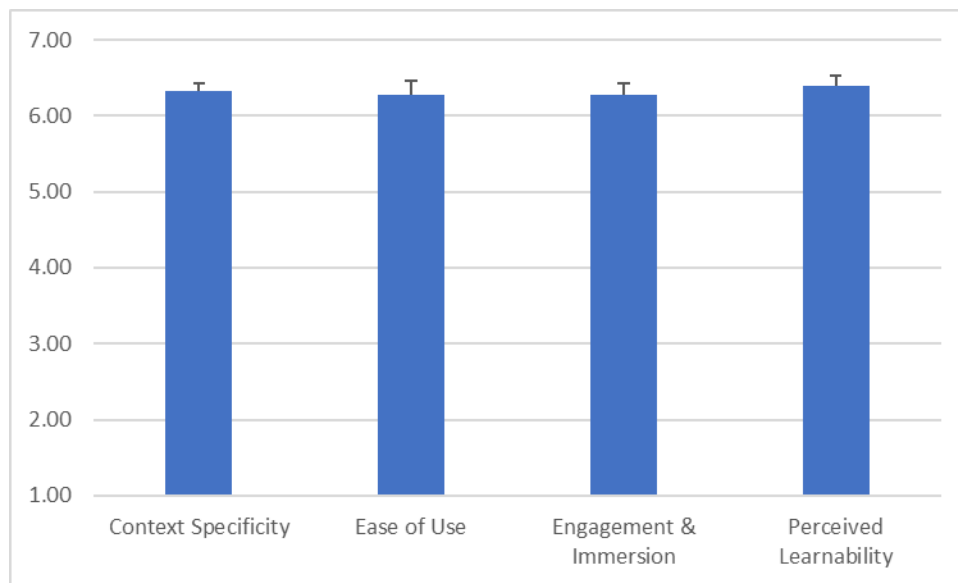


Figure 7.3. Comparison of Mean on four Dimensions of Learner Feedback.

A statistically reliable result of $p > 5.5$ was derived, along the dimensions of usability, contextual specificity, engagement, and perceived learnability. Therefore, the probability of acceptance of the null hypothesis was found to be low and it can be concluded that the prototype is aligned to the context and achieves its goals.

The pre-test and post-test empathy scores of 20 nurses were compiled after the nurses were exposed to the game environment. As the data did not follow normal distribution, the Wilcoxon Signed-Rank Test was performed. The Wilcoxon Signed-Rank Test is a non-parametric statistical test used to compare two related (paired) samples to assess whether their population median ranks differ (Wilcoxon, 1945).

It was observed that there were statistically significant differences in pre-test and post-test empathy scores [$Z(19) = -3.753$; $p < 0.001$]. The mean empathy score among 19 of the 20 Indian nurses increased after exposure to the 2D virtual environment ($M = 5.4844$, $SD = 0.82$) than the initial pretest empathy scores ($M =$

4.65, SD = 0.70). It was also concluded that this population felt that the game prototype was effective in building empathy among Indian Nurses.

Table 7.6. Wilcoxon Standard Rank Test. Pre-test and Post-test Empathy comparison

	N	Mean	Std. Deviation	Minimum	Maximum
Pre-test Empathy	20	4.6544	.69515	1.87	5.30
Post-test Empathy	20	5.4844	.81990	2.93	6.67

7.6 Learner feedback on 3 Interventions

A comparative study was conducted on 120 nurses from the emergency, gynecology, cardiology and oncology wards using three interventions, deployed on three different platforms and another batch was the control sample. The interventions included three games 1. 2D photographic game on mobile; 2. 360 VR live action game on desktop; 3. 3D VR game on Oculus Quest 2; 4. No intervention or Control.

The 12 item Learner Feedback questionnaire was bifurcated into four factors – Relatability to the Context, Usability, Engagement & Immersion, Perceived Learnability.

The data gathered did not follow normal distribution as per the Kolmogorov-Smirnov^a and Shapiro-Wilk test. Test normality significant values were all lower than 0.05 as shown in **Table 7.6**. Therefore, non-parametric tests such as Kruskal-Wallis and Mann-Whitney Test were conducted for comparison of the feedback on interventions.

Table 7.7. Tests of Normality.

	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Usability	.203	90	.000	.771	90	.000

Relatable to the Context	.193	90	.000	.880	90	.000
Engagement and Immersion	.177	90	.000	.861	90	.000
Perceived learnability	.355	90	.000	.716	90	.000

Kruskal-Wallis Test based on Learner Feedback on 3 interventions

The Kruskal-Wallis Test was conducted to calculate the mean rank across the parameters of Usability, Relatability to the Context, Engagement and Immersion and Perceived Learnability across three interventions. The Kruskal-Wallis test is a non-parametric statistical test used to determine whether there are significant differences between three or more independent groups (Kruskal & Wallis, 1952). The mean rank of intervention 1 (2D Photographic on Mobile) was found to be significantly higher across parameters, followed by intervention 3 (3D VR on Oculus Quest 2) and then intervention 2 (360 VR on desktop) as shown in **Table 7.7**. The most significant difference among the four factors was on Usability, where Intervention 1, 2D photographic game on the mobile showed a mean rank of 59.44 as opposed to Intervention 3, 3D VR at 47.00 and the lowest being Intervention 2, 360 VR at 31.30. **This suggests that nurses are more comfortable playing a 2D photographic game on a mobile, rather than other formats and platforms where there is a learning curve involved.**

Table 7.8. Kruskal Wallis Test – Learner Feedback on 3 Interventions.

	Proto_types	N	Mean Rank
Usability	1	27	59.44
	2	30	31.30
	3	33	47.00
	Total	90	
Relatable to the Context	1	27	55.13
	2	30	39.07
	3	33	43.47
	Total	90	
	1	27	55.91

Engagement and Immersion	2	30	37.00
	3	33	44.71
	Total	90	
Perceived learnability	1	27	56.17
	2	30	37.72
	3	33	43.85
	Total	90	

There was found to be significant variability in the mean across the three interventions and four factors, especially in terms of Usability.

Table 7.9. Test Statistic.

	Usability	Relatable to the Context	Engagement and Immersion	Perceived learnability
Chi-Square	17.472	5.915	7.689	9.398
df	2	2	2	2
Asymp. Sig.	.000	.052	.021	.009

There is a significant mean difference in Usability [$\chi^2 (2) = 17.472; p < 0.001$] due to types of interface design interventions (Mobile App vs. 360 VR vs. 3D VR) used by Indian nurses to improve the empathy during treatment of patients.

There is a mean difference in Relatability to the context [$\chi^2 (2) = 5.915; p < 0.001$] due to types of interface design interventions (Mobile App vs. 360 VR vs. 3D VR) used by Indian nurses to improve the empathy during treatment of patients.

There is a mean difference in Engagement and Immersion [$\chi^2 (2) = 7.689; p < 0.001$] due to types of interface design interventions (Mobile App vs. 360 VR vs. 3D VR) used by Indian nurses to improve the empathy during treatment of patients.

There is a mean difference in Perceived Learnability [$\chi^2 (2) = 9.398; p < 0.001$] due to types of interface design interventions (Mobile App vs. 360 VR vs. 3D VR) used by Indian nurses to improve the empathy during treatment of patients. **The 2D**

mobile game was considered the highest in terms of all four factors, followed by 3D VR and the lowest being 360 VR. This may help us conclude that there is ease of use, usability and engagement where there is the highest sense of comfort with the technology and platform. 3D VR is ranked second on all parameters due to the novelty of the platform as many nurses were using the platform for the first time. The 360 VR was lowest among the three in nurses' perception, although they were moderately familiar with the desktop-based platform to experience it and live actors were used.

7.7 Analysis of pre and post-test Empathy scores

Pre-Test and Post-Test was performed using the New Empathy Scale before and after the interventions (Control, 2D Photographic, 3D VR and 360 VR) and due to the non-parametric data available, the Kruskal-Wallis Test was performed on the results.

Table 7.10. Kruskal Wallis Test – Empathy Score.

	Condition	N	Mean Rank
IEENV	1	24	53.92
	2	45	47.91
	3	11	59.41
	4	22	52.25
	Total	102	
EMPMO	1	24	42.38
	2	45	52.37
	3	11	56.14
	4	22	57.36
	Total	102	
INSRES	1	24	58.71
	2	45	54.42
	3	11	44.32
	4	22	41.25
	Total	102	
EMO	1	24	40.75
	2	45	50.63
	3	11	59.95

	4	22	60.77
	Total	102	
	1	24	51.02
	2	45	44.80
COGN	3	11	60.00
	4	22	61.48
	Total	102	

**Intervention 1 is Control, Intervention 2 is 2D Photographic, Intervention 3 is 3D VR and Intervention 4 is 360 VR*

The 2D photographic mobile based intervention had the highest impact on empathy score across most factors. However, the mean rank for emotion related to empathy in 360 VR and 3D VR was higher than 2D in some factors such as empathetic motivation (EMPMO) and reverse coded data of Cognitive Negative (COGN) which was more about the nurse's own feelings on empathy and the importance of knowing the emotions of patients, thus indicating that these media evoke a higher emotional response and involvement in learners.

7.8 Gender-wise Analysis of Results

The game interventions were tested on 90 nurses (36M and 64F) and the 12-item learner feedback form was administered. Based on the test results gathered, test of Normality for the data was conducted using the Kolmogorov-Smirnov^a and the Shapiro Wilk tests, and the results were found to be 0.001 (less than 0.05) therefore not following normal distribution. Based on this the non-parametric Mann-Whitney Test was conducted to determine which gender liked the game better across three mediums (2D photographic, 360 Live Action, 3D VR); and the four dimensions of usability, engagement and immersion, relatability to context and perceived learnability.

Table 7.11. Mann-Whitney Test – ranking between Female and Male nurses based on test results on the 2D photographic game. (Female is gender 1 and Male is gender 2).

	Gender	N	Mean Rank	Sum of Ranks
Usability	1	15	14.20	213.00
	2	12	12.55	138.00

	Total	27		
Relatable to the Context	1	15	14.37	215.50
	2	12	12.32	135.50
	Total	27		
Engagement and Immersion	1	15	13.97	209.50
	2	12	12.86	141.50
	Total	27		
Perceived learnability	1	15	15.20	228.00
	2	11	11.18	123.00
	Total	27		

Table 7.12. Mann-Whitney Test – ranking between Female and Male nurses based on test results on the 360 Live Action game. (Female is gender 1 and Male is gender 2).

	Gender	N	Mean Rank	Sum of Ranks
Usability	1	21	18.10	380.00
	2	12	15.08	181.00
	Total	33		
Relatable to the Context	1	21	18.00	378.00
	2	12	15.25	183.00
	Total	33		
Engagement and Immersion	1	21	18.36	385.50
	2	12	14.63	175.50
	Total	33		
Perceived learnability	1	21	18.98	398.50
	2	12	13.54	162.50
	Total	33		

Table 7.12. Mann-Whitney Test – ranking between Female and Male nurses based on test results on the 3D VR game. (Female is gender 1 and Male is gender 2).

	Gender	N	Mean Rank	Sum of Ranks
Usability	1	17	16.15	274.50
	2	13	14.65	190.50
	Total	30		
Relatable to the Context	1	17	15.44	262.50
	2	13	15.58	202.50
	Total	30		

Engagement and Immersion	1	17	17.71	301.00
	2	13	12.62	164.00
	Total	30		
Perceived learnability	1	17	16.68	283.50
	2	13	13.96	181.50
	Total	30		

Based on the test results on a confidence level of 95% it was determined that the female nurses preferred the role-playing game on all four dimensions across three game formats and delivery platforms over and above the male players. This emphasized the fact that the genre or type of game has a significant influence on the response of the participants. Although in the 3D VR game on dimensions of “usability”, “relatability to context” the gap between male and female nurses was far less, indicating that males were finding this format easier to relate to and more user-friendly due to the immersive and tactile nature.

In the reflective discussion after all the tests were conducted, nurses shared the following comments, affirming the belief that GBL is an effective approach for building soft skills such as empathy. Although many had not played games before, they felt it was an engaging experience overall and they would like to use games as a learning intervention in the future. Some of the qualitative comments from the nurses included:

“This scenario felt real – as if I was really talking to my patients, because at times, my patients are also tired due to long term treatment and are aggressive, however we have to control our aggression and show empathy towards them.”

“This scenario taught us to be empathetic towards patients and by doing so we can counsel the patient and can provide a sigh of relief even in terminally ill disease conditions.”

“It was great experience learning through a nurse-patient scenario in this game. It is definitely going to help me in communicating with patients correctly while breaking bad news or while consoling patients going through a difficult situation.”

“The content of scenario is good, scientific, and a realistic representation of a nurse-patient relationship.”

“The scenario has taught me how to be calm and deal with such a scenario.”

“I learnt how to communicate better with patients”.

“I learnt that empathy is important while caring for patients”

“I learnt how to understand the patient’s feelings better”.

CHAPTER 8: DISCUSSION, LIMITATIONS, FURTHER EXPLORATIONS AND CONCLUSION

8.1 Overview

The overall objective of this investigative study was to determine the Effectiveness of Immersive media such as Game-based learning and Virtual Reality in building Empathy in Indian Nursing Professionals. Empathy, the ability to understand the needs of another individual is critical in the nurse-patient relationship for patient well-being, motivation and improved clinical outcomes. However, in the Indian hospitals and nursing context there are multiple barriers towards practising empathy. This investigative study included multiple phases including a review of literature, design of three game interventions, design of an Empathy Scale and a Learner Feedback form aligned to the Indian nursing context, pilot testing of a game prototype and finally a comparative study on the three types of game interventions. This concluding chapter includes a discussion and analysis of the research findings vis-à-vis existing studies, highlights some of the limitations of the research and identifies the key contributions and possible future directions this research can take.

8.2 Discussion

Through this investigative journey of four and a half years, which included the study of several peer reviewed papers, books, interviews, focus group discussions, as well as a multi-dimensional empirical research, it was gradually proven that empathy is a critical attribute in healthcare professionals, especially in Nursing Professionals who provide clinical support as well as care to patients and their families at multiple stages in the treatment journey (KA Brown, 1990). Taking time to understand patient's needs and instilling trust as an important pillar in the intricate therapeutic balance between patients and their caregivers (Rutherford, 2014). There are 3 elements of empathy including the cognitive, affective and behavioural components of empathy (Hojat et al., 2002) and the focus of nursing education should be on embodying these elements of empathy as opposed to practising sympathy which may not have the same level of impact on the patient's

well-being and may also lead to burnout in the nurses (Chichra, 2019; Wilkinson et al., 2017).

It was also proven that nurses in India face multiple barriers towards practicing empathetic behaviour with patients, such as their own upbringing, lack of empathetic education systems, lack of training, stress due to shortage of resources, non-supportive work environments, cultural factors (Chhugani & James, 2017; IndiaSpend Team, 2020).

Apart from the cultural context, gender, age and experience influence the degree of empathy practised by Indian Nurses. Studies have proven that women have a higher aptitude for practicing empathy and the level of empathy is directly proportional to the experience of the nurse (Ghaedi et al., 2020b).

Different instruments for measuring empathy, especially in the healthcare context were studied, revealing that though they are globally recognized and widely used, they do not address the cultural context of Indian Nurses and hospital scenarios (Gonnella et al., 2022). Additionally, most of these instruments do not address all components of empathy such as cognitive, affective, behavioural, motivational aspects (Hojat et al., 2023; Hojat & Gonnella, 2015). They are all mostly filled by the healthcare professionals themselves therefore findings would also be impacted by self – report bias (Mercer et al., 2004) .

Through the pilot studies conducted, it was determined that game-based learning and VR are effective tools for building empathy among nursing professionals. However, results can vary depending on the genre, treatment and storyline of the game (Eric B Bauman, 2013). They would also vary based on the delivery platform and user-friendliness of the device on which they are delivered as observed in the empirical study. The comparative study of three types of interventions, 2D photographic on mobile, 360 Live Action on desktop and 3D VR on the Oculus Quest concluded that on most parameters it was found that the effectiveness of intervention 1 (2D Photographic on Mobile) was significantly higher across parameters, followed by intervention 3 (3D VR on Oculus Quest 2) and then intervention 2 (360 VR on desktop)

2D photographic game-based approaches may be more effective on most parameters than their more immersive and realistic VR and 360 live action counterparts due to learners' familiarity with the medium. At the same time, platforms such as VR or Immersive 360 live action videos may have a longer-term impact on the emotional aspect of empathy as well as a stronger sense of walking in another's shoes and feeling a patient's pain, due to the immersive nature of VR (Dean et al., 2020) .

Based on this study, while VR-based formats have a sense of novelty and provide a high-fidelity visual experience – mobile based, 2D games score higher in terms of ease of use, relatability to context, engagement and immersion as well as perceived learnability among Indian Nurses. At the same time the 360 VR and 3D VR interventions are found to be more effective in building empathy skills in a few parameters such as emotional response to patient's feelings and needs and sense of presence or walking in patient's shoes.

While the pre and post empathy surveys administered in this study reflected an improved empathy score after the administration of the game prototypes, it is also concluded that one scenario alone cannot have a long -term impact the empathy level in nurses. Multiple scenarios of different complexity levels randomly generated and supportive of repetitive play can have a more sustainable impact on nurse's ability to practise empathetic behaviour with patients (Munjas, 1985; Oshvandi et al., 2016).

While VR is an effective medium for teaching clinical, procedural as well as soft skills such as empathy, factors such as giddiness and motion sickness on extended use should be kept in mind while designing a game or simulation(Munafo et al., 2017). For game-based learning and VR to be effective it is also imperative to keep cognisance of the instructional design models such as the ADDIE model (Chen & Teh, 2013; Roungeas, 2016), Kolb's model (A. Y. Kolb & Kolb, 2005; D. A. Kolb, 1984) while designing the game (Stavroulia & Lanitis, 2019). While the novelty and multimedia elements are important to consider, the core learning objectives should be outlined at the beginning and the learning should be assessed

at the end through a reliable assessment tool. Brenner's novice to expert theory (Munjas, 1985) should be considered in terms of building repetitive practice and engaging elements into the learning journey in order to ensure mastery in the skill that is being taught. A single scenario may not be sufficient in creating a long-term impact or behavioural change. Multiple scenarios of different complexity levels may be required to create a comprehensive learning experience. The game, simulation or VR experience should also be included as a part of a blended learning experience, interwoven with lecture and practical components so that it is easier for the learner to transition with the new learning to implement successfully in the real-world context.

A significant portion of recent research assumes that VR is superior for empathy due to its immersive nature (Foronda et al., 2017; Steenstra & Erkoyuncu, 2014) however this study proves that mobile games may be more effective due to factors such as greater user comfort, reduced cognitive overload and the possibility of longer play durations. VR games often require higher cognitive and sensory processing, which may hinder the emotional and reflective aspects of learning. The study may prove that mobile games, being simpler and more structured, allow learners to focus more on emotional connections rather than technical challenges. This can refine our understanding of cognitive load theory (Kirschner et al., 2018) in serious gaming, especially in soft-skill training like empathy. Future research may also investigate optimal levels of immersion for different types of learning, leading to better-designed educational games.

This study has also proven that GBL can be effectively harnessed for demystifying difficult concepts such as empathy, however gender differences should be considered while designing game-based interventions. Men are more likely to enjoy competitive games that involve action (Hartmann & Klimmt, 2006b). On the other hand, women are more inclined towards games which emphasize problem-solving, narrative, social interaction, and collaboration (Lucas & Sherry, 2004). These preferences suggest that gender-specific game elements could enhance the effectiveness of GBL (Chung & Chang, 2017).

Implementing gender inclusive game-based learning models requires a thorough understanding of learner preferences and learning styles (A. Y. Kolb & Kolb, 2005). Educators should gather feedback from learners as a critical input during the design of game-based activities and ensure that both genders benefit equally from the learning experience (Nietfeld et al., 2014).

The results of this study could also conclude that female nurses understand the importance of empathy better or are motivated to adopt game-based learning as a tool for empathy learning, regardless of genre. Future research should continue to explore gender dynamics in game-based learning to further refine educational strategies and enhance learning outcomes for all students (Lukosch et al., 2017). Considering that male nurses found it easier to relate to the VR interface, future research could also consider Hybrid Learning approaches (Stone, 2018) that combine the best elements of mobile and VR gaming – where mobile games serve as the primary platform while VR is used sparingly for emotional immersion, or for high intensity scenarios that the learner may progress to.

8.3 Limitations of this Research

While this study overall proved the effectiveness of immersive media such as GBL and VR in building empathy among Indian Nurses, there were certain limitations of this study in terms of the measurement instruments, sample population and type of interventions which are highlighted in this section. These limitations have been identified to provide further insights into the research findings and also provide opportunities for further explorations and studies in this area.

The new empathy scale created for this study addressed multiple aspects of empathy such as the cognitive, affective and motivational dimensions and considered the Indian context in terms of upbringing, education and the challenges of the Indian Hospital scenario. However, this is a self-reported scale and may encounter a self-report bias, wherein the nurses could provide socially acceptable and positive answers rather than reflect what their actual behaviour would be in real

clinical settings (Krumpal, 2013). This limitation is like the tools for empathy studied in section 2.7 during the review of literature. A possible further exploration could be to include physician and patient feedback on the changes in a nursing professional's behaviour after they have played the empathy game.

Another limitation of this study is that it primarily considered the Indian nursing professionals, however other health professionals such as doctors, mental health specialists, lab technicians, allied health workers and other stakeholders that the patient may encounter in their treatment journey, are not considered. The study also does not consider the patient perspective - getting into the patient's shoes can provide an interesting opportunity to understand the challenges faced directly from their point of view, however the game interventions used in this study are only focused on the nurse's lens.

These games created for this research include only one scenario of a nurse interacting with a female patient with stage 3 breast cancer. However, to build proficiency in any skill, including empathy, multiple rounds of practice in diverse scenarios of varying complexity are needed.

All three games used in this study followed only one plot, storyline and game mechanics. It was already determined through literature review and further through this empirical study, that female nurses prefer the narrative based game-based interventions whereas men prefer more competitive game formats. There is potential at a later stage to study the relative effectiveness of different genres of games on both genders of nurses' empathy.

Although the research on the scenarios considered nurses from the Emergency, Cardiology, Oncology and Gynaecology wards to address diversity, it was primarily conducted in one location, AIIMS Rishikesh. A multilocal study would have helped to cover regional and contextual variations single-location studies might overlook (Bronfenbrenner, 1979). These variations could be due to economic, educational, technological, or policy differences. As further research multiple types of hospitals including private hospitals, clinics, nursing colleges could be considered as a part of the research to study the impact that the size of the

hospital, the culture and the economic strata it belonged to would have on the empathy scores of nurses.

Although the Randomized Control Trial Method (RCT) method was used for all the tests, there are certain limitations that the test poses. Empathy is a multidimensional and complex construct that includes the emotional, cognitive, and behavioral components (Stepien & Baernstein, 2006). Unlike drug trials with clear outcome measures, empathy lacks objective, quantifiable metrics (WRIGHT et al., 2020). Most RCTs rely on self-reported surveys or patient evaluations, which can introduce social desirability bias and subjective variability.

Empathy in nursing is also context-dependent and influenced by work environment, patient interactions, and personal experiences (Mercer & Reynolds, 2002). RCTs often attempt to standardize interventions, but this reduces ecological validity because empathy naturally fluctuates based on patient condition, workload, and stress levels. Empathy training also initially improves scores. However, over time, workplace stress and emotional burnout may happen due to real world conditions (Chichra, 2019; P. A. Hunt et al., 2017; Wilkinson et al., 2017)

Lastly the survey instruments and the games used the medium of English, whereas nurses in India speak Hindi as well as their local dialects. While all the subjects considered in this study can speak and write in English, their proficiency in the language could have varied levels, therefore impacting the reliability of the findings. In empathy training for nurses, language is more than just a medium of communication; it is a cultural bridge that influences emotional connection, active listening, and compassionate care (Betancourt et al., 2005; Irwin, 2021). There is potential for exploring multi-lingual versions of the game intervention and research instruments in the future.

8.4 Contributions of this Research and Future Directions

The intent of this research is to contribute meaningfully towards building empathetic behaviour in nurses and in turn improve patient outcomes. Some of the outcomes of this study include a reliable Empathy Scale for the Indian Nursing

Context, a reliable Learner Feedback form for testing effectiveness of game-based learning on nurses, three templates of game design which can be built on to create multiple scenarios and can also be extended to other nursing skills.

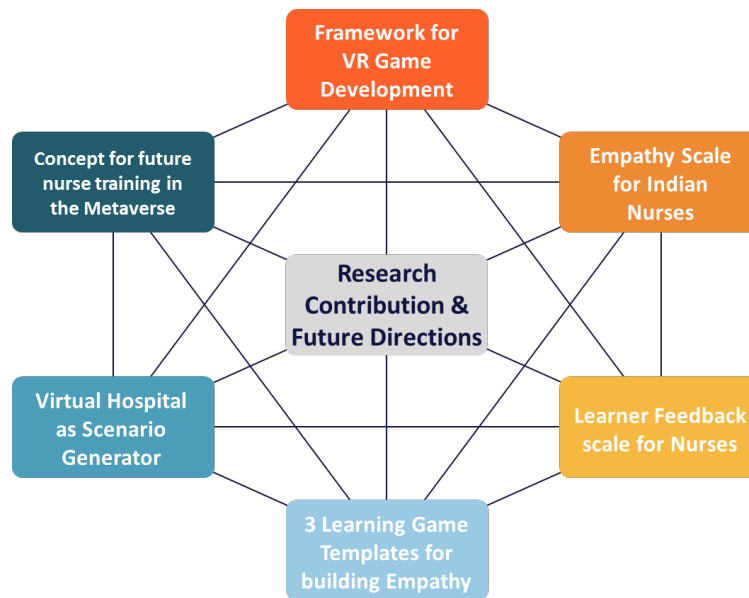


Figure 8.1. Mind map of Research Contributions and Future Directions.

Other than these a framework for creating VR-based simulations for nurses has been developed for future developers.

As this study was limited to a single scenario in a hospital, there is potential to expand this game into a virtual hospital setting which includes patient conditions of diverse complexity levels in different wards of the hospital. This has been further elaborated on in this section.

In the Indian nursing context, many nurses and patients speak their local or vernacular languages, therefore the scales as well as the games could be created as multi-lingual versions in the future.

Additionally, further explorations of this framework could include some of the new and emerging AI tools to generate new scenarios, voice-based interactions (Sinha et al., 2020; York et al., 2021) and the metaverse could be used (Park & Kim, 2022) as a platform to explore immersive, wholistic, inter-disciplinary learning for nurses.

As further research, one could also measure the impact of VR based empathy training for nurses on the learner and on the growth and success of the respective hospital/institution using Kirkpatrick Evaluation.(Carnell et al., 2022). One of the research contributions, a framework for development of a VR Environment in Indian Nursing Professionals and one of the future directions, a Virtual Hospital and Scenario Generator based on this research are described in the next two sections. The following claim table (**Table 8.1**) summarizes the contributions of this research.

Table 8.1. Contributions of this Thesis and related SDG

No.	Contribution	Stakeholder/s	Related SDG
1.	Empathy Scale for Indian Nurses	Indian Nurses	3,4, 10
2.	Learner Feedback form for Indian Nurses	Indian Nurses	3,4
3.	Three game interventions	Indian Nurses	3,4
4.	Virtual Hospital	Healthcare Professionals	3,4
6.	Scenario Generator	Across Industry	9, 17
7.	Framework for building VR based interventions	Designers, Developers of Games and VR content	3, 4, 9, 17

8.5 Research Contribution: A Framework for development of a VR environment for building empathy in Indian Nursing Professionals

A framework has been developed as one of the contributions of this research which captures some of the key decisions taken at different milestones and makes them available for future researchers who would wish to develop more games and VR experiences for learning. Although the framework described in **Figure 8.1** describes the process of developing a VR game for nurses for building empathy, it can also be used for creating learning interventions for other skills for a wider audience.

The study of existing frameworks (Coleman & Money, 2020; Mayer, 2002; Mulders et al., 2020; Stavroulia & Lanitis, 2019) stressed the importance of instructional design in the creation of VR based learning interventions as well as the criticality of choosing the right technology for making VR based learning interventions meaningful and engaging.

In essence the proposed framework considers effectiveness of learning as its core objective. The learning may not be effective unless the learning outcomes are identified at the beginning, the learning is embedded in contexts that the learners can relate to, and the mechanism for assessing and measuring them is clearly defined upfront, as described in John B. Biggs theory of Constructive Alignment (Joseph & Juwah, 2012; Mainka et al., 2005).

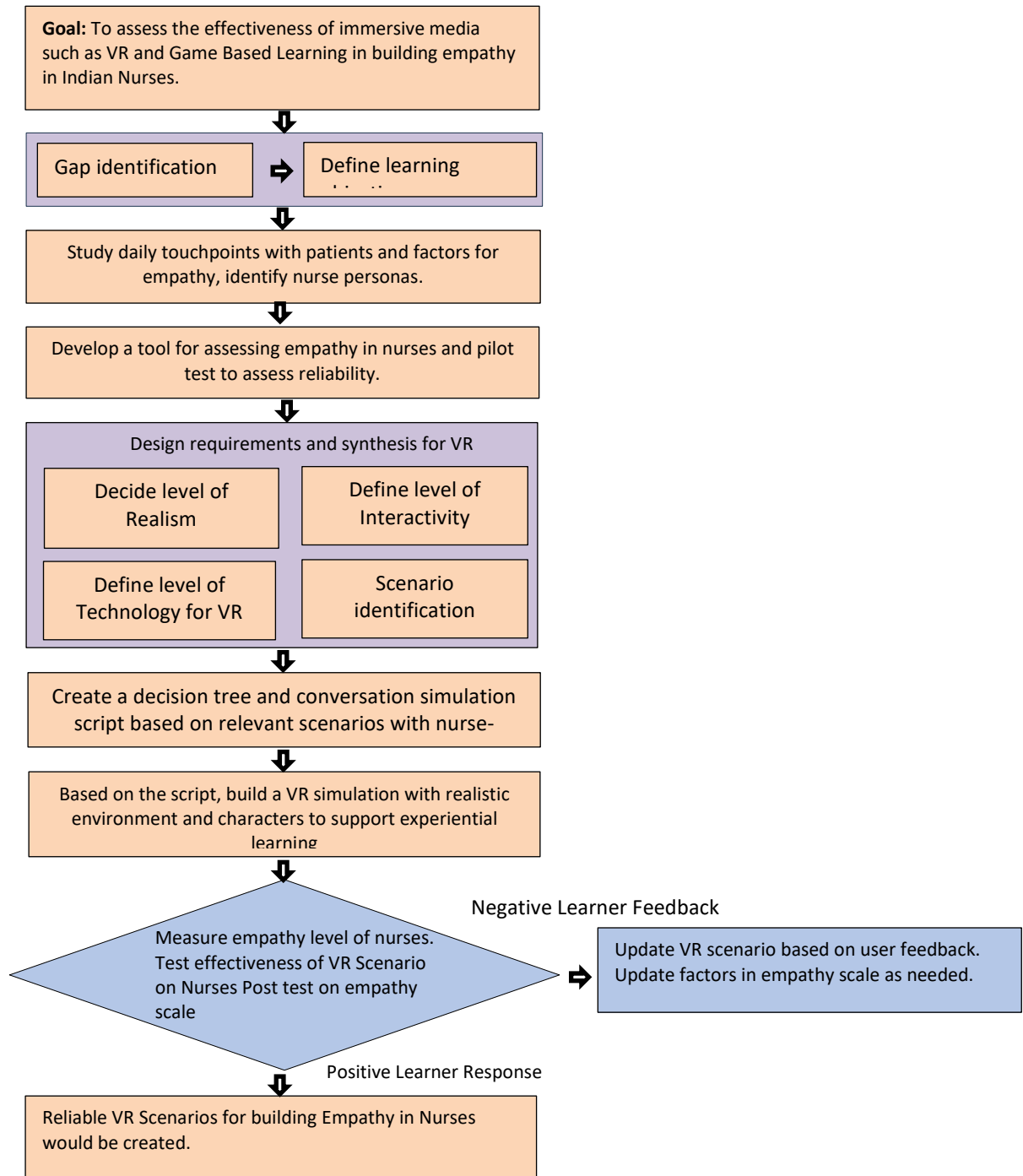


Figure 8.2. Proposed framework for the Development of a VR Environment.

As observed in the **Chapter 7: Results** section of this thesis, usability and complexity of devices needs to be considered for novice users with limited

experience with games. Simpler, phone-based devices such as the google cardboard are more accessible and cost effective, therefore easier to disseminate over a larger population of nurses (Abrash, 2014).

As studied in existing game frameworks, repetitive play and reflection is critical for meaningful learning to occur. Therefore, rather than an individual scenario a scenario bank and scenario generator can be developed which can provide nurses the opportunity to practise empathy in diverse situations (Coleman & Money, 2020)

8.6 Future Explorations: A Scenario Generator and Virtual Hospital

As concluded based on this research, a long-term impact on a nurse's ability to practice empathy would be difficult to achieve through a single scenario. One of the possible future directions for this study would be to design a scenario engine or generator which will allow either the trainer or the nurse to select or randomly generate scenarios from different wards, with different age groups, gender, severity of ailments of patients. This would be like a hospital scenario where nurses encounter a diverse set of challenges daily, however this would be a safe space which offers nurses the freedom to fail and enables them to hone their skills through repetitive practice without harming any patient. This could be an immersive platform that can not only help nurses build empathy skills but could also be open for other healthcare professionals to build multiple other skills across specializations. The data specific to an illness can be updated through an administrator. Personalization of the experience for different learners is possible through artificial intelligence by tailoring it to their competency level and learning style.

- **Scenario:**
- Handling infants and children with varying conditions such as respiratory infections, fevers and minor injuries.
- **Challenge** Dealing with anxious parents, Ensuring children are calm and cooperative. Recognizing more serious symptoms which children cannot communicate. Administering child appropriate medication.
- **Learning Focus:**
Pediatric care, emotional intelligence, and family communication.

3. Maternity Ward (Intermediate Level)

- **Scenario:**
Nurses assist with childbirth and postnatal care, managing both mothers and newborns.
- **Challenges:**
 - Monitoring vital signs of both mother and baby.
 - Assisting during deliveries, including handling complications.
 - Educating new mothers on infant care and breastfeeding.
- **Learning Focus:**
Specialized maternal and newborn care, recognizing complications, and providing emotional support.

4. Emergency Ward (Hard Level)

- **Scenario:**
Nurses work in a fast-paced environment with patients arriving due to accidents, heart attacks, and other critical emergencies.
- **Challenges:**
 - Making quick, accurate decisions under pressure.

- Prioritizing patients based on the severity of their condition.
 - Coordinating with doctors and other staff to stabilize patients.
- **Learning Focus:**
Emergency response, triage, critical thinking, and crisis management.



Figure 8.4. Virtual Hospital for Immersive Learning. (AI Generated)

The navigation through the virtual hospital includes the following steps:

1. Enter login and password

2. User will access further based on three categories – administrator, guide and student. These categories have specific features.

a. Category A: Guide/Admin

Under this category, user gets the access to view/check the enrolled students' progress or marks, assign/re-assign complexity level or assignment to students, can generate scenarios, and/or view cohort performance analytics.

b. Category B: Student

Under this category, the user further gets the option to access the simulator as a new user or the existing user.

If he/she is the new user, he/she creates username and password, and then he/she gets a welcome screen of hospital entrance after successful login. On the welcome screen, he/she is able to choose a language, get the navigation help on VR, get the details about the virtual hospital, and meet his/her virtual mentor. The next step is nurse onboarding to start the features of the present invention which includes guided tour of hospital, introduction to game features, and introduction to challenge through the welcome screen at hospital entrance.

If the user is the existing user, he/she enters username and password, and then he/she gets a welcome back screen of hospital entrance after successful login. On the welcome screen, he/she gets the navigation help on VR, option of progress so far, option of start again or teleport where your left off. The next step would be the new scenario/mission intro to start the features of the present invention which includes guided tour of the hospital, introduction to game features, and introduction to challenge through the welcome screen at hospital entrance.

Features and Navigation

Front, Left, Right, Back Navigation

The hospital can be accessed on a PC or a VR headset. The user will have access to basic navigation in the 3D space via the Front, Left, Right, Back Navigation arrows or the VR hand controllers.

Help and Instructions

Although the navigation will be simple and intuitive, there will be a help icon with instructions on how to use the VR.

Leaderboard

This will track the competitive performance of the Participants. The purpose of this tool is to motivate higher performance by making it visible.

Empathimeter

This will be a tool which will act as a mirror for the nurse on how empathetic she is based on the decisions she takes.

Walk in patient shoes

This feature will be available to nurses so that they can see the experience from the patient point of view.

Medication

The nurse will have medication available to her to administer to the patient depending on the patient's condition.

Contact for Doctor

The nurse can check back with the doctor before taking any major decisions on a patient including medication, treatment etc.

Patient Reports

Before meeting the patient, the nurse is advised to view Patient Reports to learn how to treat the patient.

Nurse Interaction with patients and their families is the indicator to empathetic behavior in different contexts and illness levels. Empathy is assessed through body language, verbal communication, sensitivity to the patient's requirements. The input for the student nurse would be via voice and motion sensors. The nurse's communication skills would be assessed basis cognitive, affective and behavioral

competencies required. Feedback is given at the end of each scenario through an empath meter score.

Learner Pathway

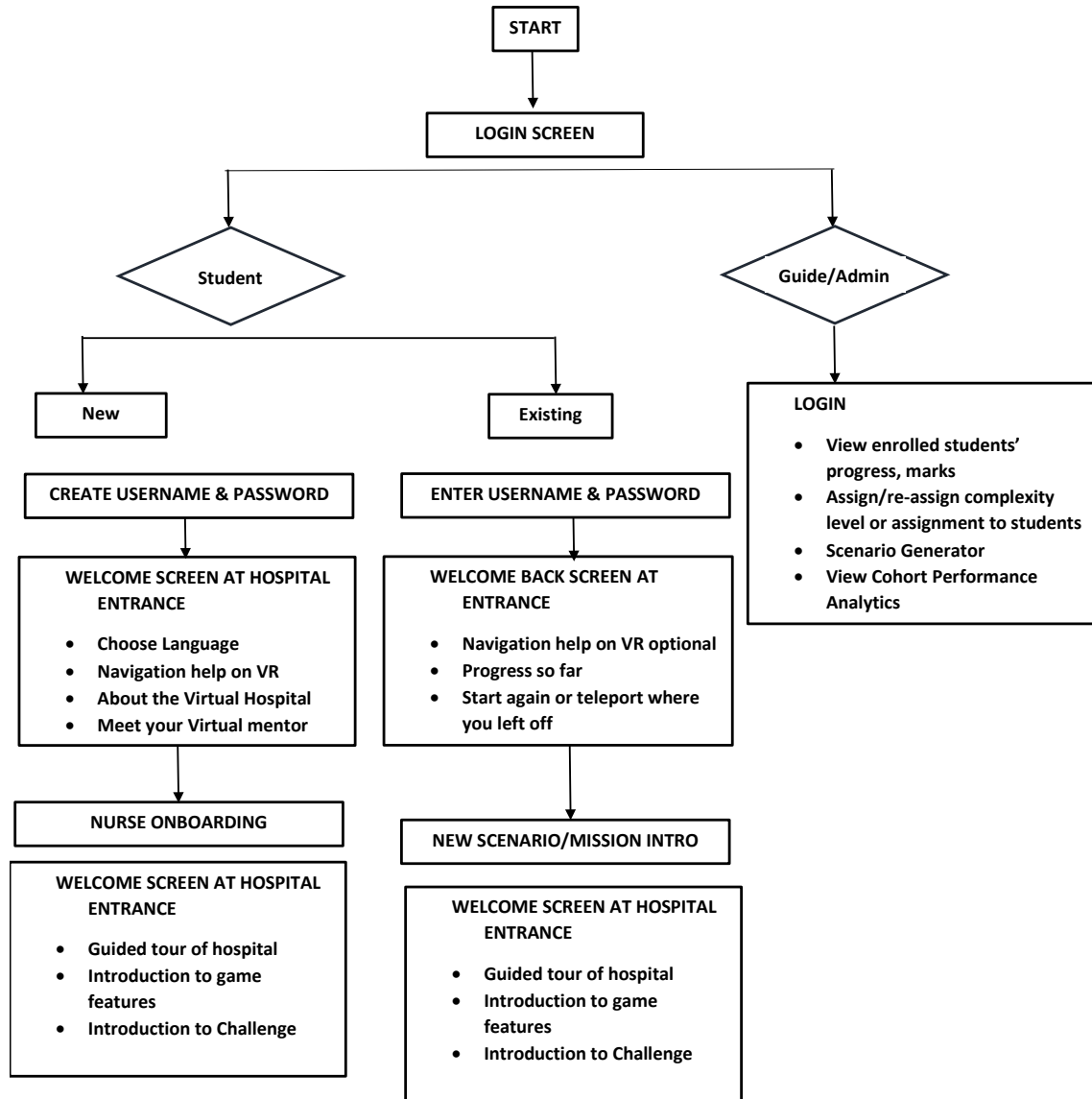


Figure 8.5. Information Architecture for Virtual Hospital.

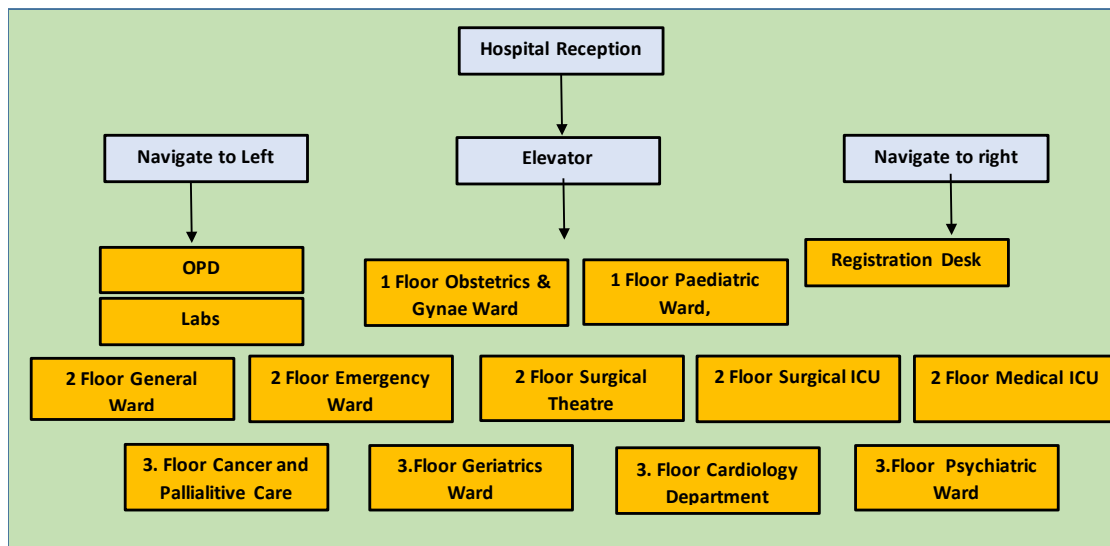


Figure 8.6. Levels and locations for the Virtual Hospital.

Process for Scenario selection:

1. Personalised approach based on aptitude

Based on skill level of nurse and specialization, the relevant scenario will be generated. The difficulty level will gradually increase

2. Instructors' choice

The instructor can choose the scenario for the student based on the capability of the nurse

3. Random approach

Scenarios will be randomly generated – they would vary based on disease, severity, age of the patient.

4. Collaborative approach

The instructor and student nurse can jointly decide on the scenario choices

8.7 Conclusion

This research has been a journey of enquiry into the effectiveness of GBL and VR in building empathy in Indian Nursing Professionals. The findings through literature review, qualitative research as well as empirical study suggest that both

games and VR offer significant scope for enhancing soft skills such as empathy which are crucial for patient wellbeing and positive clinical outcomes. Games provide nurses opportunities to engage in real – life situations and help them get a deeper sense of the emotions and perspectives of patients. VR offers an unparalleled immersive experience, allowing nurses to virtually step into the shoes of patients, thereby enhancing their ability to empathize with multiple patient experiences.

The study highlights that these innovative educational tools can complement traditional training methods, offering a more holistic approach to nursing education in India. By integrating GBL and VR into nursing curricula, educational institutions can better equip nurses with the empathy necessary to deliver patient-centered care and consequently improve patient outcomes. Furthermore, the research underscores the importance of culturally relevant content for the games, as well as measurement instruments for empathy and learner feedback to ensure that they resonate with the unique challenges and socio-cultural contexts of Indian healthcare.

In conclusion, the adoption of GBL and VR in nursing education represents a promising advancement in the development of empathetic healthcare professionals in India. Continued research and investment in these technologies will be essential to maximize their potential, ensuring that Indian nurses are not only skilled in clinical practices but are also compassionate caregivers who can meet the emotional needs of their patients.

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APPENDIX A: Publications

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NAME: MANISHA MOHAN

Name of Publication	Authorship	Indexing	Status
Mohan, M., Chowdhury, A., & Sharma, S. K. (2022). <i>Development of an Effective Scale for Measuring Empathy of Indian Nurses</i> . Lecture Notes in Networks and Systems, 391. https://doi.org/10.1007/978-3-030-94277-9_33	First	SCOPUS	Published in 2022
Mohan, M. Agrawal A., Kumar N, <i>A Framework for development of a Virtual Reality environment for building empathy in Indian Nursing Professionals, International Health Informatics Conference. Lecture Notes in Networks and Systems. Proceedings of the International Health Informatics Conference: IHIC 2023 SpringerLink</i> ISBN:978-981-97-7189-9	First	SCOPUS	Presented on Oct 17 th 2023 at Health Informatics conference Published in 2024
Mohan M, Passi V, Mohan L, Sandhya P, Agarwal A, Chowdhury A, Kumar N., Sharma R. <i>Empathy Development through Game-Based Learning: An investigative study on Nursing Professionals – Journal Nurse Education Today</i> Empathy development through game-based learning: An investigative study on nursing professionals - ScienceDirect	First	SCOPUS. PubMed	Accepted, Published 2024
Mohan, M. (2022). <i>Nursing Education Through Virtual Reality: Bridging the Gap. In Encyclopedia of Computer Graphics and Games.</i> https://doi.org/10.1007/978-3-319-08234-9_413-1	First		Published in 2022
Rawat, R., Sharma, S. K., Gupta, R., Mohan, M., & Sharma, D. K. (2022). <i>Empathic communication</i>	Third	ICI, National	Published in 2022

<i>skills: A methodological study to develop a validated video.</i> Indian Journal of Continuing Nursing Education, 23(2), 159. Indian Journal of Continuing Nursing Education (lww.com)		Science Library	
Pandey S., Mohan M., Chowdhury A., <i>Designing a VR Game for Building Empathy in Indian Nurses,</i> International Journal of Engineering Research and Applications 0120701119125.pdf (ijera.com)	Second	UGC Care	Published in 2022
Mohan, M., Nerurkar, K. (2021). <i>Metaverse – The Next Generation Classroom</i> Firstsource Metaverse – The Next Generation Classroom Firstsource	First	Industry Publication	Published in 2021
Mohan, M. (2021). <i>Design Considerations for an Immersive World.</i> CII STRIDE – a Journal of Technology Leadership and Innovation Management CII STRIDE_Vol 2_2022_Digital_Circulation.pdf (ciitechnology.in)	First	Industry Publication	Published in 2021
PUBLICATIONS IN PROGRESS			
Mohan M, Passi V, Mohan L, Sandhya P, Agarwal A, Chowdhury A, Kumar N., Sharma R. <i>Gender differences in response to Virtual Reality and Game-based Learning in Indian Nurses – ICoRD ‘25</i>	First	SCOPUS	Presented at Conference Publication accepted
Mohan M, Chowdhury A., <i>A System for Empathy Measurement for Nurses based on Virtual Reality.</i> Application No:202211038213	First	Patent	Published, In progress

APPENDIX B: Cancer Role Play

Text	Points	Link	Filename	Emotion
Scene #1				
 Hello nurse, there is a patient who has just been diagnosed with cancer. She is distressed, please support her and let her know the way forward on her treatment.			S01C	Normal 
 Sure ma'am I will attend to her right away.		#2	S01R01	
 Certainly, ma'am, I hope she is not alone. Let me look at her reports and understand her condition better.	6	#3	S01R02	
 I'm sorry all beds in the ward are full, I don't have time to talk to her, ma'am.	-3	#4	S01R03	
Scene #2				
 Don't you want to understand her condition better?			S02C	Puzzled 
 Yes ma'am, please tell me, what stage of cancer is this?		#10	S02R01	

→ I had already checked ma'am, I believe 5 #5 S02R03
it is stage III breast cancer. I will talk
to her and guide her on the next steps.

→ Ma'am - the doctor will take care of -3 #4 S02R04
the treatment anyway. There is so
much work, I don't have time for this
ma'am.

Scene #3

		S03C	Happy
I always appreciate your commitment to your patients. Here is the file, please note that she is also hypertensive.			

→ Certainly I will keep that in mind. #5 S03R01
Thank you Ma'am.

Scene #4

	I am disappointed, however, please go	S04C	Unhappy
ahead. Caring for patients is an			
important part of a nurse's job			

→ I'm sorry ma'am - but I need to go. #11 S04R01

Scene #5

	Crying			S05C	Unhappy
→	Hello Ms Sheela, how are you?	5	#6	S05R01	
→	Please stop crying, you are disturbing other patients	-3	#8	S05R02	
→	Are you the breast cancer patient, Ms Sheela?		#9	S05R03	

Scene #6

	OK!			S06C	Unhappy
→	My name is Komal, I am a nurse. I am very sorry to learn about your cancer.		#7	S06R01	
→	Hello Ms Sheela please calm down!	-3	#8	S06R02	
→	My name is Komal, I am a nurse and I am here to talk to you about your condition. I can understand how you are feeling after being diagnosed with stage III breast cancer	7	#7	S06R03	

Scene #7

	You cannot understand my condition, I will die soon.			S07C	Angry
					
→	Please calm down. You will not die if you listen to me carefully.	-3	#28	S07R01	
→	You must feel so hopeless. But I can feel the pain you are feeling, but there is a treatment that will help you improve your condition.	7	#14	S07R02	
→	I feel so sad looking at you. Patients in your condition do face the risk of death.		#18	S07R03	

Scene #8

	Please leave me alone!			S08C	Angry
					
→	OK I will do that, I get worried when I see patients in your condition.		#12	S08R01	
→	No, wait let me understand your condition better.	7	#6	S08R02	
→	Stop shouting! I am also taking out time to help you.	-3	#4	S08R03	

Scene #9

 Well yes, what do you want? Who are you? S09C Unhappy 

→ I am Nurse Komal. Please stop -3 #8 S09R01
disturbing other patients with that
crying.

→ My name is Komal, I am a nurse and I 7 #7 S09R02
am here to talk to you about your
condition.

I can understand how you are feeling
after being diagnosed with stage II
breast cancer

→ I want to tell you that a specialist #8 S09R03
surgeon will have to perform a
mastectomy or a surgery for the
affected breast and it according to the
invasion of cancer cells and after the
surgery, chemotherapy and radiation
therapy will also need to be performed
to remove all remaining cancerous
cells

Scene #10

 Stage III and she is hypertensive. Its S10C Puzzled 
important to ask the right questions so
that you understand the patient's

condition better. Please go and talk to her and guide her on the next line of treatment.

→ Ok ma'am. Will keep that in mind next time. #5 S10R01

Scene #11

 S11C Unhappy

 This simulation has ended for you. S11M
Please choose a simulation from the general ward and practice more. It's important to give time to understand the patient's condition and be empathetic towards them to ensure their well being.



Scene #12

 S12C Angry

 Please play this simulation again from the beginning. Try to talk to the patient again. You must first identify yourself and identify and greet the patient calmly. #1 S12M



Scene #14

	No, I don't want to take any treatment. I want to live with my family for the remaining few days of my life.		S14C	Unhappy 
	You are making sense. But the treatment will give you hope for living more.	7	#15 S14R01	
	If you are not planning to take treatment - its going to be painful, and there is no hope for you.	-3	#17 S14R02	
	I feel so sorry for you - and think of the strain you will put on your family too, better you stay here.		#18 S14R03	

Scene #15

	Ok! What is this treatment?		S15C	Unhappy 
	I will get back to you. I need to find out from the doctor.		#19 S15R01	
	In this the doctor will have to perform a surgery named mastectomy or another for the affected breast depending on the extent of cancer	7	#16 S15R02	

cells. And, after the surgery,
chemotherapy and radiation therapy
will remove all remaining cancerous
cells

→ Mastectomy and Chemotherapy. And -3 #18 S15R03
by the way there is this home remedy
you should try, my aunt had used it.

Scene #16

 It must be a very severe cancer that's S16C Unhappy
why all this treatment is being
performed. I know I will die soon. 

→ We all have to die one day. But can -3 #17 S16R01
we get on with it? I have to move to
the next ward.

→ I wish you did not have to go through 7 #20 S16R02
that, but the treatment will have
benefits and a high cure rate too.

→ I feel so sorry for you, it brings me to #18 S16R03
tears. I saw my aunt go through a
pretty painful time.

Scene #17

 Nurse Komal please avoid using such statements and practice empathetic behavior.	S17C	Unhappy 
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 Try Again!	#16 S17M
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Scene #18

 This statement is not correct. Please practise empathy not sympathy. This will drain you out!	S18C	Unhappy 
---	------	--

 Try talking to the patient again.	#16 S18M
---	----------

Scene #19

 Please meet the patient with complete information so that you build their trust.	S19C	Unhappy 
--	------	--

 Ok ma'am.	#17 S19R01
---	------------

Scene #20

 I don't want to go through any treatment. Please discharge me. I only want to go home.	S20C	Unhappy 
--	------	--

 Silence (non verbal cues)	7 #21 S20R01
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→ Looking at your condition I feel like #18 S20R02
crying too

→ If you go home you are going to be a -3 #17 S20R03
burden on your family.

Scene #21

 I know due to this cancer I will lose S21C Unhappy
my beautiful hair and a lot more
painful experiences 

→ I do agree with you. However, your 7 #22 S21R01
hair loss is due to chemotherapy and
radiation therapy. You can use
artificial hair for maintaining your self
esteem and other side effects will be
managed by us.

→ Yes I feel so sorry for you. #18 S21R02

→ Please don't waste time thinking of -3 #17 S21R03
unnecessary things. This is a matter of
life and death!

Scene #22

 OK S22C

→ Its a relief to see you've calmed down. #17 S22R01
I will need to move to the next patient.

→ Now you have to be patient and -3 #29 S22R02
strong. The pain will be less with
turmeric milk (haldi doodh).

→ But for this, you will have to be in 7 #23 S22R03
hospital and manage and start getting
treatment soon for breast cancer. I
have already told you about surgeries,
chemo and radiation therapy. This
combination of treatment will
definitely cure your cancer.

Unhappy



Scene #23

👤 For how long will I have to stay in the
hospital and how long will the surgery
and other treatment take to make me
feel better?

S23C

Puzzled



→ I will make an appointment with the 7 #24 S23R01
Oncologist (doctor) so that if you have
any doubts regarding the treatment and
follow up, you can directly ask him.

→ I do not know - you will need to bear -3 #17 S23R02
with it as long as the treatment lasts.
You ask too many questions.

→ Not much longer. You will be fine #29 S23R03
soon, don't worry.

Scene #24

 OK then why are you wasting my time S24C Angry
if I have to ask him directly. 

→ You are in a tough spot so I am here to 5 #25 S24R01
console you and guide you on the right
treatment.

→ I am also feeling I am wasting my -3 #17 S24R02
time with you. Please talk to the
doctor directly

→ Given your condition I feel so sad, #18 S24R03
Please tell your family member to take
you home.

Scene #25

 OK S25C

→ Chemotherapy and radiation therapy 5 #26 S25R01
have their own side effects, but most
side effects will be managed by the
medical team.

→ Its a relief to see you've calmed down. -3 #17 S25R02
Now I can move to the next patient.

Puzzled



→ Have you talked to your family about #17 S25R03
condition? They must be so sad about
this misfortune.

Scene #26

👤 Ok. It means after taking the treatment S26C
I will be fine and my cancer will be
completely cured?

Normal



→ This treatment will reduce cancer cells 7 #27 S26R01
and with treatment adherence, it will
definitely make you feel better and
live longer

→ Not really - there is no cure for cancer. -3 #18 S26R02
You have to be strong and face your
condition.

→ Yes of course! Don't worry at all. #17 S26R03
After all, my aunt was totally cured.

Scene #27

	You have practised empathy and have completed this simulation successfully!	S27C	Happy 
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Scene #28

	You need to be more empathetic when your patient is distressed.	S28C	Unhappy 
---	---	------	--

	Try again!	#7	S28R01
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Scene #29

	Please do not provide patients with alternate remedies or false hope. All treatment should be factual and recommended by the doctor.	S29C	Unhappy 
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	Please try again.	#22	S29R01
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APPENDIX C: Research in India on Empathy in Nurses

S. No.	Authors	Title	Year	Sample Size	Purpose and Study Design	Gap/Limitations
1.	Chauhan, G.; Long, A.	Communication is the essence of nursing care.1: Breaking bad news.	2000	19 Msc Nursing Students	"This study includes the interaction analysis of a classroom role-play scenario, where students presented and discussed a nursing scenario. The role play was evaluated using theoretical frameworks to guide the analysis."	The study does not explicitly address how cultural diversity among participants affects communication effectiveness. It focuses on communication within a controlled educational setting, which may not fully capture the complexities of real-world healthcare interactions involving diverse populations. Additionally, it is unclear if the findings can be generalized beyond this specific educational context due to the small sample size and the unique characteristics of the participants (new to the country, belonging to minority ethnic groups).
2.	Chauhan G.; Long A.	Communication is the essence of nursing care. 2: Ethical foundations.	2000	19 Msc Nursing Students	'Qualitative analysis of communication themes related to ethical issues (truth-telling and autonomy) from a classroom role-play scenario. This involves integrating theoretical perspectives with practical nursing considerations based on feedback from student discussions.'	The research is confined to a specific educational setting and a small, homogeneous group, which may limit the generalizability of the results to broader, real-world healthcare contexts. The conclusions drawn are also based on subjective interpretations of unique interpersonal interactions, which may not hold universally across different scenarios or cultures. Additionally, the complexity and depth of ethical issues in actual practice may not be fully captured in a simulated role-play environment.
3.	Singh M.		2003		"Descriptive/Conceptual analysis – The abstract appears to outline general principles	The abstract does not specify any empirical data to support its claims, which may limit

					and ethical considerations in neonatology without specifying a particular empirical study or data collection method. It discusses ethical frameworks and suggests educational and policy directions."	the persuasiveness of its arguments. Additionally, while it promotes a utilitarian approach focused on "value for money," it lacks a discussion on the potential ethical conflicts this may create, such as equity in access to neonatal care. The effectiveness and impact of the proposed educational programs are also not demonstrated through data.
4.	Thomas, S.; Vijayakumar, C.; Siva R.; Isaac, R.	Parenting children under three years of age in a south Indian setting.	2007	120 mothers from both rural and urban areas of South India	"Cross-sectional study using structured interviews in homes. Nutritional status assessed by Anthropometry IAP classification and Waterloo's classification, and children's development assessed by the Thiruvananthapuram Development Screening Chart (TDSC)."	The cross-sectional design limits the ability to determine causality between mothers' knowledge, attitudes, and practices and the development outcomes of their children. The study is also geographically limited to South India, which may affect the generalizability of the results to other regions. The impact of potential confounders, such as socioeconomic status or access to healthcare services, is not specified in the description, which could influence the findings significantly.
5.	Sinha A.; Goyal H.; Singh S.; Rana S.P.S.	Quality of life of ostomates with the selected factors in a selected hospital of Delhi with a view to develop guidelines for the health professionals	2009	50 ostomates from the Surgical Oncology OPD at B.R.A. Institute Rotary Cancer Hospital, AIIMS, Delhi	"Correlational survey conducted from 2005 to 2007 using a structured interview schedule. The study aimed to assess the quality of life (QoL) of ostomates, identify factors associated with their QoL, explore the relationships between these factors and QoL, and develop guidelines for health professionals to improve the QoL of ostomates."	The study uses a purposive sampling technique, which may limit the generalizability of the findings to all ostomates or those treated in other settings. The small sample size and the specific hospital setting might also restrict the applicability of the results to a broader population. The study's conclusions primarily emphasize the role of nurses without sufficiently exploring or detailing the efficacy of the developed guidelines for health professionals.

6.	Priyadarsini P.; Bharthvajan R.	Role of emotional intelligence training programme in reducing the stress of the nurses	2014	Experimental group: 25 nurses, Control group: 25 nurses (Total: 50 nurses)	"Experimental research design with pre-test and post-test measures using a structured Emotional Intelligence questionnaire developed by N.K. Chaddha. Descriptive analysis, t-tests due to small sample size, and bivariate correlation were performed using SPSS 17.0."	The study's small sample size (less than 30 per group) may not provide enough power to detect small effects reliably, which could limit the generalizability of the results. The reliance on a controlled experimental setup might not reflect real-world complexities of nurse-patient interactions and the application of emotional intelligence in naturalistic settings.
7	Rassool G.H.	Cultural competence in nursing Muslim patients	2015	Not applicable – It is a review rather than an empirical study.	"Review article – The document reviews cultural and spiritual considerations necessary for delivering culturally competent care to Muslim patients in a clinical setting."	As a review article, it may lack primary research data and instead synthesizes existing literature. The generalizability of the recommendations may be limited if the review does not include a wide range of sources or if it is biased towards certain perspectives or types of literature. Additionally, practical applications or case studies showing the implementation of these cultural competencies in real-world settings might be missing, which could be beneficial for practical understanding.
8	Labrague L.J.; Mcenroe-Petitte D.M.; Papathanasiou I.V.; Edet O.B.; Arulappan J.	Impact of Instructors' Caring on Students' Perceptions of Their Own Caring Behaviors	2015	586 student nurses from four countries: Greece, the Philippines, India, and Nigeria	"Descriptive, nonexperimental design. Data was collected using interviews and two standardized questionnaires: the Nursing Students' Perception of Instructor Caring (NSPIC) and the Caring Behavior Inventory (CBI). Inferential statistics, including Pearson r correlation and regression analysis, were used to analyze the data."	The nonexperimental design limits the ability to establish causality between instructors' caring behaviors and students' perceptions of caring. Cultural differences might also influence perceptions and behaviors, yet the study does not deeply explore how cultural factors specifically affect the results across the different countries.
9	Khowaja-Punjwani S.; Smardo C.; Hendricks M.R.; Lantos J.D.	Physician-nurse interactions in critical care	2017	3 Nurses	"Case study analysis supplemented by discussions with three nurses to explore the implications of nurse-doctor interactions on	The very small sample size (3 nurses) and the focus on a single case limit the generalizability of the findings. The study appears to rely heavily on subjective

					nurse satisfaction, patient safety, and the work environment.”	perceptions rather than objective measures, which may not provide a comprehensive understanding of the broader issues affecting nurse turnover or the dynamics between nurses and doctors in various settings
10	Ali S.S.; Basu A.; Ware N.	Quality measurement of Indian commercial hospitals – using a SERVQUAL framework	2018	210 patients recently discharged or about to be discharged from private hospitals in Delhi and NC.	“Descriptive survey using structured questionnaires based on the five-point Likert scale. The survey addressed expected and perceived service qualities and employed the SERVQUAL gap model to measure service quality”.	The study's scope is geographically limited to Delhi, potentially affecting the generalizability of the findings to other regions. The study would benefit from a longitudinal approach, capturing patient expectations before and after service delivery. Additionally, comparing patients' perceptions with medical service providers' perceptions could provide deeper insights into service quality gaps.
11	Balamurugan R.; Vijayakumar R.	Performance measures, analysis and improvements in healthcare sector by implementing tqm tools and techniques	2018	2500 patients, 350 nurses, 125 doctors, and 25 top management members from hospitals in Karur and Coimbatore, Tamilnadu	“Quantitative survey based on the SERVQUAL model, involving questionnaires to assess service quality across five dimensions (tangibles, reliability, responsiveness, assurance, empathy). The survey used a 5-point Likert scale and data were analyzed using SPSS software. Total Quality Management (TQM) tools and techniques were then applied based on the survey results.”	The study is regionally limited to specific areas in Tamilnadu, which may affect the generalizability of the findings to other regions or countries. The study focuses on the implementation of TQM tools but may not extensively explore the long-term impact of these improvements on service quality or patient satisfaction beyond the initial comparative study.
12	Saab M.M.; Drennan J.; Cornally N.; Landers M.; Hegarty J.; Savage E.; Lunn C.; Coffey A.	Impact of a compassionate care leadership programme	2019	2500 patients, 350 nurses, 125 doctors, and 25 top management	“Quantitative survey based on the SERVQUAL model, involving questionnaires to assess service quality across five dimensions (tangibles, reliability, responsiveness, assurance, empathy). The survey used a 5-point Likert scale and data were analyzed	The study is regionally limited to specific areas in Tamilnadu, which may affect the generalizability of the findings to other regions or countries. The study focuses on the implementation of TQM tools but may not extensively explore the long-term impact

				members from hospitals in Karur and Coimbatore, Tamilnadu.	using SPSS software. Total Quality Management (TQM) tools and techniques were then applied based on the survey results."	of these improvements on service quality or patient satisfaction beyond the initial comparative study.
13	Chauhan, N.	A Glass of Water	2019	Not applicable – The narrative is based on anecdotal experiences rather than a systematic study.	"Descriptive narrative focusing on personal experiences in cancer management by freelance consultants. The narrative illustrates the importance of empathy and kindness in clinical interactions through a specific anecdote titled "A glass of water.""	As a narrative, the account lacks empirical data and does not provide a structured methodology for examining the impacts of empathy and kindness in medical practice. The anecdotal nature limits the ability to generalize findings or draw robust conclusions about the broader implications of such behaviors in clinical settings.
14	Kaur H.	Professional quality of life of nurses with 6-8 years of work experience	2021	Nursing professionals with 6-8 years of work experience, employed in Punjab, India. The exact number of participants is not specified.	"Quantitative study examining the relationship between the professional quality of life of nurses and factors such as self-efficacy, empathy, aggression, and fantasy seeking. Data analysis included variance explanation for how these factors predict different aspects of professional quality of life (compassion satisfaction, burnout, secondary traumatic stress)."	The study's findings are specific to a particular group of nurses with 6-8 years of experience in Punjab, which may limit the generalizability of the results to other nursing populations or regions. Additionally, the predictors account for a relatively small percentage of variance, suggesting that other unexplored factors may also significantly impact the professional quality of life.
15	Sharma S.; Mudgal S.	Development and validation of a scale to measure attitude	2021	400 participants from a tertiary care	"Exploratory sequential design with instrument development model. The study involved developing and validating a new scale (AMnQ) to measure attitudes towards	The study focuses specifically on attitudes towards men in nursing, which may not fully address broader gender dynamics within the profession. While the scale is validated for

		of people toward men in nursing profession		hospital, selected using simple random sampling.	men in nursing. This included assessments of reliability, content validity, face validity, and construct validity, using SPSS AMOS version 23 for exploratory and confirmatory factor analyses."	use in this specific context, its applicability to different cultural or international settings might be limited. Additionally, the study was conducted at a single hospital, which may impact the generalizability of the findings to other healthcare environments or broader populations
16	Mathew A.; McQuinn H.; Flynn D.M.; Ransom J.C.; Doorenbos A.Z.		2022	12 military primary care providers from a single U.S. Army medical center.	"Qualitative descriptive study using semi-structured interviews to explore the processes and experiences of providers assessing and managing chronic pain. Interviews were audio-recorded, transcribed, and analyzed using thematic analysis to identify emergent themes."	The study is limited by its small sample size and single-center setting, which may affect the generalizability of the findings to other military or civilian medical settings. Additionally, the study is qualitative and primarily exploratory, which may limit the ability to establish broader empirical generalizations about the experiences of primary care providers in managing chronic pain across different contexts or populations.
17	Patnaik D.; Yadav S.L.; Rajderkar N.P.	Use of Principal Components Analysis to Identify Relevant Health Care Parameters Among Nursing Staff on Satisfaction Perception of Health Care Services in Selected Hospitals of Goa	2022	Initially targeted 450 clients, with 395 participating in the study.	"Cross-sectional, descriptive study conducted from May 2016 to December 2018 in government and private hospitals in Goa. Used principal component analysis (PCA) on nurse response data to identify key healthcare parameters related to satisfaction. Wards included in the study were Obstetrics/Gynecology, Medicine, Surgery, Orthopedic, and General."	The study's generalizability might be limited by its focus on specific departments within hospitals in Goa, potentially not representing conditions or sentiments in other regions or hospital settings. The response rate was less than the targeted sample size, which could affect the robustness and statistical power of the PCA results.
18	Nithya, V.; Patel, R.G.; Swetha N.B.	Prevalence of Psychological Problems among	2022	Not specified – The exact	"Cross-sectional study conducted over a period of 6 months in Chennai, Tamil Nadu. The study utilized structured questionnaires	The study's cross-sectional design limits the ability to infer causality between observed psychological problems and potential

		Healthcare Workers in a Tertiary Care Hospital, Chennai, Tamil Nadu		number of healthcare workers participating in the study was not mentioned.	including the Patient Health Questionnaire-9 (PHQ-9) and Cohen's Perceived Stress Scale to estimate the prevalence of psychological problems among healthcare workers. Data analysis was performed using SPSS 21.0 software."	contributing factors. The sample size and specific participant demographics were not detailed, which could impact the representativeness and generalizability of the findings. The absence of longitudinal data restricts understanding of the progression or changes in psychological states over time.
19	Mohan M.; Chowdhury A.; Sharma S.K.	Development of an Effective Scale for Measuring Empathy of Indian Nurses	2022	18 Indian nurses participated in the pilot study.	"Pilot study aimed at developing a new scale to measure empathy specifically for the Indian nursing context. The study involved interviews with experts to identify keywords related to empathy and then testing the new scale among Indian nurses. The scale assessed cognitive, affective, and motivational aspects of empathy. Reliability was confirmed with a Cronbach's Alpha greater than 0.70."	The small sample size of the pilot study may not be representative of the broader population of nurses in India, limiting the generalizability of the findings. Additionally, the study's focus on developing a new measurement scale means that further validation in larger and more diverse samples is necessary to confirm the scale's applicability and reliability in various settings.
20	Bhagwagar H.	Secondary trauma, burnout and resilience among mental health professionals from India: A review of research	2022	Systematic review of 14 research studies published between January 2005 and January 2022, focusing on burnout, secondary traumatic stress, vicarious trauma,	"Review of peer-reviewed journal studies involving psychiatrists, psychiatric nurses, psychiatric social workers, clinical psychologists, psychotherapists, and counsellors in India. Studies were assessed for methodological considerations, the mental health population studied, and primary outcomes. The review included analysis of sociodemographic variables, psychological impacts, risk and protective factors."	The review highlights conceptual, methodological, and analytical gaps in the existing literature, indicating areas that require further research and methodological improvement. These gaps might involve the need for more rigorous study designs, larger sample sizes, or more comprehensive analyses that could provide deeper insights into the issues faced by MHPs in India.

				compassion fatigue, and resilience among Indian Mental Health Professionals (MHPs).		
21	Daniel S.; Venkateswaran C.; Singh C.; Hutchinson A.; Johnson M.J.	"So, when a woman becomes ill, the total structure of the family is affected, they can't do anything..." Voices from the community on women with breast cancer in India: a qualitative focus group study	2022	Forty-five participants including oncologists (5), nurses (10), church members (16), and community volunteers (14) from South India.	"Qualitative study utilizing five focus groups: two with clinicians and three with the lay public. The focus groups discussed understanding of breast cancer, patient experiences related to diagnosis and treatment, and the psychological impacts. Discussions were audio-recorded, transcribed, and analyzed using thematic analysis with a cultural task analysis lens."	The study utilized only five focus groups (two with clinicians and three with the lay public). This small sample size may not capture the full diversity of experiences and perspectives on breast cancer, limiting the generalizability of the findings. The study also provides a snapshot of perspectives at a single point in time, which may not account for changes in understanding or experiences over time, especially in a rapidly evolving field like breast cancer treatment and care.
22	Sharafkhani R.; Nukpezah R.N.; Lathabhavan R.; Kallmen H.; Fournier A.; Hosseini Marznaki Z.	Factors that affect levels of alexithymia, empathy and communication skills of nursing students in northern Iran	2023	365 nursing students participated in the survey.	"Cross-sectional survey conducted using an online questionnaire. The study aimed to explore the relationships between alexithymia, empathy, and communication skills among nursing students. Data were analyzed using SPSS software version 22."	The cross-sectional nature of the study limits the ability to infer causality between the studied factors and the outcomes. The study's reliance on self-reported data from online questionnaires may introduce response biases. Additionally, the results might not be generalizable to all nursing students, as the sample might not represent

						different educational or cultural backgrounds adequately.
23	Saikia M.; George L.S.; Unnikrishnan B.; George A.; Ravishankar N.	Effectiveness of Integrated Emotional-Self Enhancement (IESE) program among staff nurses: protocol for a quasi-experimental study	2023	80 staff nurses working in a selected hospital in India.	Quasi-experimental one-group study design. The study involves a training program tailored to the emotional and mental needs of staff nurses, consisting of four two-hour sessions. Assessments were conducted at baseline, immediately post-intervention, and at 3-month and 6-month follow-ups to evaluate changes in emotional intelligence, motivation, self-compassion, and emotional labor.	The study's one-group quasi-experimental design without a control group limits the ability to attribute observed changes solely to the intervention due to potential confounding factors. The convenience sampling method may limit the generalizability of the results. Additionally, the relatively small sample size and single hospital setting may not fully represent diverse nursing environments.
24	Debnath S.; Sathiyaseelan M.; Tharyan P.; Mahasampath G.	The Association between Perceived Job Stress and Satisfaction, Empathy and Spiritual Beliefs on Burnout and Emotional Distress in Nurses: A Cross-sectional Study	2024	257 nurses participated in the study.	Cross-sectional research design. Data were collected using the modified Consultants Job Stress and Satisfaction questionnaire, Maslach Burnout Inventory, Jefferson Scale of Physician Empathy-Health Provider Version, and General Health Questionnaire-12 (GHQ-12) to assess job stress, satisfaction, empathy, spiritual beliefs, burnout, and emotional distress.	The cross-sectional design limits the ability to infer causality between perceived job stress, satisfaction, empathy, spiritual beliefs, and outcomes like burnout and emotional distress. Additionally, the data is self-reported, which may introduce bias and affect the reliability of the findings. The study's findings may not be generalizable beyond the sampled population due to the specific context and sample characteristics.

Manisha Mohan

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