University of Strathclyde Department of Architecture

Exploring Healing Spaces: Virtual Reality Simulation of Meditation Environments and Their Impact on University Students' Well-being in Thailand

By

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Declaration

This thesis represents the author's original research and has been entirely composed by the author. It has not been previously submitted for examination or awarded a degree.

Signed:

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Abstract

This dissertation probes how meditation environments—conceived as healing spaces where physical, perceptual and symbolic dimensions intersect—shape the well-being of university students in Thailand. Against a backdrop of mounting mental-health challenges, spurred by pressure, social transition and the lingering aftereffects of the post-pandemic period meditation has emerged as a valuable means of emotional regulation. Although the salutary effects of meditation are well documented the role of design, in modulating meditative outcomes remains under-explored. This project aims to bridge that gap by probing how the geometry of spaces their sensory textures and the cultural narratives they carry together sculpt the meditation experience and sway perceived well-being.

A mixed-methods approach was employed to compare four meditation environments—a classroom, a campus garden, a purpose-designed meditation room and a neutral white room. Each setting was rendered in reality (VR) to preserve consistency maintain experimental control and uphold ecological validity while still letting participants experience spaces that felt both familiar and directly comparable. Over a span of four months fifty-three Thai undergraduate participants completed guided meditation sessions, in each environment. Data were gathered through post-session questionnaires, online meditation diaries and semi-structured interviews. The quantitative dataset was subjected to repeated-measures ANOVA and a suite of correlation models while the qualitative narratives were parsed via thematic analysis aiming to capture the nuances of subjective experience and the meanings participants ascribed.

The data showed statistically significant differences among the settings ($p < 0.05$). The calming, focus-enhancing and emotionally stabilising spaces turned out to be natural

environments and those deliberately crafted for meditation while the typical classroom performed the worst. Participants linked their sense of tranquility to elements such as light, an open-plan layout, harmonious acoustics and culturally resonant symbols of calm and respect. In short the results suggest that meditation spaces are far, from backdrops—they actively shape psychological and emotional outcomes.

This research expands the terrain of psychology, mindfulness inquiry and architectural design by teasing apart how a space's sensory texture and symbolic meaning together sculpt a restorative experience. Methodologically it shows that virtual reality can function not merely as a lab instrument but as an immersive prototype for shaping healing environments. Culturally it brings Thai-Buddhist principles—simplicity, balance and a deep connection, to nature—to the surface as mediators of perceived calmness and focused attention. The findings indicate that virtual reality can broaden access to restorative experiences and provide evidence-based design recommendations, for blending virtual and physical healing spaces into university well-being initiatives.

CHAPTER 1

INTRODUCTION

1.1 BACKGROUND

Within today's higher-education landscape the welfare of university students has shifted into a matter of attention as they juggle an array of stressors along their academic trek (Auerbach et al., 2018). Class loads, the scramble to acclimate to unfamiliar settings and relentless monetary strain frequently snowball, into crushing stress eroding both mental health and scholarly achievement (Fuertes & Wayland, 2015; Lau & Yang, 2009; Writers, 2021). A large slice of the student body ends up clinging to self-destructive coping mechanisms—substance use being a prime example—that only magnify the hurdles they already face (Chavez et al., 2020). In reaction many campuses have rolled out a mix of wellness interventions from professional counseling services, to peer-based support networks (Chavez et al., 2020).

Of the approaches on the table, meditation and mindfulness programs have begun to stand out as especially potent tools for dialing down stress and nurturing well-being. Buddhist meditation in particular has been documented to sharpen stress regulation and promote a balanced emotional state (Waters et al., 2015). Yet even as the literature swells with data, on meditation's mental-health upside the role of the environment where the practice unfolds remains surprisingly underexplored (Kaplan, 2001).

The tangible and symbolic facets of a meditation setting—referred to here as a HEALING SPACE—can profoundly shape how effective the practice becomes. In this study a healing space is described as any environment whose physical, perceptual, symbolic and relational attributes work together to promote restoration, focus and overall well-being. Lighting, sound, air quality, temperature, acoustics and the presence of features each leave a measurable imprint on psychological and physiological outcomes (Akhu, 2016; Esther & Sternberg, 2009; Nilsson et al., 2003; Pi-Fen et al., 2012; Srithongchai & Gadi, 2020; Ulrich & Gilpin, 1999). Although environmental psychology and architectural research have repeatedly underscored how these variables shape health and well-being meditation spaces, within contexts remain surprisingly underexplored.

In this study the impact of distinct meditation settings on the well-being of Thai undergraduates is probed. To navigate hurdles while preserving experimental uniformity the investigation harnesses Virtual Reality (VR) to recreate a gamut of meditation environments within a tightly controlled framework. VR, with its capacity to forge computer-generated spaces is seeing ever-broader adoption, across architecture (FutureScape, 2018) healthcare (Portman et al., 2015) and education (Raja & Priya, 2021). The COVID-19 era in particular has turbo-charged interest in VR casting it as a platform, for simulating and testing environments that possess high ecological validity (Radianti et al., 2020; Wiederhold, 2020).

Adopting a mixed-methods design the study compared four meditation environments—a classroom, a campus garden, a purpose-designed meditation room and a neutral control space (a white room). Over the span of four months participants took part in guided meditation sessions lasting 13 minutes three times a week rotating through each setting. Data were gathered by weaving together tools (semi-structured interviews and meditation diaries) with quantitative metrics of stress reduction, environmental suitability and overall well-being.

By weaving the notion of healing spaces, VR simulation and a mixed-methods design this dissertation uncovers fresh insights into how meditation environments shape well-being outcomes. It also equips universities with grounded recommendations, for crafting effective meditation spaces—whether physical rooms or virtual realms—to nurture student mental health and bolster academic success.

1.2 SIGNIFICANCE OF THE STUDY

The research, titled **EXPLORING HEALING SPACES: REALITY SIMULATION OF MEDITATION ENVIRONMENTS AND THEIR IMPACT ON UNIVERSITY STUDENTS' WELL-BEING IN THAILAND** stands out for probing the ties, between the design of meditation settings and the well-being trajectories of students.

Although the psychological upside of meditation enjoys an evidentiary foundation, the setting in which the practice unfolds—its lighting, ambient noise, ventilation, thermal comfort and even symbolic cues—has received far less scholarly attention. This investigation plugs that spot, by systematically probing how each of these environmental variables influences meditation outcomes (Akhu, 2016; Esther & Sternberg, 2009; Nilsson et al., 2003; Pi-Fen et al., 2012;

Srithongchai & Gadi, 2020; Ulrich & Gilpin, 1999). By casting these environments as healing spaces, the investigation expands our comprehension of how both the material features and the subjective impressions of a setting contribute, to restoration focus and stress alleviation.

The central novelty of this investigation lies in employing reality (VR) to recreate and compare meditation spaces with a remarkable degree of control and reproducibility. VR is increasingly acknowledged as a methodological and practical resource in environmental psychology and health research (Carl et al., 2019; Radianti et al., 2020). Within this work VR wears two hats: it functions as a laboratory instrument that guarantees conditions across meditation setups and it also presents a promising low-cost and scalable avenue for universities interested, in rolling out meditation interventions.

The mixed-methods framework—pairing semi-structured interviews, meditation diaries and hard numbers—offers a view of both participants' lived experiences and the measurable outcomes. These insights carry weight for university campus design suggesting ways to craft real-world or VR meditation spaces that genuinely boost student well-being.

Overall, the significance of this study rests on its methodological and applied contributions. It advances knowledge of healing spaces showcases VR's value as both research and an intervention tool and delivers evidence-based recommendations, for bolstering well-being support in higher education.

1.3 PURPOSE OF THE STUDY

The purpose of this dissertation is twofold:

1. To examine how the quality of meditation environments conceptualised as healing spaces affects the well-being of undergraduate students in a Thai university.
2. To evaluate the role of Virtual Reality (VR) as an innovative methodological and practical tool for simulating meditation environments and informing university design strategies.

1.4 HYPOTHESIS

1. **Environmental Hypothesis**: Open and purpose-designed meditation spaces containing natural and restorative elements (e.g., greenery, natural light, acoustic harmony) will significantly enhance relaxation, stress reduction, and overall well-being compared to closed or neutral spaces such as classrooms or control rooms.
2. **Methodological Hypothesis**: VR simulation provides a valid and reliable method for assessing differences between meditation environments, producing outcomes that align with evidence from real-world studies of restorative environments.

1.5 DEFINITION OF TERMS

The following key terms form the conceptual framework of this research:

Meditation:

A deliberate mental practice involving sustained attention and heightened awareness, aimed at promoting relaxation, reducing stress, and enhancing well-being. Common techniques include deep breathing, visualisation, and mindfulness-based exercises (Waters et al., 2015).

Well-being:

A multidimensional construct encompassing optimal physical, psychological, emotional, and social health. It extends beyond the absence of illness to include life satisfaction, resilience, and fulfilment across multiple domains. In this study, well-being is shaped by personal, social, and environmental factors (Chavez et al., 2020). construct influenced by personal, social, and environmental factors.

Meditation Environment / Healing Space:

The physical or simulated setting in which meditation occurs. Healing spaces are defined by environmental attributes such as lighting, noise, air quality, temperature, acoustics, natural features, and symbolic cues, which support relaxation and restoration (Akhu, 2016; Esther & Sternberg, 2009; Nilsson et al., 2003; Pi-Fen et al., 2012; Srithongchai & Gadi, 2020; Ulrich & Gilpin, 1999). This study considers healing spaces as both physical environments (e.g., gardens, meditation rooms) and virtual simulations.

Virtual Reality (VR):

Virtual Reality (VR) refers to computer-generated, interactive simulations that immerse users in three-dimensional environments, typically experienced through specialised head-mounted displays. VR integrates graphics, spatial audio, and multisensory feedback to create a convincing sense of presence and engagement. In this study, VR functions both as a research method—allowing controlled, ecologically valid simulation of meditation environments—and as a practical tool for supporting student well-being (Baminiwatta & Solangaarachchi, 2021; Maples-Keller et al., 2017; Radianti et al., 2020; She et al., 2023; Wiederhold, 2020)

1.6 RESEARCH QUESTION

This research is guided by the following questions:

1. **How do healing spaces influence student well-being?**

   What is the relationship between the physical, perceptual, symbolic, and relational qualities of meditation environments and the psychological and physiological outcomes of meditation practice?

2. **What are the effects of different types of meditation environments on student well-being when experienced through VR simulations?**

   How do a classroom, a public garden, a purpose-designed meditation room, and a neutral control space differ in their restorative potential and their impact on meditation outcomes?

3. **Which meditation environment is most suitable for supporting student well-being in a university context, and what role can VR play in enabling access to such spaces?**

How can evidence from VR-based evaluation inform the design and implementation of meditation spaces physical or virtual within higher education institutions?

1.7 METHODOLOGY OVERVIEW

This study employed a mixed-methods design over a four-month period. Participants engaged in guided meditation sessions (13 minutes, three times per week) across four environments: a classroom, a public garden, a purpose-designed meditation room, and a plain control room. Each setting was simulated using VR technology to ensure experimental consistency and ecological validity.

Data collection integrated:

- **Semi-structured interviews** conducted biweekly,
- **Meditation diaries** documenting participant reflections, and
- **Quantitative measures** assessing stress reduction, environmental suitability, and overall well-being.

The combination of qualitative and quantitative approaches provides both statistical evidence and rich narrative accounts of student experiences.

The findings of this study contribute to existing knowledge on the relationship between meditation environments and human well-being, particularly in higher education. They also provide practical insights into the potential benefits of incorporating both physical and VR-enhanced meditation spaces within university campuses to support student well-being and alleviate stress.

1.8 CHAPTER SUMMARY

In this chapter we mapped the backdrop highlighted the significance clarified the purpose spelled out the hypotheses and pinned down the definitions that frame the investigation. Central to the effort is the notion of HEALING SPACES, a bridge that connects environmental psychology, mindfulness and design research. Bringing Reality (VR) into play gives the study a novel methodological edge, preserving experimental uniformity and unlocking scalable options, for higher-education contexts.

The research questions zero in on how healing spaces influence well-being, how various environments compare in their effects and how to pragmatically identify the supportive spaces for students. A mixed-methods design offers a flexible framework, for probing these issues.

To sum up this work pushes theory forward by deepening the concept of healing spaces validates VR as a research and intervention tool and equips universities with evidence-based guidance, for setting up meditation spaces.

Turning the page the next chapter unpacks the scaffolding of this investigation threading together restorative-environment theories, healing-space research, meditation practices and the incipient role of virtual reality. In summary, this study contributes to theory (advancing the concept of healing spaces), methodology (validating VR as a research and intervention tool), and practice (providing universities with evidence-based guidance for meditation spaces).

The next chapter reviews the literature underpinning this study, including restorative environment theories, healing space research, meditation practices, and the emerging role of VR.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION TO THE LITERATURE REVIEW

University students face increasing levels of stress and mental health challenges linked to academic pressures, social adjustment, and financial concerns. Meditation has gained recognition as an effective strategy for reducing stress and enhancing emotional regulation. However, while the benefits of meditation are well documented, the role of the environment in which meditation occurs remains less well understood. This chapter reviews the theoretical and empirical foundations relevant to this study, situating meditation environments within the broader framework of healing spaces and highlighting the contribution of Virtual Reality (VR) as both a methodological and practical innovation.

The concept of a healing space provides the central framework for this research. Healing spaces are defined not merely as physical locations but as environments whose physical, perceptual, symbolic, and relational attributes contribute to psychological restoration, stress recovery, and overall well-being. This multidimensional understanding draws from environmental psychology, healthcare design, and architectural studies. Healing spaces can therefore be understood at several levels:

- **Physical**, encompassing tangible attributes such as light, acoustics, temperature, and natural elements.
- **Perceptual**, focusing on how environments are experienced and interpreted through the senses.
- **Symbolic**, relating to cultural or spiritual meanings embedded in place.
- **Relational**, highlighting the interaction between people and their environment, including social and cultural context.

Framing meditation environments as healing spaces allows for an integrated analysis that goes beyond traditional restorative environment theories. While earlier research has demonstrated that exposure to natural or purpose-designed environments supports stress recovery (Kaplan & Kaplan, 1989; Ulrich, 1991), little work has been done to investigate how these effects translate into higher education settings, where students' well-being is under increasing strain. Moreover, there has been limited exploration of how digital technologies might extend or simulate healing spaces for wider accessibility.

Virtual Reality (VR) has recently emerged as a promising tool in this regard. VR offers immersive, controllable, and repeatable simulations of environments, enabling researchers to manipulate environmental variables while maintaining ecological validity. In healthcare, VR has been used successfully for pain management, stress reduction, and exposure therapy (Carl et al., 2019; Maples-Keller et al., 2017). In education, VR has shown value in creating engaging learning experiences and fostering mindfulness practices (Radianti et al., 2020). Early studies on VR meditation suggest that simulated natural environments can promote relaxation and reduce anxiety, comparable to real-world contexts (Navarro-Haro et al., 2017; Waller et al., 2021).

This chapter therefore reviews four key areas:

1. Theories of environment and well-being, including Attention Restoration Theory and Stress Reduction Theory.
2. Healing spaces and their applications, primarily in healthcare and architecture, with limited but emerging relevance to educational settings.
3. Meditation and environmental context, including traditional practices and contemporary applications.
4. Virtual Reality as a methodological and practical tool, with potential to simulate meditation environments and extend access to healing spaces in higher education.

The chapter concludes with a synthesis identifying the research gap: although meditation and restorative environments have been studied separately, their intersection in the context of VR-enhanced university meditation spaces remains underexplored. This research addresses that gap by systematically evaluating the effects of VR-simulated meditation environments on undergraduate student well-being in Thailand.

2.2 RESTORATIVE ENVIRONMENT

Restorative environments are settings that enable individuals to recover cognitive and emotional resources through psychological detachment, attention restoration, and stress recovery

(Kaplan & Kaplan, 1989). Exposure to such environments has been shown to reduce stress, improve mood, and enhance cognitive performance (Berto, 2014; Hartig et al., 1991). Classic research demonstrated these restorative effects: hospital patients with views of nature recovered more quickly from surgery than those facing brick walls (Ulrich, 1984), while individuals spending time in forests exhibited lower cortisol levels and greater emotional balance compared to those in urban surroundings (Korpela et al., 2008).

Restorative environments are particularly important when daily contexts lack compatibility with human psychological needs. They provide opportunities for mental replenishment and recovery from excessive cognitive demands (Kaplan, 1992). Measuring the qualities that contribute to restoration helps refine both theory and practice (Hartig et al., 1997). Symptoms of directed-attention fatigue—such as irritability, reduced task performance, and diminished empathy (Kaplan, 2001) can be alleviated by spending time in environments that support effortless attention and emotional release. Natural environments are especially effective because they contain visual and auditory elements that are inherently captivating and symbolically associated with safety, growth, and continuity. Research consistently demonstrates that natural settings have greater restorative potential than sterile or built environments (Berto, 2005; Kaplan, 1992; S. Kaplan, 1995; Kaplan, 2001; Ulrich, 1984; Ulrich et al., 1991).

Although the benefits of restorative environments are well established, there remains an ongoing need to clarify which specific environmental attributes—spatial structure, sensory quality, or symbolic meaning—most effectively enhance recovery, and how these can be embedded in designed or virtual spaces to support well-being. For this thesis, such understanding is vital, as it informs the interpretation of participants' responses to the different Virtual Reality (VR) meditation environments used in the study.

2.2.1 ATTENTION RESTORATION THEORY

Attention Restoration Theory (ART) (S. Kaplan, 1995) offers a cognitive explanation for how certain environments help individuals recover from directed-attention fatigue. Directed attention refers to the mental effort required to focus, inhibit distractions, and complete goal-oriented tasks. When overused, it leads to fatigue, irritability, and reduced concentration. ART proposes that environments rich in restorative qualities help replenish this cognitive capacity by providing stimuli that engage attention effortlessly.

The theory identifies four experiential properties that together support psychological restoration: being away, extent, fascination, and compatibility (Kaplan & Kaplan, 1989; Kaplan, 1983; Kaplan & Talbot, 1983). Each property reflects a distinct but interconnected aspect of how people interact with their surroundings to regain focus and balance. The framework is widely applied in environmental psychology, landscape design, and, increasingly, in digital and VR-based interventions for stress reduction.

2.2.1.1 <u>Being Away</u>

The concept of being away refers to psychological or physical separation from the sources of everyday demands and fatigue. It allows individuals to disengage from goal-driven tasks, routines, and mental clutter. This sense of detachment does not necessarily require travelling to distant natural areas; rather, it can occur in nearby parks, meditation rooms, or even purposefully designed VR environments that symbolically remove the user from daily pressures (Hartig et al., 1997).

Effective "being away" involves both cognitive and emotional distance. It enables a temporary suspension of identity roles—student, worker, or caregiver—and facilitates mental reset. In physical spaces, such distance is often achieved through spatial contrast: moving from a noisy, structured environment such as a classroom into a quiet garden or sanctuary-like room immediately changes sensory focus. In virtual settings, the same effect can be achieved through immersive visuals, ambient sound, and removal of task-related cues.

In this study, "being away" is particularly relevant to the university context, where academic and social pressures dominate daily life. VR meditation allowed participants to experience temporary psychological detachment without leaving campus, demonstrating how virtual immersion can recreate restorative separation. For Thai students, this also resonated with Buddhist principles of samatha (tranquil concentration), in which stepping away from external disturbance is the first step toward internal calm.

2.2.1.2 Extent

Extent relates to the scope, coherence, and connectedness of an environment. It describes how a space feels large enough—physically, perceptually, or conceptually—to sustain exploration and immersion. Environments high in extent provide a sense of being part of a larger, meaningful whole rather than an isolated fragment (S. Kaplan, 1995).

Natural landscapes such as forests or seashores typically provide strong extent through continuous spatial depth, layered perspectives, and predictable visual flow. Designed environments can also achieve extent by creating legibility and spatial rhythm—such as coherent pathways, consistent lighting, and repeated visual motifs. In both cases, extent maintains engagement long enough for psychological recovery to occur.

In VR meditation contexts, extent is expressed not by physical distance but by perceptual continuity. Users may feel immersed in a "whole world" even within a limited physical area. The Public Garden environment in this study, for example, created extent through panoramic views, ambient sound layers, and horizon lines that suggested openness and continuity. The Designed

Meditation Room achieved a more inward form of extent through balanced geometry and symbolic enclosure, encouraging introspection. Extent therefore operates both spatially and experientially: it supports the feeling of continuity—either outward into nature or inward into self-awareness.

2.2.1.3 Fascination

Fascination refers to the effortless attention elicited by environmental features that naturally draw interest without requiring conscious effort. According to ART, fascination restores cognitive resources because it engages attention gently, allowing the directed-attention system to rest (Herzog et al., 1997; Kaplan & Kaplan, 1989).

Kaplan distinguishes between "soft fascination," associated with calming stimuli such as rippling water, swaying trees, or birdsong, and "hard fascination," triggered by intense or dramatic events such as sports competitions or city traffic. Soft fascination is particularly restorative because it holds attention while leaving cognitive space for reflection, daydreaming, or emotional processing (Herzog et al., 1997; Kaplan & Kaplan, 1989).

In VR meditation, fascination is a key factor in sustaining engagement without overstimulation. Participants in the current study described feeling absorbed by the garden's moving leaves and ambient sound—a digital equivalent of soft fascination. The Designed Meditation Room, while visually simpler, evoked fascination through symbolic presence and rhythmic lighting, reinforcing the meditative focus. These forms of digital fascination parallel natural stimuli in their ability to maintain gentle awareness, demonstrating that well-designed virtual spaces can substitute natural cues through multisensory coherence and dynamic motion.

Fascination also interacts with culture and meaning. In the Thai context, gentle attention is associated with sati (mindfulness)—a form of alert relaxation. Environments that cultivate fascination therefore do more than capture attention; they mirror the moral quality of balanced awareness valued in meditation practice. (Herzog et al., 1997; Kaplan & Kaplan, 1989).

2.2.1.4 Compatibility

Compatibility is achieved when a person's purposes align with what the environment affords. A highly compatible setting allows individuals to pursue their goals with minimal effort or conflict. In restorative contexts, this means that environmental cues support rather than hinder relaxation, reflection, or focused activity (Kaplan & Talbot, 1983).

High compatibility occurs when spatial layout, soundscape, and sensory tone facilitate the intended behaviour, such as contemplation or breathing—without distraction. Conversely, low compatibility arises when external stimuli (e.g., noise, visual clutter, or discomfort) interfere with desired experiences. Compatibility thus encompasses both physical and psychological dimensions: the degree to which a person feels "at home" within the space and the extent to which it meets their expectations.

In VR meditation, compatibility depends on the user's sense of comfort with the digital medium, headset fit, and perceived naturalness of the environment. Participants in this study reported that the Designed Meditation Room felt inherently "appropriate" for meditation because its visual and symbolic elements—such as symmetrical layout and cultural imagery—aligned with familiar rituals of respect and stillness. By contrast, the Classroom environment lacked compatibility; its visual association with study and deadlines conflicted with relaxation goals, reducing its restorative potential.

Compatibility is thus not merely functional but moral and cultural. Spaces that express harmony and respect, as in traditional Thai temples or gardens, resonate deeply with users' internalised expectations of tranquillity. In virtual settings, reproducing these symbolic cues can enhance both comfort and authenticity, ensuring that VR environments do not feel artificial but continuous with real-world traditions of calm and mindfulness.

Synthesis

Together, the four properties—being away, extent, fascination, and compatibility—explain why certain environments are more restorative than others. They describe not only cognitive recovery but also emotional resonance: an environment restores when it creates psychological distance from stress, offers coherent immersion, engages gentle attention, and aligns with personal and cultural goals. For this thesis, ART serves as a conceptual bridge linking environmental psychology with architectural design and VR technology. It provides a structured lens through which to analyse participants' experiences across the four meditation environments, revealing how spatial qualities, sensory patterns, and symbolic meanings converge to promote well-being. In the chapters that follow, these concepts guide both the interpretation of qualitative themes and the analysis of quantitative results, demonstrating how restorative theory can inform the design of healing spaces in both physical and virtual domains.

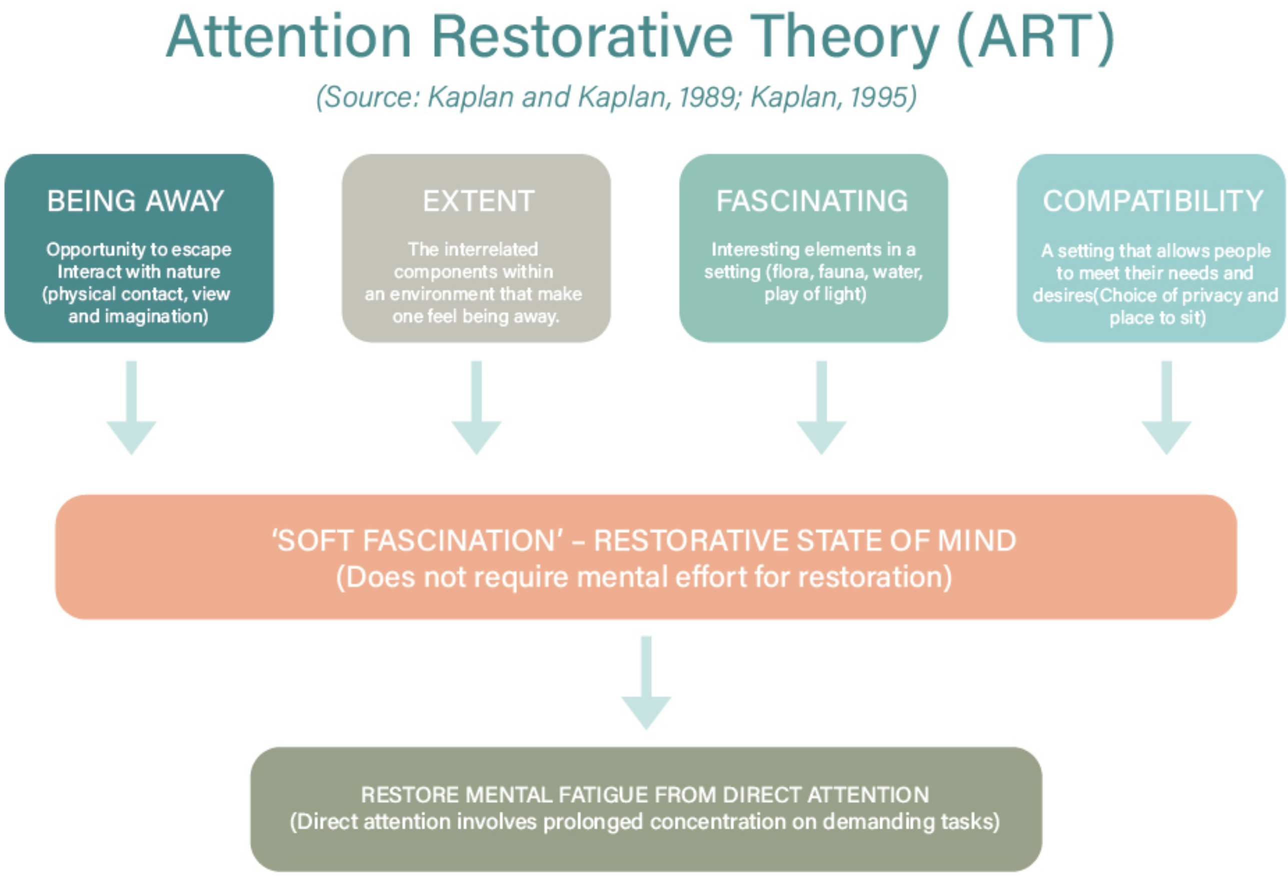


FIGURE 1: CONCEPTUAL FRAMEWORK OF ATTENTION RESTORATIVE THEORY (ART)

2.2.2 MEDITATION AND RESTORATION

Environmental studies on mental rehabilitation highlight the role of natural settings in reducing stress and directed attention fatigue (Hartig & Evans, 1993). According to Attention Restoration Theory (ART), restorative experiences emerge from person–environment interactions shaped by four qualities: being away, fascination, extent, and compatibility (S. Kaplan, 1995). Each of these properties describes how an environment can facilitate restoration, either through physical or psychological distance, effortless attention, coherent scope, or alignment with personal goals.

Meditation shares overlapping aims with restoration, as both seek calm, recovery of attention, and respite from cognitive overload (Kaplan, 2001). However, the two routes differ. Meditation is a disciplined practice requiring effort and training, at least initially (Larkin, 2008), whereas restorative experiences are accessible without specialised skills. Despite these differences, meditation and restorative settings may be complementary: meditation reduces unnecessary use of directed attention, while supportive environments provide external conditions that facilitate this state.

Various meditation methods illustrate this connection. Mantras help silence internal dialogue, repetitive actions (e.g., breath-focused Buddhist practice) reduce cognitive load, and Zen traditions emphasise mindful engagement in daily routines. These approaches align with ART's aim of easing demands on directed attention. Both meditation and restorative environments prevent incompatibility and promote psychological renewal, although meditation demands active discipline while restoration occurs more passively.

Practical limitations exist for both approaches. Individuals in urgent need of restoration (e.g., serious illness) may lack the capacity to practice meditation (Cimprich, 1993), while access to restorative environments may also be constrained, especially in urban settings. Notably, meditation spaces are often located in naturally restorative locations, suggesting that architecture and setting intentionally reinforce meditative aims.

This convergence highlights two key ideas. First, restorative settings and meditation may form a continuum, from passive environmental support to active contemplative practice. Second, under suitable conditions, even untrained individuals may achieve meditation-like states through exposure to restorative environments (S. Kaplan, 1995). Empirical work supports these links: exposure to natural environments enhances restoration and cognitive functioning (Berto, 2014), while meditation improves psychological and physiological well-being (Tang et al., 2015). Combined, the two practices amplify benefits. Berto et al. (2005) found meditation in natural environments yielded stronger restorative effects than indoor meditation, and Annerstedt et al. (2013)reported improved mood and stress reduction in natural retreats compared to urban ones.

Incorporating natural settings into meditation therefore represents a powerful strategy for promoting well-being. For individuals in urban environments with limited access to nature, integrating restorative qualities into meditation spaces can harness the benefits of both practices to support healing and recovery.

2.2.3 PHYSIOLOGICAL SIGNS OF RELAXATION

Physiological signs of relaxation serve as critical indicators of an individual's state of calm and stress reduction. These include heart rate reduction, lower blood pressure, decreased cortisol levels, and improved respiratory patterns. These markers help assess the effectiveness of different environments in promoting relaxation and well-being.

- **Heart Rate Reduction**

  Heart rate is a primary indicator of physiological stress and relaxation. Studies demonstrate that natural environments can significantly lower heart rate compared to urban or indoor settings. Park et al. (2010) found that forest environments produced significantly lower heart rates than urban environments. Similarly, Tsunetsugu et al. (2007; 2010) reported that forest therapy (Shinrin-yoku) decreased heart rate, attributing this to sensory stimuli such as rustling leaves and greenery. In contrast, plain white rooms did not produce similar effects.

- **Blood Pressure Reduction**

Lower blood pressure indicates a relaxed state and reduced hypertension risk. Hartig et al. (2003) demonstrated greater blood pressure reduction in participants who walked in natural settings compared to urban environments. Li et al. (2008) found that forest environments significantly reduced both systolic and diastolic blood pressure, attributing this to phytoncides released by trees. Time spent in plain white rooms did not result in significant blood pressure changes.

- **Cortisol Level Reduction**

Cortisol, a stress hormone associated with negative health outcomes, provides insight into stress levels. Ulrich et al. (1991) found that viewing nature scenes decreased cortisol levels compared to urban scenes. Hunter et al. (2019) confirmed lower cortisol levels in natural settings versus built environments. Brown et al. (2013) demonstrated that meditation in plain white rooms did not significantly reduce cortisol levels compared to meditation in natural environments.

- **Improved Respiratory Patterns**

Slow, deep breathing indicates relaxation and improved oxygenation. Gladwell et al. (2013) found that nature walks produced slower, deeper breathing compared to urban walks. Song et al. (2017) reported significantly improved respiratory patterns when deep breathing exercises were practiced in forests versus plain white rooms, highlighting nature's holistic impact on physiological relaxation.

- **Comparison of Natural and Controlled Environments**

  Natural environments provide rich sensory inputs that engage body and mind, promoting relaxation and reducing stress. These include visual greenery, sounds of water, gentle breezes, and natural scents. Plain white rooms lack these stimuli, resulting in less effective relaxation environments. Kaplan and Kaplan (1989) noted that nature's restorative effects stem from providing escape and fascination, which sterile environments lack.

- **Implications**

  The research demonstrates that natural environments significantly reduce stress and promote well-being through measurable physiological changes. These findings have implications for meditation practices and space design, suggesting that incorporating natural elements can enhance effectiveness. Applications extend to healthcare facilities, workplace design, and urban planning, where integrating natural elements can improve health outcomes, reduce stress, and enhance quality of life.

In summary, the exploration of physiological signs of relaxation underscores the significant impact that natural environments have on reducing stress and promoting well-being. The evidence from various studies consistently demonstrates that exposure to natural settings leads to notable reductions in heart rate and blood pressure, decreased cortisol levels, and improved respiratory patterns. These physiological changes are indicative of a relaxed state and are less pronounced or absent when individuals are in controlled environments like plain white rooms.

The reduction in heart rate and blood pressure highlights the calming effect of natural surroundings on the cardiovascular system. Studies by Park et al. (2010) and Hartig et al. (2003) illustrate that participants in natural environments exhibit these reductions more significantly than those in urban or indoor settings. The decreased cortisol levels, as reported by Ulrich et al. (1991) and Hunter et al. (2019), further emphasize the stress-relieving properties of nature, given cortisol's role as a primary stress hormone. Additionally, the enhancement of respiratory patterns in natural settings, noted in the research by Gladwell et al. (2013) and Song et al. (2017), suggests a holistic improvement in physiological functions associated with relaxation.

These findings have profound implications for meditation and relaxation practices. Incorporating natural elements into meditation spaces can amplify the effectiveness of these practices by leveraging the inherent stress-reducing benefits of natural environments. This could involve designing outdoor meditation areas or integrating features such as plants, water elements, and natural sounds into indoor spaces to simulate the calming effects of nature. The sensory richness of natural settings encompassing visual, auditory, olfactory, and tactile stimuli plays a crucial role in eliciting these physiological responses and should be a key consideration in the design of relaxation environments.

However, it is important to acknowledge the limitations of the current research and identify areas for future exploration. Many studies focus on short-term effects, and there is a need for longitudinal research to assess the sustained impact of natural environments on physiological relaxation markers. Additionally, individual differences such as age, cultural background, and personal preferences may influence responses to natural settings, suggesting that personalized approaches could enhance the effectiveness of relaxation practices. Exploring a wider variety of natural environments and their specific features could also provide deeper insights into which elements most effectively promote relaxation.

Practical applications of this research extend to various fields, including healthcare, workplace design, and urban planning. Healthcare facilities can enhance patient recovery and well-being by incorporating natural elements into their environments. Workplaces can reduce employee stress and improve productivity by integrating green spaces and natural features. Urban planners have the opportunity to improve public health by prioritizing the development of accessible natural areas within cities.

In essence, the physiological signs of relaxation serve as critical indicators of the beneficial impact of natural environments on human health. The consistent evidence supporting the positive effects of nature on reducing stress and promoting relaxation underscores the importance of integrating natural elements into our daily environments. By doing so, we can harness these benefits to improve overall well-being and quality of life.

2.3 HEALING SPACE

Healing spaces are environments designed to support well-being, reduce stress, and promote recovery. They have been integral to human history, dating back to ancient Greek sanctuaries built on hilltops to provide restorative settings (Esther & Sternberg, 2009). Modern studies emphasize that healing spaces influence both physical and emotional health, with design elements such as natural light, color, sound, and accessibility to nature playing key roles in enhancing well-being (Hussain, 2015; Ulrich et al., 2010).

2.3.1 HEALING SPACE AND HEALING ENVIRONMENT

Referring back to ancient times, healing space was introduced in the Greek period, i.e., they built healing spaces on hilltops overlooking the sea (Esther & Sternberg, 2009). Several studies highlight different factors in creating a healing space or building an effective healing environment. First, past studies indicate that physical space can contribute to the healing process both physically and emotionally. The surroundings influence healing, and the design of places can enhance healing properties. Roger Ulrich examined the effects of the patient's room on patients' treatment outcomes at hospitals, i.e., the views of nature have a positive impact on the patient's healing process (Ulrich et al., 2010). Patients whose beds were located near windows often left the hospital sooner than those located near a wall. Moreover, patients with nature views often required fewer doses of moderate and strong pain medication (Ulrich, 1984). Florence Nightingale further adds that natural light contributes to patients' health. Specifically, the patient's room should provide open windows as it could help the healing process and sunlight could kill bacteria (Esther & Sternberg, 2009). Sunlight can also affect the immune system and trigger chemical reactions in the body's cells, thus speeding healing processes. Getting enough sunlight can also activate vitamin D for growth and healing. In other words, exposure to light and certain visual scenes can lead to speedy healing processes.

Second, colours in the surroundings, such as wall colours, clothing colours, object colours, and the various wavelengths in ambient light can influence the emotions of individuals. Based on research carried out in New York City in 2006, a colour scientist and colour lighting expert experimented on how lights and colours affect moods and emotions (Esther & Sternberg, 2009). Three rooms were set as cocktail party spaces and each room was painted red, blue, and yellow respectively. Visitors were measured using wristband monitors and questionnaires were used to ask about their moods and emotions during their visit. The results reveal that people in the blue room were standing around the perimeter and were significantly calmer than those in the yellow and red rooms. While people in the red room tended to feel hungrier and thirstier, i.e., food and beverage consumption was twice as high. People were the most animated, i.e., they moved around and spent more time talking and laughing loudly in the yellow room. This experiment provides evidence showing that different room colours and wavelengths of light, therefore, affect the behaviours and moods of people (Esther & Sternberg, 2009).

Third, sound is another factor that contributes to the healing process. It is always highlighted that music can alter people's moods. In ancient Greek, music was used to heal the sick in the temple (Ulrich & Gilpin, 1999). In the modern era, technologies are developed by scientists to understand how music is connected and positively affects moods. Several studies provide evidence showing that patients undergoing hernia repair, under anaesthesia, or in the recovery room for one hour immediately after surgery, who listened to music, required significantly lesser morphine (i.e., one-third to one-half doses), compared to those who did not listen to music (Nilsson et al., 2003). More importantly, listening to music has measurable effects on the production of certain antibodies in the saliva, the so-called IgA antibodies, which are the first line of defense in protecting against infection. In other words, music can affect not only the emotions and the emotional outflow pathways of the brain but also the ability of immune cells to fight infection (Esther & Sternberg, 2009).

Furthermore, building healing spaces and environments has been increasingly argued in a clinical context, such as healthcare centres and hospitals, to support and improve the healing process of patients, including mental health of patients. Past studies emphasise different factors for creating healing spaces, such as planning, landscape and accessibility to nature. The Optimal Healing Environment (OHE) model is a model that promotes health and well-being via healing spaces, i.e., the OHE model consists of the place elements (e.g., nature, site location, and building design) and the elements of people (e.g., spirituality), with care processes to create an effective health environment. The design of healing environments aims to balance mind, body and spirit, which can reduce stress and anxiety and become more restorative. The elements of place focus on both the design environment (e.g., exterior architecture, designed landscape, interior space planning, and interior design) and the natural environment (e.g., site topography, orientation, and the natural landscape) (Zborowsky & Kreitzer, 2009). Moreover, there are key overarching design criteria for creating open spaces in an urban area conducive to health and healing, i.e., creating open space, safety and access to nature (Pleasant et al., 2013).

Given that human beings cannot live without natural surroundings, a physical and visual link with nature has positive beneficial qualities that help in healing and health in general. Therefore, the most important element of creating a healing environment is the connection between humans and nature. In the cases of the patients recovering in bed, they still need views or access to nature (e.g., looking out to the window or walking in the garden) to boost their healing effectiveness. Several studies emphasise that patients located by the window tend to require fewer doses of pain medication and are healing at a rapid rate compared to those located somewhere else (Hussain, 2015).

The study defines the harmony of place and people as an essential factor for creating a healing space. Past scholars identified five keys to creating healing spaces as the roads to the spirit, i.e., the energies between objects and people that have passed through spaces. These five keys consist of (i) visual (including colours and symbols), (ii) tactile (i.e., sense of touch), (iii) auditory (i.e., sounds and music about mental health and well-being), (iv) olfaction (i.e., some scents can create positive emotions) and (v) gestation (i.e., healing through food and drink) (Akhu, 2016). Although past studies emphasise creating healing spaces and environments in different aspects, most studies focus on the impacts of healing spaces on healthcare. However, there are still limited studies that explore the effects of healing space from other aspects.

2.3.2 HEALING GARDEN

Extant literature highlights several benefits of natural spaces on the mental health of different parties, including patients, students, and general people. In the modern urban, dwellers are suffering from pressure, deadlines, and the eyesores of the concrete jungle. The existence of natural parks and other open spaces is, therefore, appreciated by dwellers as these places soothe their senses and provide venues for leisure activities (Lau & Yang, 2009).

Previous studies investigate many fields showing the positive psychological and physiological effects of natural settings. According to Ulrich, patients tend to recover faster when exposed to a natural setting in the healthcare centre (Ulrich et al., 1991). A study shows that patients in recovery from surgery had shorter post-operative hospital stays when located near windows, looking out onto a natural scene, and received fewer potent analgesics than those located facing a brick building wall (Ulrich, 1984). Furthermore, a study reveals that patients often prefer a garden view rather than a hospital ward as open space, scenic views, pleasant sounds and smells, sunlight, and fresh air contribute to the positive healing effects (Said et al., 2005).

Apart from the landscape design, the functionality should also be taken into consideration when creating effective healing garden environments to meet the special needs of users. This aims to specifically provide the simplicity of maintenance for both physical protection and therapeutic benefits, to generate environmental sustainability, and pleasant surroundings in all senses, as well as to produce restorative effects for its users (Lau & Yang, 2009). According to Ulrich's theory, there are several significant aspects to be considered when designing healing gardens to facilitate psychological recovery:

- **Security and sense of control**: The gardens should provide the users with a sense of security and a simple and easy-to-understand pattern to help them feel in control of their surroundings and feel protected.

- **Various space patterns**: A quiet garden, for example, with sufficient enclosed subspaces and well-designed vegetation as visual buffers, is ideal for activities like contemplation, reading, and writing. If the adjoining indoor areas, such as reading rooms, could be dedicated to quieter academic usage, subspaces and surrounding windows and visual barriers (e.g., greenery fences or other landscape features) are necessary; otherwise, inhabitants of the garden may feel like they are trapped within a fishbowl. Therefore, well-designed site furniture (i.e., seating such as benches, tables, weatherproof canopies, etc.) is important to improve usability and enable people to enter and linger.
- **Sufficient plants and water features**: The spaces should incorporate sufficient planting and water features, where possible. Given the benefits of the garden on mental health, it's critical to improve the physical and visual accessibility of the garden's natural scenery to create a proper healing garden. Furthermore, the garden can include a variety of trees, shrubs, and grass to create multi-levelled greenery, i.e., adding fragrant plants and offering buffer planting.

Moreover, some studies investigate the effects on university students. (Lau & Yang, 2009) explain that most college and university students are stressed with their studies. They have been experiencing ever-increasing pressures as a result of fierce competition to achieve academic excellence and better future career development, which in turn influences their mental health. College stress exerts negative impacts on their psychological well-being (Li & Lin, 2003). A high level of pressure not only causes negative study outcomes but also leads to critical deceases, such as heart attack, stroke or cancer (Lau & Yang, 2009). Thus, it is important to promote a health-supportive and sustainable campus environment to protect and maintain the health of university students. Natural spaces on campus could be of value in sustainable campus landscape design. About 75% of university students seek outdoor nature settings, such as wooded urban parks and places next to water features, during times of depression or a high-stress (Francis & Cooper Marcus).

2.3.3 HEALING ENVIRONMENT IN RELATION TO MEDITATION

Creating healing spaces plays a crucial role in fostering wellness and alleviating stress. Meditation spaces whether physical locations or virtual settings are designed to facilitate meditation practices through calm, peaceful ambiance that encourages relaxation and tranquility (Kirklin & Richardson, 2003).

2.3.3.1 Space Healing Concept and Mechanisms

Space healing refers to environments' capacity to facilitate psychological and physiological recovery. This concept recognizes that spaces are not passive backdrops but active participants in shaping mental and physical states (Gesler, 1992). The relationship between healing spaces and meditation environments is deeply interconnected.

Environmental elements significantly impact meditation experiences. Lighting and color schemes influence mood during meditation (Boyce et al., 2006), with dim lighting conditions promoting greater relaxation (Ulrich et al., 2008). Colors like blue and green create soothing environments that enhance meditation practices. Similarly, layout and furniture arrangement affect meditation effectiveness, with minimalist designs and minimal distractions promoting higher perceived relaxation (Lwin et al., 2025).

Understanding space healing provides insights into how environmental design can improve mental health outcomes, particularly relevant as stress-related disorders increase in modern society (Ulrich, 1984). This knowledge informs the design of therapeutic spaces including meditation rooms, hospitals, and urban parks (Esther & Sternberg, 2009). As urbanization increases, well-designed spaces become critical for reducing stress, enhancing mood, and improving cognitive function (Kaplan & Kaplan, 1989).

2.3.3.2 Theoretical Foundations

Several psychological and environmental theories explain how surroundings influence mental and physical health:

- **Attention Restoration Theory (ART)**: Developed by Kaplan & Kaplan (1989), ART posits that natural environments uniquely restore cognitive function, particularly directed attention. Natural settings provide opportunities for involuntary attention through four key elements: being away (psychological distance), extent (coherent environment), fascination (effortless attention), and compatibility (matching individual preferences). Studies show that people in natural environments exhibit improved cognitive function and reduced stress compared to those in built environments (Berman et al., 2008).
- **Stress Reduction Theory (SRT)**: Proposed by Ulrich, SRT focuses on emotional and physiological responses to environments. Natural settings elicit positive emotional responses that lead to physiological benefits such as lower blood pressure, reduced heart rate, and decreased cortisol levels (Ulrich et al., 1991). Even passive nature exposure, such as window views, can measurably reduce stress and improve health outcomes (Ulrich, 1984).

- **Biophilia Hypothesis**: Introduced by Edward O. Wilson, this hypothesis suggests humans have an inherent affinity for nature stemming from evolutionary history. Studies demonstrate natural environments' positive effects on mental health, including reduced anxiety, improved mood, and enhanced cognitive function (Wilson, 1993).

Environmental Affordances Theory: Developed by Gibson (2014), this theory addresses opportunities for action that environments provide individuals. A space that offers relaxation opportunities through comfortable seating, natural light, and pleasant views is more likely to support healing.

2.3.3.3 Environmental Factors Contributing to Healing

- **Natural Elements:**
  - **Greenery and Plants**: Exposure to vegetation reduces stress, improves mood, and enhances cognitive performance (Bringslimark et al., 2009). Indoor plants improve air quality, creating calming, restorative atmospheres (Largo-Wight et al., 2011). Engagement with plants reduces symptoms of depression and anxiety (Clatworthy et al., 2013).
  - **Water Features**: Fountains, ponds, and aquariums induce relaxation through auditory and visual stimuli (Pheasant et al., 2010). Water sounds effectively mask unpleasant noises (White et al., 2010) and water features provide dynamic, soothing focal points supporting mental restoration. Proximity to water decreases heart rate and blood pressure (Beute & De Kort, 2018).
  - **Natural Light**: Exposure to natural light improves mood, enhances sleep quality, and increases productivity (Boyce et al., 2003). Patients in sunlit rooms experience

less stress and take fewer pain medications (Walch et al., 2005). Natural light regulates melatonin and serotonin production, essential for sleep and mood (Cajochen, 2007).

- **Fresh Air and Ventilation**: Proper ventilation removes pollutants, controls humidity, and supplies oxygen-rich air (Sundell et al., 2011). Improved air quality reduces headaches, allergies, and asthma while enhancing cognitive function (Fisk, 2017).

- **Sensory Stimuli:**
  - **Visual Stimuli**: Calming colors like blues and greens reduce anxiety (Küller et al., 2006). Nature-inspired textures evoke comfort and serenity (Joye, 2007). Aesthetically pleasing environments lower stress markers and contribute to faster recovery (Dijkstra et al., 2006).
  - **Auditory Stimuli**: Natural sounds like birdsong and flowing water reduce stress and improve mood (Alvarsson et al., 2010). Sound-absorbing materials minimize unwanted noise. Music therapy effectively reduces pain, anxiety, and stress (Bradt et al., 2013).
  - **Olfactory Stimuli**: Pleasant scents evoke positive emotions and memories (Herz, 2004). Aromatherapy with essential oils reduces stress, alleviates pain, and improves sleep quality (Lee et al., 2012). Lavender and chamomile possess calming properties (Koulivand et al., 2013).
  - **Tactile Stimuli**: Varied textures and materials influence perceptions of comfort and safety (Pallasmaa, 2024). Natural materials provide tactile richness (Guest et al., 2009). Tactile interaction with nature increases connectedness and reduces stress (Sato & Conner, 2013).

Creating environments that incorporate appropriate lighting, colors, natural elements, and sensory experiences while minimizing distractions can significantly enhance meditation effectiveness and improve overall well-being (Schweitzer et al., 2004).

2.3.3.4 Physiological Mechanisms of Space Healing

Space healing is deeply rooted in psychological mechanisms that significantly impact the healing process. Understanding these mechanisms is crucial for comprehensively evaluating how spaces contribute to human well-being and recovery.

- **The Role of Perception in Space Healing**

  Perception plays a fundamental role in how individuals interact with surroundings, affecting their psychological state and overall healing. Perception of space is shaped by various sensory inputs that contribute to emotional and cognitive responses (Ulrich, 1991). Spaces perceived as safe, comfortable, and aesthetically pleasing can induce relaxation and reduce stress, promoting healing. Conversely, spaces perceived as chaotic or uninviting may exacerbate stress and impede healing (Ulrich, 1984). This highlights the importance of designing spaces that are not only functional but also psychologically supportive.

- **Emotional Responses and Healing Environments**

  Emotional responses elicited by physical environments significantly influence space healing. Positive emotions such as tranquility, contentment, and security can facilitate recovery by lowering stress levels and promoting psychological well-being (Kaplan & Kaplan, 1989). Environments evoking positive emotions through natural elements, soothing colors, and harmonious design can enhance mood and contribute to faster recovery (Esther & Sternberg, 2009; Sternberg, 2009). Conversely, environments inducing negative emotions can hinder healing by maintaining psychological distress (Lundberg & Frankenhaeuser, 1980).

- **Cognitive Engagement and Restorative Spaces**

Cognitive engagement with a space is another critical mechanism influencing healing. Spaces encouraging cognitive engagement through exploration, creativity, or mental relaxation can foster mastery and control, vital for psychological recovery (Kaplan & Kaplan, 1989). Restorative environments characterized by natural landscapes, complexity, and mystery engage cognitive processes that help restore attention and reduce mental fatigue (S. Kaplan, 1995). Attention Restoration Theory posits that environments rich in natural stimuli can replenish depleted cognitive resources, enhancing mental clarity and overall well-being.

- **Social Interactions and Psychological Support**

Space healing extends to social interactions occurring within environments. Social support, facilitated by spaces designed to encourage interaction and communication, can profoundly affect psychological healing. Environments promoting social engagement through communal spaces or thoughtful layouts provide opportunities for emotional support, shared experiences, and connection-building (Golembiewski, 2010). These interactions can alleviate isolation, reduce stress, and enhance overall psychological well-being.

- **The Impact of Control and Personalization on Healing**

The sense of control and personalization within a space is crucial for healing. When individuals can exert control over their environment by adjusting lighting, temperature, or arranging personal items, they experience greater autonomy and comfort, significantly contributing to healing (Ulrich, 1991). The ability to personalize a space to reflect one's identity enhances emotional well-being by fostering ownership and familiarity. Spaces allowing such personalization and control are more likely perceived as supportive and conducive to healing.

2.3.3.5 Case Studies and Empirical Evidence

Empirical evidence and case studies provide critical support for understanding space's impact on healing processes. These studies offer real-world insights into how different environments influence psychological and physiological outcomes.

- **Healing Gardens in Healthcare Settings**

  Healing gardens in healthcare settings represent well-documented examples of space healing. A seminal study by Ulrich (1984) demonstrated that surgery patients with nature views required less pain medication and had shorter hospital stays than those with brick wall views, providing early empirical evidence linking natural spaces to improved health outcomes. Sherman et al. (2005) found that cardiac rehabilitation patients who spent time in healing gardens experienced significant stress reduction and improved heart rate variability, indicating that thoughtfully designed spaces can support physiological recovery.

- **Green Spaces in Urban Areas**

  Urban green spaces provide another valuable case study. Mitchell and Popham (2008) found that populations living near green spaces had lower mortality rates, particularly from circulatory diseases. Maas et al. (2006) demonstrated that people in greener environments reported better health, with effects particularly pronounced among lower socioeconomic groups, suggesting green spaces can buffer against health impacts of social inequality.

- **Therapeutic Spaces in Mental Health Treatment**

  Studies by Golembiewski (2010) and Tyson et al. (2002) showed that mental health facilities designed with natural light, soft colors, and organic shapes contributed to reduced anxiety and agitation among patients. Patients in wards with garden access and natural light had shorter stays and required less medication compared to those in sterile environments, supporting the idea that thoughtfully designed spaces enhance therapeutic outcomes.

- **Virtual Reality (VR) Studies**

  Anderson et al. (2017) demonstrated that VR simulations of natural environments facilitated stress recovery, with participants showing significantly lower heart rates and reporting greater relaxation compared to those experiencing virtual urban environments. This highlights VR's potential as a tool for studying space healing.

2.3.3.6 Challenges and Criticisms

While the concept of space healing has gained significant traction in both academic and practical applications, it is not without its challenges and criticisms. This section explores the various obstacles faced in the implementation and study of healing environments, as well as the critiques from different perspectives regarding the effectiveness and generalizability of space healing. Understanding these challenges is crucial for advancing the field and addressing the limitations that may hinder the broader application of healing spaces.

- **Methodological Challenges**

  Isolating environmental factors from confounding variables presents a significant challenge. Many studies rely on observational data influenced by participants' health conditions, socioeconomic backgrounds, and psychological predispositions, making it difficult to establish direct causal relationships between environment and healing (Ulrich et al., 2008). Additionally, psychological and physiological responses to environments vary significantly among individuals based on preferences, cultural backgrounds, and previous experiences, complicating standardized measurement of a space's healing potential (Golembiewski, 2010).

- **Generalizability of Findings**

Many studies are conducted in specific settings (hospitals, urban green spaces) and may not translate to other contexts. Much empirical evidence comes from Western contexts, raising concerns about cross-cultural applicability of space healing principles, as calming environments in one culture may not have the same effect in another (Gesler, 2003).

- **Economic and Practical Constraints**

Implementing healing environments often faces economic and practical constraints. Designing and maintaining spaces like healing gardens can be costly, particularly in resource-limited healthcare settings. Practical considerations such as space availability, climate, and maintenance requirements can limit feasibility in certain environments (Whitehouse et al., 2001).

- **Environmental Psychology Critiques**

Some scholars critique the emphasis on physical space as potentially overshadowing other critical healing aspects, such as social support, healthcare access, and personal agency. They advocate for a more holistic approach considering the interplay between environmental, social, and psychological factors (Evans & Furlong, 2003).

- **Ethical Considerations**

Ethical concerns include inequitable access to healing environments, particularly in urban areas where green space is often limited and unequally distributed. This raises environmental justice concerns, as individuals in lower-income neighborhoods may have less access to healing spaces. Additionally, there's risk of overselling benefits of healing spaces, particularly in commercial settings where wellness is increasingly commodified (Jennings et al., 2016).

2.3.3.7 Future Directions in Space Healing Research

The study of space healing continues to evolve, with numerous avenues for deeper understanding and practical application. As society increasingly recognizes environments' impact on well-being, multidisciplinary research exploring the nuanced interactions between space and health becomes essential.

- **Integration of Multisensory Environmental Factors**

  A promising research direction is exploring multisensory environmental factors and their cumulative effects on healing. Current studies often examine isolated elements like light, sound, or greenery without considering their interactions. Future research should investigate how combinations of natural sounds, natural light, and biophilic design elements collectively influence psychological and physiological well-being. This multisensory approach aligns with the understanding that human experiences are not compartmentalized by sense but are holistic and integrated, potentially revealing optimal conditions for promoting health across various settings (Daykin et al., 2008; Devlin & Arneill, 2003).

- **Longitudinal and Cross-Cultural Studies**

  Most existing research tends to be short-term and focused on specific populations in Western contexts. Longitudinal studies would provide insights into how sustained exposure to certain environments affects long-term health outcomes. Cross-cultural studies would help understand how cultural perceptions and practices related to space influence the effectiveness of healing environments. This is particularly important as the concept of healing spaces varies significantly across cultures, affecting how space is designed and utilized for health promotion in diverse populations. Such studies would ensure that principles of space healing are applicable and beneficial across different cultural contexts rather than being limited to Western perspectives (Gesler, 2003; Ulrich, 2006).

- **Technological Integration in Space Healing**

Advancements in virtual reality (VR), augmented reality (AR), and artificial intelligence (AI) offer potential for creating adaptable, personalized healing environments. VR could simulate natural environments in urban areas with limited green space access, allowing individuals to experience nature's psychological and physiological benefits without leaving their immediate surroundings. AI could monitor and adjust environmental conditions in real-time to optimize a space's healing potential. However, research must also examine potential downsides, such as over-reliance on technology or reduced physical interaction with nature. This balanced approach would ensure that technological innovations enhance rather than replace authentic healing experiences (Anderson et al., 2017; White et al., 2018).

- **Ethical Considerations and Social Justice**

Future research must address ethical considerations and social justice implications associated with healing spaces' design and accessibility. This includes examining who benefits from healing spaces and who might be excluded, exploring accessibility for marginalized communities, and ensuring equitable distribution of benefits. Moreover, the environmental impact of creating and maintaining healing spaces should be considered within sustainable development contexts. Addressing these ethical concerns will ensure that space healing evolves in an effective, just, and inclusive manner that benefits diverse populations rather than exacerbating existing inequalities (Dyck & Kearns, 2006; Esther & Sternberg, 2009; Jennings et al., 2016).

- **Expanding the Scope of Healing Spaces**

Research has traditionally focused on specific environments like hospitals, workplaces, and residential settings. There is a need to expand this scope to include other critical spaces such as schools, prisons, and public urban areas. Each environment presents unique challenges and opportunities for promoting health and well-being. In educational settings, healing spaces could support students' mental health while enhancing learning outcomes. In prisons, healing environments could contribute to rehabilitation and reduce recidivism. Research into these diverse contexts could provide valuable insights into how space healing principles can be adapted to different populations with varying needs (Kearns & Moon, 2002; Martin et al., 2013).

- **Methodological Innovations**

Future research should focus on methodological innovations to improve the robustness and applicability of findings. This includes developing new tools and metrics for assessing space's impact on health, as well as adopting interdisciplinary approaches combining insights from architecture, psychology, medicine, and environmental science. Researchers should explore big data and advanced statistical methods to analyze complex interactions between environmental variables and health outcomes. Refined methodologies would provide more precise, actionable recommendations for healing space design that can be implemented across various contexts (Esther & Sternberg, 2009; Gesler, 2003).

2.3.3.8 Conclusion of Healing Environment in Relation to Meditation

Space healing has emerged as a critical area within environmental psychology and healthcare design. The mechanisms influencing health through spatial design encompass psychological, physiological, and environmental factors, supported by theories including biophilia, environmental affordances, and therapeutic landscapes. These frameworks help explain how natural elements and thoughtful design impact psychological states and physiological markers (Kaplan & Kaplan, 1989; Ulrich, 1991).

Environmental factors—including light, sound, air quality, and spatial arrangement—create therapeutic atmospheres that can enhance healing. Natural elements combined with design considerations for comfort and accessibility have demonstrated measurable benefits including stress reduction, lower blood pressure, and improved outcomes across various settings (Esther & Sternberg, 2009; Ulrich, 2006).

The bidirectional relationship between psychological mechanisms (stress reduction, attention restoration, positive emotional states) and physiological responses (cortisol regulation, improved immune function) highlights the need for holistic approaches to healing space design (Hartig et al., 1991; Kaplan & Kaplan, 1989). Case studies and empirical evidence provide practical validation of these concepts, offering insights into successful implementations from hospital gardens to therapeutic landscapes (Gesler, 2003).

Despite its promise, the field faces challenges including ethical considerations of accessibility, sustainability concerns, and methodological limitations. Addressing these issues while expanding research to include diverse environments, populations, and approaches will be essential for advancement (Dyck & Kearns, 2006).

Space healing represents a dynamic, interdisciplinary field with significant potential for improving health outcomes through evidence-based design. As the field evolves, ensuring that healing environments are accessible, sustainable, and effective across diverse populations will be critical. By addressing current challenges and pursuing innovative research directions, space healing can significantly contribute to holistic health promotion that recognizes our surroundings' profound impact on well-being.

2.4 THE SPATIAL AND SPIRITUAL EXPERIENCES

The connection between space and spirituality has long been explored in architecture and environmental psychology. Spaces designed with sensory and symbolic elements influence human emotions, fostering mindfulness, introspection, and transcendental experiences (Pearson, 2005). By integrating natural and built environments, healing spaces can facilitate both spatial and spiritual experiences, shaping emotional well-being and self-awareness.

2.4.1 THE SPATIAL EXPERIENCES AND SENSORY EXPERIENCE

Pearson (2005) argues that health and well-being are associated with the body's spirit, with spiritual sensitivity combining with ecological values to create healthy buildings. Architecture links sensitivity and sensuality, with personal emotion allowing buildings to evoke spirituality through expression, aesthetics, and natural forces (Luckoo, 2011).

In the 21st century, architectural spirit has been redefined. Tadao Ando's work aims to create transcendent spaces like the Pantheon in Rome (Jodidio, 2007). His architecture communicates spirituality that remains neutral to all seekers rather than serving a specific religion.

The Water Temple exemplifies this approach through an experiential journey engaging multiple senses. The lotus pond (symbolizing enlightenment in Buddhism) features a central walkway leading to a lower staircase. Visitors descend via this stairway in a purification process before entering the underground shrine (Nitschke, 1993). The temple's design combines square mandalas (representing transparent wisdom) with a womb-like oval form creating an incredible experience, associating meditative spaces with human experiences (Nitschke, 1993).

Another example is Ando's Meditation Space at UNESCO headquarters, a concrete cylinder with no doors but two openings through which light emanates. A narrow skylight strip creates a sense of spirituality. The space remains calm yet powerful through its structure, with natural ventilation through breezes and light from above (Jodidio, 2007). This simplicity demonstrates that minimal elements can achieve profound objectives.

Sensory experience in space involves multiple dimensions. Visual components affect how space is perceived, activating the whole body beyond just the eyes. Color and texture are physical in phenomenological terms (Nitschke, 1993). Conversely, hearing is passive—sound fills space, displacing humans aurally. In natural settings like Zen gardens, sensory depth is structured through elements like flowing water or rhythmical sounds from bamboo striking stone (Nitschke, 1993).

2.4.2 SPIRITUALITY AND PLACE

Extensive research was conducted to evaluate the relationship between spirituality and architecture. The phenomenology of place is concerned with the level of consciousness that one experiences internally and externally in an environment. Understanding the importance of self-education and how to build a holistic environment would be aided by an understanding of the relationship between spirituality and nature (Luckoo, 2011). Humans are multi-faceted creatures and they adapt to various environmental conditions – i.e., physical, social and spiritual, as natural beauty induces reverent feelings about the spirit. Specifically, the human spirit can be a vessel in transcending influences to shape and nourish an individual environment (Day, 2002).

Beautiful places are ecological in nature and foster good health caused by the social disharmony that later causes stress and psychological and hormonal imbalances that propagate illnesses. Architecture is a tool for making pleasurable spatial experiences and cannot be separated from its environment. Its components form the entire atmosphere of the inner space it creates within a building, while the exterior represents a part of the environment. That is, some buildings demonstrate their influence over nature while others stick to a contour, such as a path or a field boundary. Hence, buildings can be defined as space boundaries. If the qualities of movement, life, harmony, and dynamic forces are emphasised in the forms, shapes, and lines, the space may have an impact on the human mind (Day & Rose, 2004). Therefore, architecture informs, educating and being responsible towards life. It starts from the outside to the inside and there should be a link between the sensual and spiritual experiences (Cusack, 2012).

2.4.3 BUILD ENVIRONMENTS AND SPIRITUAL PRACTICE

Spiritual practices are optimally performed in natural environments (Luckoo, 2011). Natural elements positively affect the human body and improve the seeker's path. Individuals connect with environments through personal experiences and sensory interactions. A holistic place emerges when natural elements integrate into built environments, contributing to harmonious living.

The association of light, space, visual structures, and tactile qualities creates transcendent experiences. Architectural efforts characterized by minimalist styles can be calming and structural, initiating journeys of positive spiritual and psychological experience. Integrated landscaping consolidates the relationship between humans and nature, creating settings suitable for spiritual activities (Luckoo, 2011).

The conditions of meditation spaces directly influence practice outcomes. If a meditation hall is dirty, noisy, or poorly ventilated, practitioners cannot concentrate effectively (นร วั ฒ น์ เจริญ รัช ต์ & สุดา วรรณ, 2018). Mindfulness is a key practice for present-moment awareness that reduces stress, anxiety, and depression (Steemers, 2019). Group meditation in appropriate environments promotes engagement from diverse participants with positive outcomes (Porter et al., 2017). Effective meditation spaces, such as rooms with semi-circular seating arrangements, help connect participants to both the environment and each other, facilitating achievement of practice goals.

2.5 MEDITATION SPACE

Meditation spaces have evolved over centuries, adapting to cultural and technological shifts while maintaining their core function providing an environment conducive to mindfulness and relaxation. These spaces integrate natural elements, sensory experiences, and architectural design to support meditation practices, reflecting diverse traditions and contemporary needs (Easwaran, 2016).

2.5.1 HISTORY OF MEDITATION SPACE

Meditation has a long history that spans cultures and continents. In ancient India, early practitioners often sought out natural environments like forests and mountains as their meditation spaces. Over time, more formalized meditation spaces emerged, including caves, temples, and monasteries (Easwaran, 2016). In China, Taoist meditation spaces were often designed to evoke natural landscapes, such as gardens and water features (Jou, 1983). In Japan, Zen Buddhism has had a significant impact on the history of meditation spaces, with Zen temples often featuring gardens and architectural elements that encourage mindfulness and contemplation (Fast, 2011).

In addition, during the early years of Buddhism, monks traveled without a permanent residence in search of spiritual goals. Today, monasteries serve as a place for religious activities for both Buddhists and monks. Within the monastery, the vihara is a designated space for meditation and other religious practices following morning and evening chants. In the past, Buddhists would meditate in groups in a vihara after listening to sermons and performing good deeds. In Southeast Asian countries, monks are required to meditate in their rooms after completing their daily monk duties (Hays, 2019).

In the realm of meditation spaces Zen serves as an example that underscores the role these spaces play in the practice of Zen Buddhism. Within Zen meditation spaces, known as zendo hold value as they embody the principles of simplicity, minimalism and a connection, to nature. These crafted spaces aim to cultivate mindfulness and serenity enabling practitioners to focus on their breath and inner tranquility. The quality of meditation and the attainment of a state of Zen can be influenced by the environment itself. As Takahiko Kameyama, a Zen monk and scholar aptly stated, "the zendo is an embodiment of Zen itself—a place where Zen teachings come alive through the practice of meditation" (F, 2017). Henceforth designing the zendo plays a role, in creating an atmosphere to practicing Zen meditation.

Natural elements play a role in the design of Zen meditation spaces. They are believed to foster a sense of tranquility and calmness creating an atmosphere that's conducive, to meditation. The incorporation of elements like wood, stone, water and plants aims to establish a connection between the practitioner and nature. This connection encourages a feeling of unity and interdependence (LETELLIER, 2022). According to feng shui expert Sarah Rossbach having elements is vital for creating an environment for meditation. These elements help ground the practitioner and bring forth stability and balance which're essential for meditation practice (Rossbach, 1983). Hence the presence of elements in Zen meditation spaces goes beyond decoration; it serves a practical purpose, in facilitating meditation practice.

While incorporating elements is undoubtedly crucial, in creating Zen meditation spaces it's vital to acknowledge that it's not the factor influencing the effectiveness of meditation. The mindset, level of training and intention of the practitioner also play a role in Zen meditation. Additionally placing emphasis on elements might overlook the importance of considering cultural and historical context when designing meditation spaces. As architectural historian Grace Yen Shen suggests, "Meditation space design should reflect the historical background of the practice than relying solely on a standardized belief in natural elements as essential, for meditation" (Leggett, 2022). Therefore while natural features can enhance meditation spaces effectiveness it's crucial to recognize their limitations and incorporate them appropriately within the historical context of the practice.

2.5.2 MEDITATION SPACE IN RECENT DAYS

Meditation has gained popularity in Western cultures in recent years, leading to the creation of purpose-built spaces and adaptations of existing spaces like churches or community centers (Cameron, 2018). These modern meditation spaces typically blend Eastern traditions, such as incense or Buddha statues, with contemporary features like technology and soundscapes (Wilson, 2020).

The modern meditation movement has seen significant growth in the number and variety of meditation spaces. Meditation studios, retreat centers, and apps have become increasingly popular, catering to individuals looking for convenient, accessible, and personalized meditation experiences (McCormick, 2023). Mindfulness-based stress reduction (MBSR) and other secularized forms of meditation have also gained popularity in healthcare settings, schools, and workplaces (Schmalzl et al., 2015). The development of technology has also had a significant impact on modern meditation spaces. Meditation apps like Headspace and Calm offer guided meditations and personalized recommendations, while virtual reality meditation allows individuals to immerse themselves in a digital environment (Thompson, 2022). While some critics argue that the commercialization of meditation and commodification of mindfulness undermines the authenticity and ethical foundations of meditation (Purser, 2019), others argue that the accessibility and democratization of meditation spaces have made meditation more inclusive and beneficial to a wider range of individuals (Lomas et al., 2019).

The suitability of meditation settings relies on an individuals requirements and preferences. Typically, serene and tranquil surroundings are considered optimal, for meditation since they minimize disturbances and enable concentration and relaxation (Lomas et al., 2015). Some individuals find solace in environments like parks or forests as they believe the calming influence of nature enhances their meditation experience (Joye & Bolderdijk, 2015). Nonetheless meditation can also be practiced in natural settings such as meditation halls, homes or workplaces. Certain forms of meditation like loving kindness meditation may be more fitting in an environment such, as group practice sessions (Galante et al., 2014). The appropriateness of environments also hinges on the type of meditation being pursued and the practitioners level of expertise. For instance, beginners may benefit from guided meditations offered by apps or teachers while seasoned meditators may prefer self-guided practices within a comfortable space.

Research indicates that specific meditation settings can enhance the effectiveness of meditation practice. Creating an distraction free environment has been found to be beneficial, for reducing stress and promoting relaxation (Bennett, 2017). A study discovered that experienced meditators preferred a meditation room with distractions and comfortable seating (Mullins, 2017).

Additionally being in surroundings like parks or forests has been shown to have an impact on meditation by lowering stress levels and increasing feelings of well-being (Tsunetsugu et al., 2010). Incorporating aromatherapy into meditation environments, such, as using lavender oil has also been proven to have an effect and encourage relaxation (Fismer & Pilkington, 2012). However, it's important to recognize that the choice of meditation environment may vary depending on needs and preferences.

The trend of meditation is increasingly growing in the present day, creating an opportunity for a new design of places and spaces for meditation. The emphasis of modern meditation spaces is on design space, which integrates with the building principles of healing space. Golenda (2017) explores the collection of meditation pavilion surveys spaces created out in the open, surrounded by nature, and distanced from the buildings. The space for meditation can be effectively designed with concern for the quality of space, which can increase mental health. The Won Dharma Centre is a place for meditation and spiritual retreat in Claverack, New York, focusing on the harmony of design for meditation, i.e., structures and interior design incorporates the natural environmental surroundings and are created to support meditation activities (Hanrahan, 2012).

2.5.3 LITERATURE ANALYSIS OF ENVIRONMENTS' IMPACT ON MEDITATION PRACTICE

Meditation has been used for centuries as a means to reduce stress induce relaxation and improve well-being. In times it has gained popularity due, to its benefits leading to the creation of various meditation environments. The effectiveness of meditation greatly depends on the surroundings in which it takes place. To ensure meditation practice it is important to have a peaceful space that is clean and well ventilated (Khoury et al., 2013).

When it comes to creating a meditation space one crucial aspect to consider is the environment surrounding it. Natural settings, like gardens forests and parks are ideal for practicing meditation because they offer an serene atmosphere that aids in relaxation (Rowland, 2023). Moreover research by Berman et al. (2008) has shown that being in environments can enhance performance and reduce stress levels. Therefore, incorporating elements of nature, like plants and water features into your meditation space will help create a soothing ambiance that fosters mindfulness.

Nowadays meditation spaces have evolved to accommodate design principles. These spaces utilize elements, like lighting, music and fragrance to enhance the meditation experience. When it comes to designing a meditation space it's crucial to consider the lighting. Harsh or bright lights can be. Disrupt the process of meditation. On the hand soft and gentle lighting can create an atmosphere of relaxation and tranquility (Moore & Malinowski, 2009). Additionally incorporating soothing music or natural sounds such as flowing water or birdsong can contribute to an environment that complements the practice of meditation (Kang et al., 2018). Fragrance also plays a role in establishing an ambiance. Essential oils, like lavender, frankincense and sandalwood have been discovered to promote relaxation and alleviate anxiety (Bradley et al., 2007).

Creating the space and ambiance is essential, for a meditation practice (Lomas et al., 2015). Natural surroundings like gardens, forests and parks offer a serene atmosphere that enhances relaxation (Rowland, 2023). According to Park et al. (2010) spending time in forests can help reduce stress and improve well-being. Integrating elements such as plants, water features and pleasant scents into the meditation space can also promote relaxation (Van Den Berg & Custers, 2011). For instance Lee et al. (2015) discovered that having plants can effectively decrease stress and anxiety among hospital patients. Besides incorporating elements factors like lighting and music are worth considering to create a tranquil environment. Ratcliffe et al. (2013) revealed that bird sounds aid in stress recovery while Bradt et al. (2013) found that walking with music can reduce stiffness in patients, with artery disease. Therefore when designing a meditation space it is crucial to take these aspects into account to establish an environment to meditation practice (Ulrich, 1979).

Creating the setting, for meditation is essential for its success. Researchers have examined two types of environments; gardens and designed spaces for meditation. Natural settings like gardens forests and parks can offer an tranquil atmosphere that enhances relaxation during meditation (Kang et al., 2009). By incorporating elements such as plants, water features and pleasant scents the calming ambiance of a garden can be further enhanced for meditation practice. On the hand modern design spaces that take into account factors like lighting and music can also provide an environment, for meditation (Chen et al., 2006). Thoughtfully selected lighting, soothing music or natural sounds and comfortable seating arrangements contribute to creating an atmosphere to mindfulness and relaxation.

When creating a garden, for meditation purposes it's beneficial to include elements like plants, water features and pleasant scents. Research conducted by Raanaas and their team (2011) suggests that having greenery in the form of plants and trees can help reduce stress levels and uplift ones mood. Additionally incorporating water features like fountains or streams can have a soothing effect since the sound of flowing water has been proven to lower cortisol levels. A hormone associated with stress (Lee et al., 2015). Furthermore, adding natural fragrances such, as lavender or jasmine can further enhance relaxation during meditation (Diego et al., 1998; Kuroda et al., 2005).

In designing a proper design space for meditation, it is essential to consider elements such as lighting and music. Research by Yoto and colleagues (2007) found that lighting can significantly impact relaxation and mindfulness during meditation. Using dim, warm lighting can help create a calming atmosphere, while bright, cool lighting may be too stimulating. Incorporating music or natural sounds such as flowing water or birdsong can also create a soothing environment that enhances meditation practice (Ratcliffe et al., 2013). Comfortable seating, such as cushions or chairs, can also aid in relaxation during meditation practice.

In summary, creating an environment that is conducive to meditation practice requires careful consideration of elements such as natural settings, lighting, music, and seating. Both gardens and proper design spaces can provide an ideal environment for meditation practice. The inclusion of natural elements such as plants, water features, and scents can enhance the calming atmosphere of a garden, while lighting, music or natural sounds, and comfortable seating can create a peaceful atmosphere in a proper design space. By taking these factors into account, individuals can design a meditation space that facilitates mindfulness, relaxation, and overall well-being.

2.5.4 IMPACT OF SENSORY EXPERIENCES IN MEDITATION

Sensory experiences play a fundamental role in meditation, influencing relaxation, focus, and the overall effectiveness of the practice. Traditional meditation environments, such as natural landscapes, provide multi-sensory engagement through visual, auditory, and tactile stimuli, which can enhance mindfulness and well-being (A. Kaplan, 1995). In contrast, modern meditation settings, including enclosed rooms and virtual reality (VR) environments, may lack certain sensory elements, raising questions about their ability to support meditation as effectively as natural settings (Baños et al., 2011). Understanding the impact of different sensory modalities vision, sound, touch, and olfaction can provide valuable insights into designing optimal meditation environments.

- **The Role of Visual and Auditory Stimuli**

  Visual perception significantly influences meditation, shaping focus and emotional responses. Studies suggest that exposure to natural scenery, such as greenery and water, reduces stress and promotes cognitive restoration (Kaplan & Kaplan, 1989; Ulrich et al., 1991). Natural landscapes offer "soft fascinations" gentle, engaging visual elements that effortlessly capture attention and support meditation by reducing mental fatigue (S. Kaplan, 1995). In contrast, artificial environments with excessive clutter or harsh lighting may disrupt meditation by overstimulating the senses, making it harder to maintain focus (Hartig et al., 2003).

VR technology attempts to replicate natural visuals, offering immersive environments that mimic real-world landscapes (Riva et al., 2012). While VR-generated nature scenes can provide relaxation, their impact on meditation varies. Meditation techniques that involve closing the eyes, such as mindfulness-based stress reduction (MBSR), limit the role of visual input, reducing the effectiveness of VR's immersive qualities (Chiesa et al., 2011). However, for open-eye meditation techniques, VR may serve as a useful alternative to real-world natural environments by offering simulated restorative settings.

Auditory stimuli also play a crucial role in meditation, influencing emotional states and physiological responses. Natural sounds, such as rustling leaves, flowing water, or birdsong, have been shown to lower stress and enhance relaxation (Wrightson, 2000). Soundscapes in meditation environments help mask distracting noise, creating a more immersive experience. However, VR meditation faces challenges in sound replication; while it can generate calming audio, it often lacks the spatial depth and organic variations of real-world sound, reducing its effectiveness (Blesser & Salter, 2007). Furthermore, wearing headphones during VR meditation may isolate users from their physical surroundings, potentially diminishing the connection to the practice.

- **Tactile and Olfactory Influences on Meditation**

Touch and physical comfort are essential factors in meditation. The sensation of sitting on a cushion, the texture of a mat, or the warmth of a meditation blanket provides grounding and enhances bodily awareness, supporting focus and relaxation (Field, 2014). VR meditation, however, often lacks haptic feedback, meaning users miss out on the physical sensations that contribute to meditation depth. Some studies suggest that incorporating haptic elements, such as weighted blankets or vibrating feedback, may improve the effectiveness of VR meditation by compensating for missing tactile stimuli (Culbertson et al., 2018).

Olfactory stimuli, such as incense, essential oils, or natural scents, have also been found to influence meditation experiences. The sense of smell is directly linked to the limbic system, the brain region responsible for emotion and memory, making it a powerful tool for relaxation and mental clarity (Herz, 2004). Traditional meditation spaces often incorporate aromatic elements, such as sandalwood or lavender, to enhance focus and tranquility (Goel & Grasso, 2004). However, VR meditation currently lacks olfactory integration, which may limit its ability to fully replicate the sensory richness of physical meditation environments. Emerging technology in digital scent delivery may help address this gap, enabling more immersive VR meditation experiences in the future (Ranasinghe et al., 2017).

- **The Challenges of Sensory Deprivation and Future Considerations**

While sensory engagement enhances meditation, sensory deprivation can also be a technique for deepening practice. Closed-eye meditation reduces visual distractions and heightens awareness of other senses, such as sound and touch, allowing meditators to achieve a more introspective state (Lazar et al., 2005). Some studies suggest that visual deprivation activates brain regions linked to self-awareness and emotional regulation, supporting meditative states (Davidson & Lutz, 2008). However, the effectiveness of sensory deprivation varies among individuals while some experience greater focus, others find that it intensifies internal distractions (Siegel, 2007).

For VR meditation, closed-eye techniques present a challenge, as they negate the immersive visual component, limiting the technology's effectiveness (Riva et al., 2012). Additionally, VR's lack of natural tactile and olfactory engagement may reduce meditation depth. Future advancements in haptic feedback and digital scent technology could enhance sensory realism, creating a more immersive experience (Culbertson et al., 2018; Ranasinghe et al., 2017). In the meantime, combining real-world elements such as incense, soft lighting, and textured surfaces with VR meditation may help bridge the sensory gap, offering a more holistic approach to digital meditation.

The role of sensory experiences in meditation is crucial, as vision, sound, touch, and smell all contribute to relaxation, focus, and overall well-being. Natural environments provide the most comprehensive sensory engagement, supporting mindfulness through a combination of restorative visual, auditory, and tactile elements. VR meditation, while offering immersive visual simulations, still faces challenges due to the absence of full sensory integration. Closed-eye meditation techniques further complicate VR's effectiveness, highlighting the need for multi-sensory solutions. Future research should explore integrating haptic feedback, olfactory stimuli, and dynamic soundscapes to enhance VR meditation, ensuring it provides a rich and effective experience comparable to traditional meditation environments.

2.6 MEDITATION PRACTICE

Meditation is a long-standing practice that promotes self-awareness, emotional regulation, and mental well-being. It has evolved from religious origins into a widely recognized method for stress reduction and cognitive enhancement. Across different cultures and traditions, meditation incorporates diverse techniques, yet all share the common goal of achieving inner peace and mindfulness. With increasing scientific interest, meditation has gained prominence in healthcare, education, and psychological therapies. This section explores its significance across religious traditions, various forms, and its therapeutic applications.

2.6.1 MEDITATION IN DIFFERENT RELIGIONS

Throughout history, meditation has been deeply embedded in religious traditions, shaping spiritual practices across different cultures. The earliest records trace meditation back to 1500 BCE in India, where it was used as a path to spiritual enlightenment (Feuerstein, 2012). Over time, meditation techniques have evolved uniquely within each tradition, adapting to cultural and philosophical contexts.

- **Hinduism**

  Meditation in Hinduism is closely tied to yoga, a spiritual discipline aimed at self-realization and union with the divine. The earliest references appear in the Vedas, ancient Hindu scriptures that discuss practices like mantra chanting and breath control (Hays, 2023). Hindu meditation emphasizes achieving Moksha (liberation) by transcending worldly distractions (Singh & Srinivasan, 2019). Popular meditation forms in Hinduism include Transcendental Meditation (TM), mantra meditation, and yoga-based contemplative practices.

- **Buddhism**

Buddhist meditation is fundamental to the path of enlightenment. The Buddha himself meditated for six years before attaining enlightenment, and his teachings emphasize mindfulness and concentration techniques (Gethin, 2011). The two principal Buddhist meditation practices are:

  - **Samatha (Calm-Abiding Meditation)**: Focusing on an object (e.g., breath) to cultivate deep concentration.
  - **Vipassana (Insight Meditation)**: Observing thoughts and sensations to develop awareness and detachment from suffering (Schaeffer, 2016).

Meditation is central in both Theravāda and Mahāyāna Buddhism, influencing mindfulness-based therapies used in modern psychology.

- **Christianity**

Christian meditation dates back to early Christian mystics, such as St. John of the Cross and St. Teresa of Avila, who practiced contemplative prayer (Underhill, 2002). This form of meditation involves silent reflection, scripture reading, and prayer recitation, aiming to deepen one's connection with God (Paintner, 2013). While not as formalized as Eastern traditions, meditation remains a crucial practice in monastic and mystical Christian traditions.

- **Judaism**

Meditation in Jewish tradition includes practices such as Hitbodedut (self-reflection in solitude) and Kavanah (intention-focused prayer) (A. Kaplan, 1995). These meditative approaches aim to enhance spiritual awareness and connection with God. While less structured than Eastern meditation, Jewish contemplative practices remain essential for personal growth and self-discovery (Hilert & Gutierrez, 2020).

- **Islam**

  In Islam, meditation is practiced through Fikr (deep contemplation) and Zikr (remembrance of God). These techniques involve silent introspection and repetitive chanting of divine names to attain spiritual clarity and emotional stability (Caponigro, 2012). Meditation is especially prominent in Sufi traditions, where rhythmic breathing, movement, and chanting are used to achieve spiritual transcendence (Beatty, 2008).

Meditation is a universal practice that transcends religious boundaries, adapting to different cultural and philosophical beliefs. While Hinduism and Buddhism emphasize meditation as a path to self-realization, Christianity, Judaism, and Islam use it to deepen spiritual connection and contemplation. Over time, meditation has expanded beyond religious traditions, becoming a valuable therapeutic tool in modern psychology and well-being practices.

2.6.2 FORMS OF MEDITATION

Meditation is a broad practice encompassing various techniques aimed at improving self-awareness, relaxation, and cognitive function. While traditionally rooted in religious and spiritual practices, many meditation forms have evolved into secular approaches widely used for stress reduction, emotional regulation, and overall well-being. This section highlights key meditation techniques, their benefits, and their applications.

- **Transcendental Meditation (TM)**

  Transcendental Meditation originated in India and was introduced to the West in the 1950s by Maharishi Mahesh Yogi (Feloni, 2016). From the Vedic tradition, TM involves using a mantra, a sound or word repeated silently to focus the mind and achieve deep relaxation while maintaining alertness (Karpen, 2015). Its goal is to release mental and physical stress; while the body rests deeply, the mind remains fully alert (Barnes et al., 2016). TM is practiced by closing eyes, sitting comfortably, and using mantra sounds without specific meaning, enabling practitioners to access finer levels of awareness beyond normal thinking (Rees et al., 2014). Research suggests TM can reduce stress, anxiety, and depression (Jevning et al., 1992) and improve health and functioning (Rosenthal et al., 2011), though some researchers call for more rigorous investigations (Krisanaprakornkit et al., 2010).

- **Mindfulness-Based Stress Reduction (MBSR)**

Developed by Jon Kabat-Zinn in the 1970s (Kabat-Zinn, 2003), MBSR aims to help individuals manage stress, anxiety, and pain through mindfulness cultivation—observing present-moment experiences without judgment. MBSR typically includes seated meditation, body scan meditation, and gentle yoga exercises (Kabat-Zinn, 2013), usually taught over an eight-week program requiring 30-45 minutes of daily practice.

MBSR has expanded to approximately 120 programs worldwide and has been carefully distanced from religious contexts despite drawing inspiration from Buddhism. Kabat-Zinn developed it as a universal concept beyond religious and cultural frameworks (Hickey, 2010). The practice focuses on breathing, walking, sitting, and simple yoga postures. Studies have shown MBSR's positive effects on symptoms of physical and mental illnesses, including cancer, depression, and anxiety. The core principle of mindfulness requires focused, non-judgmental present-moment awareness (Dargah, 2016).

Research indicates MBSR can alleviate symptoms of depression, anxiety, and chronic pain (Chiesa et al., 2011; Garland et al., 2015; Hilton et al., 2017) and positively affect brain structure and function (Creswell et al., 2012; Davidson et al., 2003). While evidence supports MBSR's effectiveness, some researchers advocate for further investigation into its underlying mechanisms (Carmody & Baer, 2009).

- **Loving-Kindness Meditation (LKM)**

Also known as Metta Meditation, Loving-Kindness Meditation is rooted in Buddhist teachings (Salzberg & Kabat-Zinn, 2004). Its main objective is to nurture feelings of love, kindness, and compassion toward oneself and others (Salzberg, 2011). Practitioners repeat intentional phrases directed first toward themselves, then loved ones, acquaintances, and eventually all living beings.

LKM aims to develop an affective state of unconditional kindness to all people, cultivating care, concern, and tenderness (Brown, 2016). Techniques vary based on different Buddhist traditions but use the same core psychological operation—generating kind intentions toward specific targets. Practitioners typically begin with wishes for inner peace and well-being for themselves and loved ones before extending these feelings to friends, family, neighbors, acquaintances, and eventually people worldwide, focusing on connection and compassion (Scott, 2018).

Research shows LKM can reduce depression and anxiety symptoms (Hofmann et al., 2011; Seppala et al., 2014), increase social connectedness and empathy, and positively impact brain activity—increasing activity in regions associated with positive emotions while decreasing activity in regions linked to negative emotions (Hölzel et al., 2011; Klimecki et al., 2014).

- **Vipassana Meditation**

Vipassana Meditation, dating back over 2,500 years in India, is linked to Buddhist tradition (Hart, 2011) and was one of the meditation methods discovered by Buddha to attain enlightenment (Goenka, 2016). It focuses on developing awareness of mind and body, rooted in mindfulness principles and emphasizing present-moment observation of thoughts and emotions without attachment.

Typically practiced in tranquil retreats lasting 10 days or longer, participants follow a structured schedule of meditation, mindfulness practices, and introspection (Hart, 2011). Exercises aim to deepen momentary awareness through focus on breath, sensations, thoughts, and emotions. The technique emphasizes non-judgmental mindfulness and cultivates self-awareness, acceptance, and compassion (Salzberg, 2010).

Research indicates Vipassana Meditation produces various beneficial effects. Studies show decreased stress and anxiety levels (Hoge et al., 2018; Khoury et al., 2015), enhanced mood (Jain et al., 2015), and improved overall well-being (Davidson et al., 2003). Brain research shows increased activity in regions connected to attention, self-awareness, and emotional regulation (Farb et al., 2007; Lazar et al., 2005). Ultimately, Vipassana cultivates self-awareness and emotional resilience with potential for long-term well-being.

As the main meditation form in Thai Buddhist Theravada and other Asian countries, Vipassana is also known as 'mindfulness meditation' in Western countries (Young, 1994). The practice requires mindful movement and focused attention, such as maintaining awareness on the rising and falling of the abdomen during sitting meditation. Courses typically last 3-7 days, featuring sitting and walking meditation in silence. The technique can also serve therapeutically to reduce persistent pain and recurrence of depression and anxiety (Dargah, 2016).

2.6.3 HOW BUDDHIST MEDITATION IS PRACTICED?

The practice of Vipassana meditation is taught in a variety of techniques by different teachers. This form of meditation is known in Western countries and US under the name, insight meditation or mindfulness meditation (Dargah, 2016). Vipassana practice is defined as observing the self and being aware of any mental content including thoughts, imagery, and physical sensations as they occur in consciousness during meditation practice (Birnbaum, 2005).

The Vipassana meditation course requires silence during the course, i.e., not allowed to say except getting practice directions or emergencies with trainers (Dargah, 2016). This practice includes walking and sitting meditation as the main activities. According to the National Office of Buddhism, walking meditation requires keeping the mind on the feet, i.e., starting from the right foot followed by the left foot. Specifically, walking meditation requires practising more slowly than the usual walk, feeling the moment of feet moving and keeping the mind on the feet, and acknowledging any distraction that comes to thought. While sitting meditation requires sitting mindfully and keeping the mind on the rising and falling of the abdomen movement, when the mind is distracted, bring the concentration back to the abdomen movement immediately, and continue keeping the awareness on the rising and falling of the abdomen. Moreover, everything that comes to the mind, including seeing, hearing, eating, thinking and smelling, needs to be observed mindfully and accept those senses without judging, and be aware of the mind in the present (National & Buddhism, 2017).

According to research, incorporating meditation into students' routines can improve their metacognitive skills and encourage critical, analytical, and creative thinking (Napora, 2011). It also enhances attention (Valentine & Sweet, 1999), problem-solving abilities (Valentine & Sweet, 1999), emotional intelligence (Rosaen & Benn, 2006), psychosocial strengths, and self-regulation (Wisner et al., 2010). Developing these skills can lead to improved performance in the classroom, including during exams.

Two studies, conducted by Mata (2012) and Ching et al. (2015), have demonstrated the successful implementation of meditation in the classroom. Mata (2012) introduced a 5-7 minute meditation practice to undergraduate students in an early childhood education course, resulting in improved calmness, relaxation, centeredness, attention readiness, concentration, and clarity of mind. Incorporating meditation techniques into a college curriculum has the potential to improve cognition, clarity of mind, and attention among college students (Ching et al., 2015; Mata, 2012). Additionally, Ching et al. (2015)found that a one-semester mindfulness meditation course led to significant improvement in attention and memory components of cognitive performance among university students, with the intervention group demonstrating increased accuracy in digital vigilance tasks, choice reaction time, and spatial working memory.

2.6.4 MEDITATION AS A TREATMENT

Nowadays, meditation is no longer necessarily connected to religion and new forms of meditation always welcome people to practice (Oslo, 2014). Mindfulness plays an important role in helping new generations to improve their mental health and reduce stress. This is supported by several scientific research showing that mindfulness meditation helps in stress reduction, lowering blood pressure, stroke prevention, mental health treatment, immune system improvement and many more. Moreover, some studies further argue that meditation practice can increase T-cell production in the mail with HIV (Francis, 2016).

Mindfulness-Based Stress Reduction (MBSR) is the 8-week class of mindfulness meditation run by Jon Kabat-Zinn. Kabat-Zinn has learned and was inspired by Buddhism and Buddhist meditation for several decades to develop the MBSR program as a universal programme.

The MBSR program consists of meditation practice focusing on breathing, walking and sitting. Simple yoga posture is also a part of this course but breathing is the main practice. Several medication research provides evidence showing that MBSR can improve recovery and provide a better healing process, such as cardiac health, better immune responses to the flu vaccine and positive mood enhancement (Shannon Hickey, 2010).

A study reveals a positive effect of Kundalini Yoga Meditation Techniques on cancer therapies, i.e., these techniques deserve serious consideration for the treatment of psycho-oncology symptoms, palliative care, and cancer symptomatology and progression (Shannahoff-Khalsa, 2005). Another study reveals a positive impact of mindfulness meditation on health among patients with cancer. To extend the current knowledge on this topic, the author further calls for research to evaluate the impact of mindfulness meditation in the cancer population to support interventions and enhance the well-being of cancer survivors (Matchim & Armer, 2007).

In recent years, mindfulness practice is known as a way to reduce stress and increase psychological functioning in cancer patients. Most participants reported the positive effects after the practices, including increased calm, better sleep quality, better energy, less physical pain, and increased well-being. As a result, the patients can enhance their capacity to handle the stresses that affect the body's ability to heal. "Mindfulness is not a cure for cancer but certainly can contribute to the overall well-being of the body," (Lindberg, 2017). Meditation practice is a safe and effective treatment for the new natural-healing medical solutions. Meditation practice can heal psychological conditions and improve mental health, however, scientific research shows that it can also be helped with some serious diseases. More importantly, people in the West are now accepting it as a treatment for not only mental health but also for well-being and a way of healing diseases (van den Berg & Wagenaar, 2006).

2.6.5 SENSORY EXPERIENCES IN BUDDHIST MEDITATION

Buddhist meditation emphasizes sensory awareness, particularly in mindfulness and Vipassana practices where practitioners observe sensations, thoughts, and emotions without judgment or immediate reaction. In Buddhist philosophy, sensory experiences are viewed as fleeting and impermanent; acknowledging this impermanence provides insights into reality and self-nature.

Cultivating awareness during meditation reduces anxiety and depression symptoms, enhances attention and cognitive function, and promotes overall well-being. Research demonstrates that long-term meditation practice causes brain changes, increasing activity in regions associated with sensory processing and attention regulation (Lutz et al., 2008; Tang et al., 2015).

Most meditation courses aim to increase concentration and awareness by gradually observing feelings, directly affecting sensory experiences. Meditation physically alters brain structures related to self-control, emotion regulation, positive emotions, and attention (Salzgeber, 2018). Meditation activities focus on sitting, walking, and daily activities with primary emphasis on present-moment awareness. As noted by Sraman (2016): "when I walked keeping the mind on feet, I felt the difference from the usual walk," experiencing a calmer mind while walking mindfully at a slower pace.

Bringing awareness to each moment is essential in mindfulness meditation, attending to sensory experiences, thoughts, emotions, and body sensations. Regular meditation results in positive mental states (Wittmann & Schmidt, 2014). Beginners often find Vipassana meditation challenging despite its apparent simplicity—sitting still, focusing, clearing the mind, and experiencing the present moment can be disrupted by emotions like anger, despair, or impatience (Peterson, 2010).

According to Wittmann (2014), four functional aspects encompass mindfulness, predominantly involving modulating and generating time experiences. In meditation practice, the meditator focuses on the present moment through embodied self-experience; the feeling of time emerges by attending to the embodied self, and being exceptionally mindful appears to slow the passage of time.

2.7 MEDITATION IN ACADEMIC SETTINGS

Universities increasingly recognize the impact of mental health challenges on student performance, with rising levels of stress, anxiety, and burnout affecting academic success. The transition to higher education presents academic, financial, and social pressures, leading to emotional distress. While universities provide counseling services and wellness programs, there is growing interest in meditation as a non-pharmacological intervention to improve well-being.

Research suggests that meditative practices enhance cognitive performance, emotional stability, and stress management, making them a valuable tool in academic environments. Many institutions are integrating meditation, mindfulness programs, and dedicated spaces to promote resilience among students. This section explores the challenges faced by students, the role of meditation in addressing these concerns, and practical applications within academic settings.

2.7.1 COLLEGE STUDENT HEALTH AND WELL-BEING

The well-being of college students has become a growing concern for universities worldwide, as their physical and mental health significantly impacts academic success and quality of life. Students are particularly prone to stress and anxiety from academic pressures, financial worries, isolation, and time management difficulties (Dyrbye et al., 2014; El Ansari et al., 2014).

The transition to college itself creates stress as students adapt to new environments and challenges (Arnett, 2000; Bodenmann et al., 2010; Storrie et al., 2010).

- **Academic Pressure**

  College students face substantial pressure meeting expectations set by themselves and others. This includes pursuit of high grades, fear of failure, peer competition, and external pressures to excel (Patel et al., 2018). Research links academic pressure to anxiety, depression, reduced self-esteem, elevated stress, and diminished life satisfaction (Andrews & Wilding, 2004; Patel et al., 2018).

  Universities should provide counseling services, stress management workshops, and support programs for developing effective study habits (Hamaideh, 2011). Parents and society must balance academic achievement with students' mental health and well-being (Desai; Mackenzie et al., 2011; Stallman, 2010).

- **Financial Struggles**

  Financial hardships significantly impact students' academic performance and mental health. Two-thirds of college students face food or housing insecurity, with 12% experiencing homelessness (Goldrick-Rab et al., 2017). These difficulties often force students to work long hours, disrupting studies and leading to burnout and mental health issues (Hunt & Eisenberg, 2010; Li et al., 2022).

  Solutions include financial aid programs, financial literacy education, and addressing root causes like high tuition fees (Abad, 2018; Cuseo, 2022; Elliott & Lewis, 2016).

- **Social Isolation**

Social isolation negatively affects student well-being. Establishing connections and belonging are vital for academic achievement and emotional wellness (Eisenberg et al., 2012), while isolation increases depression and anxiety risks (Primack et al., 2017).

Universities can promote social connections through events, clubs, counseling services, and support groups (Center, 2023; Cutrona et al., 2005). Technology offers additional social engagement opportunities, though balance with face-to-face interactions is essential (Valkenburg et al., 2006; Waldron et al., 2020).

- **Lifestyle Changes**

College often brings lifestyle changes affecting health. Students typically consume more fast food and less nutritious options (Larson et al., 2020), increasing risks of obesity and cardiovascular diseases (McIntyre et al., 2018). Physical activity often decreases due to academic demands (Sheehan et al., 2018), and irregular sleep patterns impact cognitive function and mental health (Gaultney, 2010; Tsai et al., 2022).

Universities can encourage healthy behaviors through nutrition education, healthy food options, fitness opportunities, and sleep hygiene awareness (Gaultney, 2010; Larson et al., 2020).

- **Exam Pressure and Interventions**

High-stakes exams create significant stress, potentially leading to depression and even suicidal thoughts (Rosiek et al., 2016; Sax, 1997). Recent challenges like the pandemic shift to online learning have further impacted student mental health (Ferdig et al., 2020; Hartshorne et al., 2020).

Effective interventions include meditation practices, mindfulness-based stress reduction, and cognitive-behavioral therapy (Biegel et al., 2009; Kauts & Sharma, 2009;

Sibinga et al., 2013). By addressing these various stressors, universities can promote healthier, more successful academic experiences.

2.7.2 IMPACTS OF MEDITATION PRACTICE ON EDUCATION: PREVIOUS STUDIES

The incorporation of meditation practices into educational settings has gained considerable attention due to its potential to enhance cognitive, emotional, and interpersonal development among students and educators. Research has demonstrated that meditation fosters self-awareness, improves attention, regulates emotions, and reduces stress factors that contribute to an enriched academic experience. This section synthesizes previous studies exploring the impact of meditation in education, including methodological considerations, key findings, and the broader implications for pedagogical practices.

- **Theoretical Foundations of Meditation in Education**

  Meditation practices in education often draw upon mindfulness, loving-kindness meditation, and contemplative self-reflection. These principles, rooted in Buddhist traditions but adapted for secular educational applications, have been studied for their role in fostering emotional intelligence, self-regulation, and interpersonal harmony. Mezirow's transformative learning theory (1991) and Salovey and Mayer's emotional intelligence framework (1990) provide conceptual support for meditation's role in shifting cognitive and emotional perspectives, leading to enhanced academic engagement and psychological well-being. Additionally, Vygotsky's sociocultural theory highlights the potential of meditation in collaborative learning environments, supporting social-emotional development alongside academic performance.

- **Key Empirical Studies on Meditation in Educational Contexts**

Several influential studies highlight the benefits of meditation in academic settings. Birnbaum (2005) introduced mindfulness-based self-observation techniques among first-year social work students, revealing that guided introspection through meditation enhanced self-awareness and critical reflection. Brown (2016) examined the practice of loving-kindness meditation in classrooms, demonstrating that meditation contributed to emotional stability, improved teacher-student relationships, and created a positive learning atmosphere.

Tobin (2018) proposed mindfulness heuristics in education, such as Mindfully Speaking and Mindfully Listening, which emphasized the role of meditation in enhancing communication and classroom interactions. Meanwhile, the Marina Middle School case study illustrated the practical benefits of structured contemplative sessions, showing that regular meditation led to improved academic performance and behavior (Pentsil, 2021). Additionally, Davidson et al. (2003) demonstrated that mindfulness-based stress reduction (MBSR) programs enhanced students' cognitive flexibility and emotional regulation, further supporting the argument for incorporating meditation into curricula.

- **Impact on Cognitive and Emotional Development**

Research suggests that meditation positively affects both cognitive and emotional development. Studies have found that meditation enhances attention span, working memory, and cognitive flexibility, contributing to improved learning outcomes (Eberth & Sedlmeier, 2012). Furthermore, emotional intelligence research by Goleman (1995) supports the role of meditation in helping students develop self-regulation skills, which contribute to better conflict resolution and academic resilience. Kabat-Zinn et al. (2013)

found that MBSR programs reduce anxiety and enhance overall well-being in students, suggesting a link between meditation practice and academic success.

- **Environmental and Cultural Considerations**

The effectiveness of meditation in education is influenced by environmental and cultural factors. Comstock (2015) explored the role of physical spaces in meditation efficacy, suggesting that architectural elements such as lighting and acoustics can significantly impact meditative experiences in schools. Additionally, studies on the global adoption of meditation programs, including initiatives in the USA, UK, Israel, and India, indicate that while meditation is widely embraced, its reception varies across cultural contexts (Waters et al., 2015). Future research should consider cross-cultural adaptability and the scalability of meditation interventions in diverse educational settings. Furthermore, university students, particularly in high-pressure academic environments, may benefit from meditation interventions tailored to their unique stressors, such as examination anxiety and career-related concerns.

- **Methodological Considerations and Gaps in Research**

While qualitative studies have provided rich insights into the subjective benefits of meditation, the field lacks large-scale quantitative research to validate these findings. Many studies rely on self-reported measures, which, while valuable, may introduce bias (Paulhus & Reid, 1991). Incorporating objective assessments, such as academic performance tracking, neuroimaging studies, and physiological markers (e.g., heart rate variability and cortisol levels), could strengthen the empirical foundation of meditation research in education (Creswell et al., 2012).

Furthermore, most studies focus on primary and secondary education, with limited research examining meditation's long-term effects in higher education. Given the unique stressors faced by university students, investigating meditation's role in academic resilience and well-being at the tertiary level remains a crucial area for exploration. Longitudinal studies could further clarify whether meditation produces sustained improvements in academic and emotional well-being over time.

The existing literature underscores the transformative potential of meditation in education, highlighting its impact on cognitive function, emotional well-being, and classroom dynamics. However, further empirical research is needed to explore its long-term benefits, particularly in higher education contexts. By addressing methodological limitations and considering environmental and cultural factors, future studies can enhance our understanding of how meditation can be effectively integrated into educational curricula, ultimately supporting holistic student development and academic success.

2.8 VIRTUAL REALITY TECHNOLOGY

Virtual Reality (VR) refers to a computer-generated simulation that immerses users in interactive three-dimensional environments, engaging multiple sensory channels such as vision, hearing, and, increasingly, touch and proprioception. The goal of VR is to recreate a convincing sense of presence—the subjective feeling of "being there"—within an artificial space. Over the past four decades, VR has evolved from experimental laboratory prototypes into widely adopted systems across education, healthcare, therapy, entertainment, and design (Radianti et al., 2020).

The technological maturity of VR has made it a particularly powerful tool for meditation and mental health research. Through the capacity to build realistic yet controlled spaces, VR enables users to experience carefully designed restorative environments regardless of location or material constraints. It thus bridges two domains central to this thesis: the spatial psychology of healing environments and the digital mediation of mindfulness practices. The use of VR in meditation is especially relevant for university contexts, where students face psychological stress but may lack access to natural or purpose-designed restorative spaces.

VR systems can reproduce calming natural settings, simulate purpose-built meditation rooms, or construct abstract minimalist environments that isolate users from external distractions. This flexibility allows researchers to manipulate environmental features—such as light, colour, sound, and spatial openness—while measuring users' emotional and cognitive responses under controlled conditions. Within this thesis, VR is not only a technological platform but also a methodological instrument for understanding how spatial design mediates well-being.

This section examines VR from three perspectives: (1) its definition and conceptual foundations, (2) its recent developments and applications in meditation and psychological research, and (3) its specific strengths and limitations when used for experimental studies of well-being.

2.8.1 DEFINITION OF VIRTUAL REALITY

VR can be defined as an interactive, computer-generated environment that responds dynamically to user input, producing a sense of immersion and presence within a simulated world (Sherman & Craig, 2003). Unlike conventional two-dimensional media, VR engages the body as well as the mind: users move, look, and react as if physically situated within the virtual space. The experience of VR depends on four core components:

1. **Virtual World** – the computer-generated environment itself, including the spatial layout, textures, soundscape, and interactive elements.

2. **Presence** – the subjective feeling of "being there," or perceiving the virtual environment as a place rather than a display.
3. **Sensory Feedback** – visual, auditory, and increasingly haptic or olfactory inputs that reinforce realism.
4. **Interactivity** – the user's ability to act within and influence the environment in real time.

These four elements combine to produce the illusion of immersion that differentiates VR from passive media such as film or video. Through head-tracking, spatialised sound, and real-time rendering, users experience congruent sensory feedback that convinces the brain of being located within a coherent spatial environment (Slater, 2018).

The interactive nature of VR is central to its educational and therapeutic value. Whereas traditional media deliver information one-way, VR allows individuals to explore, manipulate, and experience cause-and-effect relationships directly. This experiential quality makes VR particularly effective for applied research where behaviour, emotion, and perception are shaped by environmental context. Its applications now span education (Alqahtani et al., 2017), rehabilitation and therapy (Borsci et al., 2015; Chirico et al., 2016), and increasingly, mindfulness and meditation (Navarro-Haro et al., 2017; Rodríguez et al., 2015).

2.8.1.1 Future Directions in Space Healing Research

Recent scholarship has expanded the understanding of VR's psychological, educational, and therapeutic potential. In higher education, Radianti et al. (2020) conducted a systematic review showing that immersive learning through VR enhances engagement, memory retention, and motivation, while also identifying limitations in scalability and user comfort.

In healthcare, VR has been successfully employed in pain management, anxiety reduction, and motor rehabilitation (Chirico et al., 2016; Malloy & Milling, 2010). These studies confirm that virtual environments can evoke genuine physiological and emotional responses comparable to real-world stimuli—a key premise for using VR in well-being research.

Within the domain of meditation and mindfulness, the past decade has seen substantial growth. Anderson et al. (2017) demonstrated that VR nature simulations lowered heart rate and reduced physiological stress markers, validating VR as a restorative medium. Similarly, Navarro-Haro et al. (2017) found that VR-enhanced mindfulness interventions improved emotional regulation among participants with anxiety disorders. Baminiwatta and Solangaarachchi (2021) reviewed VR mindfulness interventions during the COVID-19 pandemic and concluded that they can increase accessibility and continuity of practice, particularly for students and remote populations.

Most recently, She et al. (2023) proposed an interaction-design model for VR mindfulness that integrates imagery-based transformation, positive feedback, and multisensory engagement. Their work highlights how environment design and sensory congruence are crucial to achieving effective meditative immersion. This convergence of design research and psychological science demonstrates that the success of VR meditation is not only technological but also environmental—dependent on the spatial, acoustic, and symbolic qualities of the virtual setting.

Together, these developments establish VR as a credible and versatile tool for examining the intersection of space, perception, and well-being—the conceptual core of this thesis.

2.8.1.2 Strengths and Limitations

VR offers several unique strengths for meditation and environmental research:

- **Experimental control and consistency**: Virtual environments can be precisely standardised, allowing the isolation of spatial variables such as light, openness, and sound without interference from external factors like weather or noise.
- **Accessibility and scalability**: VR enables restorative experiences in contexts where access to natural or purpose-built meditation spaces is limited, making it especially relevant for university populations.
- **Safe testing and replication**: VR allows environments to be tested and modified iteratively without physical construction costs, supporting evidence-based design and prototyping.
- **Engagement and motivation**: The immersive nature of VR can enhance participant focus and adherence compared with traditional audio or video meditation formats.

Despite these advantages, several limitations persist. Current VR technology does not yet achieve full multisensory fidelity—particularly regarding tactile, olfactory, and thermal cues (Ranasinghe et al., 2017) which may constrain immersion and affect the authenticity of experience. Individual differences in VR tolerance (e.g., susceptibility to cybersickness, visual strain, or discomfort) can also impact participation and data quality. Furthermore, while VR offers rich visual and auditory engagement, some traditional forms of meditation (such as closed-eye Vipassana) depend less on visual stimuli, questioning VR's relevance across all techniques.

From a methodological standpoint, high equipment costs, varying hardware quality, and the need for technical supervision can limit scalability. Finally, as VR meditation often involves digitally mediated cultural symbols, issues of authenticity and cultural adaptation must be considered when designing cross-cultural or spiritually inspired environments.

2.8.1.3 Implications for This Study

Within this research, VR serves a dual purpose—as both a methodological tool and a potential practical intervention.

1. **As a methodological tool**, VR enables the creation of controlled yet immersive simulations of four distinct meditation environments (classroom, garden, meditation room, and white control room). This allows the systematic study of how environmental qualities affect relaxation, attention, and well-being under consistent experimental conditions. The technology bridges the gap between laboratory precision and experiential realism, offering a platform for ecologically valid experimentation in environmental psychology.
2. **As an applied innovation**, VR demonstrates how digital design can extend access to restorative experiences for students in higher education. For institutions with limited physical resources or space constraints, VR meditation offers a cost-effective and scalable alternative to constructing dedicated meditation rooms or gardens. It supports well-being initiatives by providing repeatable, on-demand access to calming environments that align with cultural expectations of mindfulness and tranquility.

This study therefore positions VR as more than a representational medium—it is an active instrument for exploring human–environment relationships. By integrating insights from mindfulness, design research, and cognitive science, the thesis advances VR as both an investigative and therapeutic technology capable of transforming how universities conceptualise and deliver mental health support.

2.8.2 VIRTUAL ENVIRONMENT

A Virtual Environment (VE) refers to a computer-generated three-dimensional space that enables users to perceive, navigate, and interact with simulated objects or surroundings through multiple sensory channels (Hale & Stanney, 2014). Unlike traditional screen-based media, VEs replicate real-world spatial properties such as depth, scale, and movement, engaging the user in an embodied experience. When combined with head-mounted displays and spatialised audio, these digital environments can evoke a convincing sense of immersion—where the user responds to the virtual setting as if it were real (Mihelj et al., 2014).

From a technical perspective, VEs are composed of several interdependent elements:

1. **Spatial geometry and layout** – the three-dimensional structure defining boundaries, pathways, and spatial relationships;
2. **Visual fidelity** – surface textures, lighting, and perspective accuracy contributing to realism;
3. **Sound design** – environmental and ambient audio reinforcing spatial awareness and atmosphere;
4. **Interactivity and navigation** – user control mechanisms that support exploration and agency;
5. **System performance** – frame rate, latency, and rendering quality, which affect comfort and presence.

While these components define the form of a VE, the experience of being within it depends on how technical features interact with psychological and perceptual processes. As Slater (2018) notes, immersion alone does not guarantee engagement—users must also experience presence, or the subjective feeling of being "inside" the environment. For meditation applications, this sense of presence is essential for facilitating focus and emotional calmness, allowing participants to temporarily detach from their physical context and engage with the virtual setting as a restorative space.

Design and Psychological Considerations

Beyond technical fidelity, the design of a virtual environment fundamentally shapes the quality and meaning of user experience. A growing body of research highlights that spatial composition, lighting, colour palette, soundscape, and symbolic cues all influence emotional and physiological responses. For example, Anderson et al. (2017) found that naturalistic VR scenes—incorporating vegetation, open views, and ambient nature sounds—significantly reduced heart rate and cortisol levels. Similarly, She et al. (2023) demonstrated that environmental design principles, such as warm colour tones, smooth motion transitions, and auditory congruence, directly affect relaxation and attentional stability during VR mindfulness sessions.

In architectural psychology, these findings align with established theories of restorative environments, particularly Attention Restoration Theory (Kaplan & Kaplan, 1989) and Stress Recovery Theory (Ulrich, 1984), which emphasise the restorative impact of natural elements, coherence, and perceived safety. In VR, these restorative properties can be digitally reproduced through biophilic cues—such as greenery, water sounds, and daylight simulations—thereby transferring the benefits of natural environments into virtual spaces. This process is sometimes described as digital biophilia (Bertani et al., 2024), referring to the replication of nature's psychological benefits through virtual design.

For meditation-based VR applications, designers must balance realism with abstraction. Excessive realism can create cognitive load or distraction, while overly minimalistic environments may lack emotional resonance. Studies by Navarro-Haro et al. (2017) and Baminiwatta & Solangaarachchi (2021) suggest that a moderate level of realism—supported by coherent visual and auditory cues—best facilitates mindfulness by maintaining focus without sensory overload. This balance mirrors the principle of compatibility within restorative design theory, where environments should support the user's intended activity without competing for attention.

Virtual Environments in Meditation Research

In meditation studies, VEs are increasingly used to explore how environmental qualities influence well-being outcomes. Rodríguez et al. (2015) pioneered VR-based meditation prototypes integrating breathing guidance with virtual landscapes. Subsequent studies, such as Anderson et al. (2017) and She et al. (2023), confirmed that exposure to digitally simulated nature or purpose-built VR meditation spaces can significantly enhance relaxation and emotional regulation compared to control conditions.

These environments allow systematic manipulation of design variables—such as colour saturation, openness, and auditory density—enabling researchers to isolate how specific spatial characteristics influence meditation depth and emotional tone. For example, warmer colours and diffuse lighting are often associated with psychological warmth and safety, while open configurations promote a sense of freedom and expansive calm.

From a methodological perspective, VR meditation environments provide a controlled yet immersive testbed for studying restorative space. Unlike physical settings, which are subject to unpredictable factors such as noise or weather, VR environments can be reproduced precisely for every participant. This enables reliable comparison across conditions, as in this study's four-environment design (classroom, garden, meditation room, and white room).

Design Implications for This Study

The design of the virtual environments in this research followed architectural and psychological principles drawn from both restorative environment theory and meditation practice. Each of the four environments was intentionally constructed to embody distinct spatial characteristics and symbolic meanings:

- **The classroom** represented a functional, enclosed, task-oriented setting associated with focus and cognitive effort;
- **The campus garden** embodied openness, greenery, and natural acoustic cues promoting relaxation and restoration;
- **The meditation room** incorporated minimalist geometry, subdued lighting, and cultural symbols of tranquillity, supporting contemplation and attentional stability;
- **The white control room** served as a perceptual baseline, offering minimal sensory cues and no symbolic content.

These environments were developed using a combination of 360° video capture (for real spaces) and 3D modelling (for designed spaces), allowing the study to balance ecological realism with design precision. The inclusion of both real and constructed environments supports comparison between naturalistic and architecturally mediated forms of calmness.

In this way, virtual environments serve as both research tools and design laboratories, enabling the exploration of environmental effects on well-being while prototyping potential spatial solutions for higher-education contexts. The design decisions taken in this study thus not only operationalise environmental hypotheses but also exemplify how digital technologies can inform future architectural practice in promoting psychological restoration.

2.8.3 VIRTUAL PRESENCE

Virtual presence—often described as the sense of "being there" within a computer-generated environment—forms the psychological cornerstone of Virtual Reality (VR) experience. Presence is more than technical immersion; it is a cognitive and emotional phenomenon where users respond to virtual stimuli as though they were physically real (Slater, 2018). The stronger the presence, the more convincingly the virtual space becomes a lived, meaningful experience. For meditation research, presence represents a critical bridge between spatial design and psychological outcome, determining how effectively a virtual environment can evoke calmness, focus, and restorative states of mind.

Presence can be conceptualised along two interrelated dimensions—physical presence and mental (or psychological) presence—each contributing differently to the overall sense of immersion and engagement (Mihelj et al., 2014; Waterworth & Waterworth, 2003).

Physical Presence

Physical presence refers to the perceptual illusion of being physically located within the virtual world. It arises when visual, auditory, and kinaesthetic feedback correspond closely with user movement and expectation. Head-tracking, spatialised sound, and accurate stereoscopic rendering all contribute to this sensory realism, while low latency ensures that the environment reacts instantaneously to user actions, preserving the illusion of co-location (Slater, 2018).

The degree of physical presence depends on several factors:

1. **Sensory fidelity**: The resolution, frame rate, and realism of graphics and sound directly affect the credibility of the virtual space.
2. **Sensorimotor contingency**: The accuracy with which the system translates user motion into corresponding environmental changes (e.g., turning the head and seeing the scene shift naturally).
3. **Embodied interaction**: The extent to which users can manipulate virtual objects or perceive a sense of bodily agency within the environment.

In meditation applications, physical presence is essential for creating a convincing setting that promotes sensory stability and focus. For example, a VR garden environment can reproduce gentle ambient sounds, dynamic lighting, and depth perception that collectively convey spaciousness and serenity. Studies by Anderson et al. (2017) and Chirico et al. (2016) demonstrate that realistic visual and auditory cues in VR can trigger physiological relaxation similar to real natural exposure, including lowered heart rate and reduced skin conductance.

However, excessive sensory realism can sometimes interfere with meditation by overstimulating attention or triggering distraction. Designers must therefore strike a balance between environmental fidelity and perceptual simplicity—an equilibrium known as cognitive compatibility, where the sensory input supports rather than competes with the meditative task (Kaplan, 1992).

Mental Presence

Mental presence, sometimes referred to as psychological or attentional presence, occurs when users allocate their full cognitive and emotional engagement to the virtual environment. It reflects a state in which attention is absorbed in the virtual world rather than divided between the simulation and the real physical context. This form of presence involves both top-down attention (intentional focus) and bottom-up perception (automatic sensory engagement).

In mindfulness and meditation contexts, mental presence aligns with the concept of awareness without distraction. When users report "losing track" of time or forgetting the boundaries between the virtual and real world, they are experiencing heightened mental presence. This absorption is comparable to the psychological state of flow (Csikszentmihalyi & Csikzentmihaly, 1990), where task engagement and intrinsic enjoyment converge.

Research suggests that mental presence is influenced by narrative coherence, emotional resonance, and cultural familiarity of the virtual scene (Khoury et al., 2013; Slater & Sanchez-Vives, 2016). For example, Navarro-Haro et al. (2017) found that participants practicing mindfulness in VR reported greater emotional regulation when the environment conveyed cultural and symbolic meanings consistent with calmness and acceptance. Similarly, She et al. (2023) showed that the congruence between visual atmosphere, sound design, and meditative guidance enhanced focus and reduced anxiety during VR meditation.

In this sense, mental presence is not merely a sensory phenomenon but also a meaningful engagement shaped by context and cultural symbolism. For Thai participants, familiar visual cues—such as gentle lighting, natural landscapes, and references to Buddhist aesthetics—may enhance emotional authenticity, deepening the sense of connection with the environment and supporting a state of mindful attention.

Interdependence of Physical and Mental Presence

Although conceptually distinct, physical and mental presence are deeply interlinked. Physical immersion provides the sensory foundation for engagement, while mental presence transforms sensory perception into emotional or cognitive absorption. High sensory fidelity without mental engagement results in a technically realistic but emotionally empty experience, whereas strong emotional identification with a low-fidelity environment can still generate powerful presence through meaning and intention (Slater, 2018).

This interdependence is particularly evident in VR meditation. As users settle into meditative focus, attention often shifts from external sensory details toward internal awareness, gradually reducing the reliance on high-fidelity visuals. The transition from external presence (awareness of the VR space) to internal presence (awareness within meditation) mirrors traditional contemplative progression described in mindfulness theory (Kabat-Zinn, 2003). Effective VR meditation environments therefore accommodate both modes, offering enough sensory richness to facilitate entry and sufficient simplicity to sustain concentration.

Presence as a Mediator of Restorative Experience

Presence plays a mediating role between environmental design and psychological outcome. The stronger the sense of presence, the more effectively users perceive the environment's restorative qualities—such as safety, fascination, and compatibility (Hartig et al., 1997). In empirical studies, presence has been shown to correlate positively with relaxation, attentional focus, and stress recovery (Chirico et al., 2016; Navarro-Haro et al., 2017).

In this study, presence is treated as both an indicator and a mediator of experience. It reflects how successfully participants engage with the virtual meditation environment, while also influencing their reported levels of calmness, focus, and emotional stability. Quantitative measures of presence complement self-reported well-being scores, and qualitative accounts further illustrate how participants describe being "absorbed," "separated from reality," or "transported" during VR meditation.

From a design perspective, presence provides feedback on environmental quality and user engagement, informing iterative improvement of VR healing spaces. A well-designed virtual environment thus does more than replicate reality—it creates a psychologically convincing space that enables users to inhabit, rather than merely observe, the conditions of tranquility and restoration.

Summary

Virtual presence transforms digital space into lived experience. By integrating perceptual fidelity with psychological engagement, VR environments achieve the conditions necessary for meditation and emotional regulation. Within this study, presence represents a key evaluative construct: it captures how users experience being there in the virtual meditation spaces and how that experience relates to perceived well-being.

Understanding presence is therefore fundamental to interpreting the study's results and contributes to broader discussions of how technology, design, and consciousness intersect in the creation of healing spaces.

2.8.4 MEDITATION AND VIRTUAL REALITY

Meditation refers to a diverse set of contemplative practices aimed at cultivating mental clarity, emotional balance, and physiological relaxation. Rooted in ancient spiritual and philosophical traditions, it has increasingly been adopted in modern psychology, neuroscience, and healthcare as a secular therapeutic method. The practice typically involves focused attention, open monitoring, or guided visualization designed to foster mindfulness and reduce mental distraction (Davidson & Kaszniak, 2015; Tang et al., 2015).

Meditation has demonstrated benefits across a wide range of conditions, including anxiety, chronic pain, depression, insomnia, and post-traumatic stress (Goyal et al., 2014). These benefits arise partly from improved metacognitive awareness—the ability to observe thoughts and emotions non-reactively—enabling practitioners to regulate internal states and respond more calmly to stressors (Shamekhi & Bickmore, 2015). Meditation also activates neurophysiological mechanisms associated with attention and emotion regulation, such as reduced amygdala reactivity and increased prefrontal engagement (Tang et al., 2015).

In educational and workplace contexts, meditation is increasingly recognised as a form of mental hygiene—a skill for managing stress, enhancing focus, and supporting overall well-being. For university students, meditation can help counter academic pressure, digital overload, and emotional fatigue. However, despite growing acceptance, physical access to quiet or purpose-designed meditation spaces remains limited in many institutions. This spatial constraint provides the rationale for exploring Virtual Reality (VR) as a medium for delivering meditation experiences.

TECHNOLOGY-ASSISTED MEDITATION

Although meditation is traditionally perceived as a non-technological practice, the past two decades have seen rapid expansion in technology-assisted mindfulness. Early experiments involved the use of ambient music, visualisations, or biofeedback to support relaxation (Marcus & Davis, 2015; Sudheesh & Joseph, 2000). With the growth of mobile and web technologies, meditation apps and online mindfulness courses (e.g., Headspace, Calm, Insight Timer) have enabled millions to access guided practice anytime and anywhere (Buie & Blythe, 2013a; Shaw et al., 2011).

These digital tools introduced scalability and accessibility but also revealed limitations: two-dimensional screens provide limited sensory engagement, and distraction from external surroundings often reduces the depth of immersion. This gap has led to increasing interest in Virtual Reality as a next-generation medium capable of reproducing the experiential qualities of place and atmosphere that are central to traditional meditation settings. VR extends beyond mere instruction delivery; it offers a spatial and sensory environment that can induce psychological absorption similar to that achieved in physical meditation spaces.

VR AS A MEDITATION TOOL

VR meditation harnesses the immersive potential of computer-generated environments to suppress external distractions and evoke a strong sense of presence. By transporting users into digitally simulated natural scenes—such as forests, beaches, or gardens—VR recreates the sensory and spatial conditions conducive to meditative calm (Anderson et al., 2017; Navarro-Haro et al., 2017).

The technology integrates visual immersion, spatialised soundscapes, and guided narration to create a coherent meditative experience. Many commercial and research prototypes employ features such as breathing-synchronised visuals, ambient nature sounds, or slow camera movement to induce relaxation. Popular consumer applications such as Guided Meditation VR and Perfect Beach illustrate the growing interest in VR meditation for personal well-being, while academic research increasingly investigates its therapeutic and educational potential.

In clinical psychology, VR interventions have shown effectiveness for phobia treatment, anxiety reduction, and post-traumatic stress disorder (PTSD) (Chirico et al., 2016; Reger & Gahm, 2008). These findings suggest that immersive exposure can regulate physiological arousal and emotional reactivity, mechanisms also central to meditation. The capacity of VR to combine exposure, relaxation, and attentional control makes it particularly relevant for university mental-health initiatives seeking non-pharmacological interventions.

EMPIRICAL RESEARCH ON VR MEDITATION

A growing body of empirical evidence supports the benefits of VR-based meditation and mindfulness:

1. **Navarro-Haro et al. (2017)**: In a pilot study integrating VR with dialectical behavioural therapy, participants who meditated in a tranquil virtual river environment reported decreased anxiety and sadness and high levels of presence.
2. **Kosunen et al. (2016)**: Developed the RELAWORLD neuroadaptive system combining VR meditation with EEG-based feedback, showing that head-mounted VR produced deeper relaxation than traditional desktop displays.
3. **Waller et al. (2021)**: Found that college students reported higher engagement and relaxation during 360° guided meditation in VR compared to standard 2D video formats.

4. **Miller et al. (2021)**: Demonstrated that undergraduate participants experienced greater positive affect and immersion during VR-guided meditation than during audio-only practice.
5. **Baminiwatta & Solangaarachchi (2021)**: A systematic review confirmed VR mindfulness interventions improved accessibility during the COVID-19 pandemic and enhanced emotional well-being under social-distancing conditions.
6. **She et al. (2023)**: Proposed an interaction-design framework for VR mindfulness using imagery-based transformation and positive reinforcement, showing that design congruence between visuals, audio, and feedback mechanisms increases meditative depth.

Collectively, these studies indicate that VR can reproduce many of the physiological and psychological outcomes traditionally associated with meditation in physical environments. Presence, sensory congruence, and environmental symbolism consistently emerge as key predictors of effectiveness.

CRITICAL REFLECTIONS

While the empirical results are promising, several challenges and ethical considerations remain.

First, technological limitations persist: current VR systems often lack full multisensory integration, particularly tactile, thermal, or olfactory cues that contribute to realism (Ranasinghe et al., 2017). Without these, the sense of "being there" may plateau after repeated exposure. Secondly, individual variability in susceptibility to cybersickness, headset discomfort, or visual fatigue can limit session duration and participant diversity.

Third, some meditation techniques—particularly closed-eye practices like Vipassana or transcendental meditation—may not fully benefit from visually immersive environments. For such methods, VR's potential lies more in auditory or haptic guidance than in visual simulation. Furthermore, as with all digital technologies, issues of cost, accessibility, and digital inequality must be considered to ensure equitable adoption across student populations.

Despite these challenges, the advantages of VR meditation remain compelling. The technology offers replicability, accessibility, and scalability—qualities rarely achievable in physical meditation spaces. For educational institutions, VR provides a flexible medium through which students can access restorative experiences within dormitories, libraries, or counselling centres. Beyond experimentation, VR meditation represents a practical intervention for student well-being, aligning with contemporary movements toward digital mental-health solutions.

In this thesis, VR is therefore conceptualised as having a dual role:

1. **A methodological instrument**—used to construct controlled yet immersive environments for systematically analysing the impact of spatial qualities on meditation outcomes.
2. **An applied design strategy**—offering scalable, evidence-based approaches for supporting well-being in higher-education contexts where physical restorative spaces are scarce.

This dual perspective situates VR at the intersection of architecture, psychology, and technology, reinforcing its relevance as both an investigative and transformative medium for understanding and designing healing spaces.

2.9 SYNTHESIS AND RESEARCH GAP

The reviewed literature demonstrates substantial evidence that environmental qualities profoundly influence human health, cognition, and emotional well-being. Within environmental psychology, restorative-environment theories such as Attention Restoration Theory (ART) and Stress Reduction Theory (SRT) explain how natural or aesthetically coherent settings promote recovery from mental fatigue and physiological stress (Kaplan & Kaplan, 1989; Ulrich, 1991). Exposure to nature has been shown to reduce cortisol levels, lower blood pressure, and improve attentional performance (Berto, 2005; Park et al., 2010; Tsunetsugu et al., 2010).

The concept of healing spaces extends these psychological insights into architectural design, emphasising the multisensory and symbolic dimensions of place—light, colour, sound, scent, and tactile quality—that contribute to holistic well-being (Esther & Sternberg, 2009). Frameworks such as the Optimal Healing Environment (OHE) model integrate physical, social, and spiritual dimensions of care, highlighting how built form and sensory design can foster healing (Zborowsky & Kreitzer, 2009). However, most applications remain concentrated in healthcare contexts, leaving educational settings under-examined despite their potential to influence stress and performance.

Parallel to this, a large body of evidence confirms the effectiveness of meditation in reducing anxiety, enhancing emotional regulation, and supporting cognitive control (Tang et al., 2015; Waters et al., 2015). Yet the environmental conditions in which meditation occurs have received limited empirical attention. Research suggests that natural or purpose-designed spaces yield stronger restorative responses than neutral or utilitarian ones (Annerstedt et al., 2013; Berto, 2014), but systematic comparisons between contrasting environments remain rare—particularly in non-clinical or university contexts.

Recent technological advances have introduced Virtual Reality (VR) as a new medium for exploring healing and meditative environments. As discussed in Section 2.8, VR provides immersive, controllable, and replicable simulations that allow researchers to isolate spatial variables while preserving experiential richness (Radianti et al., 2020). Studies on VR-based meditation indicate reductions in stress and anxiety, improved attentional focus, and enhanced sense of presence (Navarro-Haro et al., 2017; She et al., 2023; Waller et al., 2021). Nevertheless, questions remain regarding ecological validity, multisensory fidelity, and the short-term nature of most VR interventions (Culbertson et al., 2018; Ranasinghe et al., 2017).

Identified Gaps

Taken together, the literature reveals several interrelated gaps that this study seeks to address:

1. **Limited integration between restorative-environment theory, healing-space design, and meditation research.**

   Although ART and SRT explain cognitive restoration, and models such as OHE guide spatial design, few studies directly examine how these frameworks intersect in the context of meditation practice.

2. **Underexplored use of VR for comparative meditation-environment studies.**

   Existing VR mindfulness research often focuses on single settings or short-term interventions. Systematic comparisons across multiple simulated environments—particularly within higher-education populations—are scarce.

3. **Lack of cultural and geographic diversity in research on meditation environments.**

   The majority of studies are based in Western clinical contexts. Little empirical work investigates meditation environments in Asian universities, despite the deep cultural significance of mindfulness and Buddhism in Thailand.

4. **Methodological limitations in mixed-methods integration.**

Few studies combine quantitative measures of relaxation and focus with qualitative accounts of experience. As a result, the holistic interplay between environmental perception and meditative state remains insufficiently understood.

Direction of This Study

This dissertation addresses these gaps by employing Virtual Reality as both a methodological instrument and an applied intervention to simulate and evaluate four distinct meditation environments within a Thai university setting. By combining quantitative measures (e.g., Likert-scale assessments of relaxation, focus, and presence) with qualitative reflections (e.g., diaries and interviews), the study integrates insights from environmental psychology, architecture, and mindfulness research.

The research contributes to:

- Theory, by linking healing-space and restorative-environment frameworks to meditation practice;
- Methodology, by validating VR as a reliable, ecologically aware research and design tool; and

Practice, by generating evidence-based recommendations for implementing physical and virtual meditation spaces in higher education to support student well-being.

2.10 SUMMARY OF CHAPTER 2

This chapter presented a comprehensive review of the literature relevant to meditation, healing spaces, and the emerging role of Virtual Reality (VR) as a medium for studying and enhancing human well-being. The discussion began by establishing theoretical foundations through Attention Restoration Theory (ART) and Stress Reduction Theory (SRT), which explain how natural and restorative environments facilitate psychological recovery, attention restoration, and emotional regulation. These frameworks provided the conceptual basis for understanding how environmental design influences calmness, focus, and mental restoration—core aspects of meditation practice.

The review then explored the evolution of healing spaces, highlighting their physical, perceptual, and symbolic dimensions. Research from architecture, healthcare, and environmental psychology demonstrates that multisensory design features—light, colour, sound, air quality, and natural elements—can actively promote well-being. The chapter also extended this discussion to educational settings, suggesting that universities can apply healing-space principles to support student mental health. The exploration of spiritual and sensory experience further emphasised how built environments can evoke mindfulness, transcendence, and emotional balance, linking architectural design to psychological healing.

The section on meditation examined its development across religious, therapeutic, and educational contexts, illustrating its universal effectiveness in reducing anxiety, improving concentration, and enhancing cognitive performance. Empirical research confirms that both traditional and secular meditation practices benefit from supportive environments—particularly those with natural or purpose-designed qualities. Yet, the environment itself remains an underexplored factor in meditation research, often treated as a passive backdrop rather than an active component influencing outcomes. This omission forms one of the key motivations for the present study.

The final part of the review focused on Virtual Reality technology as a methodological and experiential innovation. VR enables the immersive simulation of diverse environments, offering precise experimental control while preserving ecological validity. Recent advances demonstrate VR's capacity to replicate restorative qualities and induce mindfulness-like states through multisensory engagement. Studies have shown that VR-based meditation can enhance relaxation, emotional regulation, and presence; however, systematic comparisons across multiple VR environments—especially within non-Western higher-education contexts—remain limited. These insights underscore both the promise and the methodological challenges of applying VR to the study of healing spaces.

Taken together, the literature reviewed in this chapter identifies a clear research gap at the intersection of environmental psychology, architectural design, and VR-enabled meditation. Few studies have integrated restorative-environment theory and healing-space models with empirical research on meditation, particularly through immersive digital simulations. This gap informs the direction of the present research, which employs VR as both a methodological tool and a practical intervention to investigate how environmental qualities influence meditation outcomes and student well-being in a Thai university context.

Building upon these theoretical, cultural, and technological foundations, Chapter 3 outlines the study's research design, including its mixed-methods approach, VR experimental framework, and analytical procedures developed to examine the impact of distinct meditation environments on the well-being of university students in Thailand.

CHAPTER 3

METHODS

This chapter outlines the methodological framework employed in this research, which investigates how different meditation environments influence the well-being of university students in Thailand through Virtual Reality (VR) simulation. The study adopted a mixed-methods design that integrates qualitative and quantitative approaches to provide a comprehensive understanding of participants' experiences and the measurable effects of meditation in varied environments.

A phenomenological perspective guided the research, as it seeks to explore the lived experiences of participants during meditation sessions rather than merely recording outcomes. Phenomenology is particularly suitable for studies focused on subjective experience, perception, and consciousness (Creswell & Poth, 2016). In this context, it enables an exploration of how students perceive, interpret, and emotionally respond to meditation within virtual healing spaces.

The chapter begins by presenting the methodological rationale, explaining the justification for adopting a mixed-methods approach and how VR functions as both a methodological and experiential tool. Subsequent sections describe participant recruitment and sampling, virtual site selection, data collection instruments, and analytical procedures. The chapter concludes with ethical considerations and methodological limitations, ensuring transparency and rigour throughout the research process.

The combination of qualitative insight and quantitative evidence strengthens the validity of findings by allowing methodological triangulation, thereby capturing both the richness of lived experience and the consistency of measurable data. Through this framework, the study aims to establish how VR-simulated meditation environments such as a classroom, garden, purpose-designed meditation room, and control space affect students' well-being and to determine which type of environment offers the most restorative potential for university settings.

3.1 METHODOLOGICAL RATIONALE

The choice of a mixed-methods approach was driven by the need to capture both the subjective and measurable dimensions of meditation experiences. Meditation involves deeply personal, emotional, and cognitive processes that cannot be fully understood through numerical data alone. At the same time, quantitative measures provide the reliability and comparability necessary to identify statistically significant patterns. Combining both approaches therefore allows for a more holistic and credible interpretation of findings (Creswell & Clark, 2017; Johnson & Onwuegbuzie, 2004).

The study followed a convergent parallel design, where qualitative and quantitative data were collected concurrently and integrated during interpretation. This design enabled the researcher to compare participants' reflective accounts drawn from interviews and meditation diaries with their quantitative questionnaire responses, thus revealing convergences or discrepancies between perception and measurable outcomes (Fetters et al., 2013).

A phenomenological lens was applied to the qualitative component to investigate how participants experienced meditation in diverse VR environments. This approach seeks to describe phenomena as perceived by individuals, emphasising meanings and emotions rather than external explanations (Moustakas, 1994). The phenomenological method is well suited to exploring how different environments evoke feelings of calmness, presence, or distraction during meditation, providing insight into the experiential qualities of healing spaces.

The inclusion of Virtual Reality as both a methodological and experiential tool reflects the innovative dimension of this research. VR enabled the simulation of multiple environments with a high level of experimental control while maintaining ecological validity a recognised challenge in environmental psychology (Radianti et al., 2020; She et al., 2023). It allowed participants to engage with consistent environmental stimuli such as lighting, sound, and spatial configuration, while safely exploring conditions that would be logistically difficult to access in the real world. This use of VR also aligns with contemporary developments in architectural and psychological research, where immersive technologies are increasingly used to examine human–environment interactions (Navarro-Haro et al., 2017; Waller et al., 2021).

Overall, the methodological rationale rests on three key considerations:

1. **Complexity of the research problem** – Understanding meditation experiences requires both subjective interpretation and objective assessment.
2. **Complementarity of data sources** – Integrating qualitative and quantitative strands enhances explanatory power and cross-validation.
3. **Innovation through VR technology** – VR offers a controlled yet immersive platform for studying environmental influences on meditation and well-being.

This methodological framework ensures that the study not only measures outcomes but also uncovers the nuanced ways students perceive and experience healing spaces, forming a solid foundation for the subsequent analysis of results.

3.2 RESEARCH DESIGN AND DATA COLLECTION FRAMEWORK

This research employed a mixed-methods design to examine how different meditation environments influence student well-being when experienced through Virtual Reality (VR). The approach combines qualitative and quantitative strands collected in parallel and integrated during interpretation. This structure enables both the statistical comparison of experiences across environments and a rich, contextual understanding of participants' perceptions, emotions, and reflections.

The convergent-parallel design (Creswell & Clark, 2017) was selected because it allows independent yet complementary data collection within the same research phase. Quantitative data provided measurable indicators of environmental suitability and well-being, while qualitative data captured deeper insight into lived experience and meaning. The integration of these two forms of evidence offered methodological triangulation, strengthening the validity of the findings (Fetters et al., 2013; Johnson & Onwuegbuzie, 2004).

3.2.1 FRAMEWORK OF THE STUDY

The overall study was designed to investigate how different types of meditation environments influence students' well-being, concentration, and restorative experience when mediated through Virtual Reality (VR). The research followed a structured, sequential framework over a four-month period that integrated both quantitative and qualitative approaches. The sequence was intentionally designed to allow participants to experience, reflect, and compare multiple virtual environments while maintaining methodological control and ecological plausibility.

Participants engaged with four distinct meditation environments, each representing a different spatial condition commonly found or proposed within university contexts:

1. **a standard classroom**, reflecting a familiar academic setting;
2. **a campus garden**, representing natural, open, and restorative space;
3. **a purpose-designed meditation room**, symbolising intentional calm and spatial focus; and
4. **a control space**, presented as a neutral white room to provide a perceptual baseline.

Each environment was simulated entirely through VR to ensure environmental consistency and to minimise uncontrolled factors such as weather, lighting, or background noise. The use of VR also enabled precise replication of camera position, viewpoint, and sound levels across sessions. Two environments (classroom and garden) were captured as 360-degree panoramic videos from actual university locations, while the meditation room and white-room were modelled digitally using 3D rendering software to achieve uniform lighting and acoustic control. This hybrid approach balanced environmental realism with experimental consistency.

Participants completed guided meditation sessions within each virtual environment for approximately three consecutive weeks, engaging in three sessions per week, each lasting around ten minutes. This schedule allowed adequate exposure for experiential familiarity without inducing fatigue or adaptation effects. The sessions were delivered individually in a quiet laboratory space, with headsets calibrated to each participant before every session. Between environments, a one-week interval was scheduled to minimise carry-over effects and to allow participants to reset before entering the next condition.

Data were collected through three complementary instruments:

1. **Post-session questionnaires**, which captured immediate cognitive and emotional responses using a five-point Likert scale (−2 to +2) measuring comfort, focus, relaxation, and perceived realism;
2. **Online meditation diaries**, where participants provided narrative reflections on emotional, sensory, and spatial experiences after each session; and
3. **Semi-structured interviews conducted at the end of the study**, exploring broader themes of presence, preference, and perceived benefits.

The integration of these methods enabled a mixed-methods design, combining measurable indicators of well-being with rich qualitative insights into lived experience. Quantitative data provided structured comparisons between environments, while qualitative narratives revealed personal interpretations, contextual meanings, and emotional nuance. This dual-strand approach enhanced both the reliability and the interpretive depth of the findings, supporting triangulation between datasets.

A summary of the methodological framework is presented in Figure 3.1, which illustrates the relationship between the study stages, the sequence of environmental exposure, and the corresponding data collection instruments. The figure demonstrates how each phase—exposure, reflection, and interpretation—contributes to the integrated analytical structure underpinning the study.

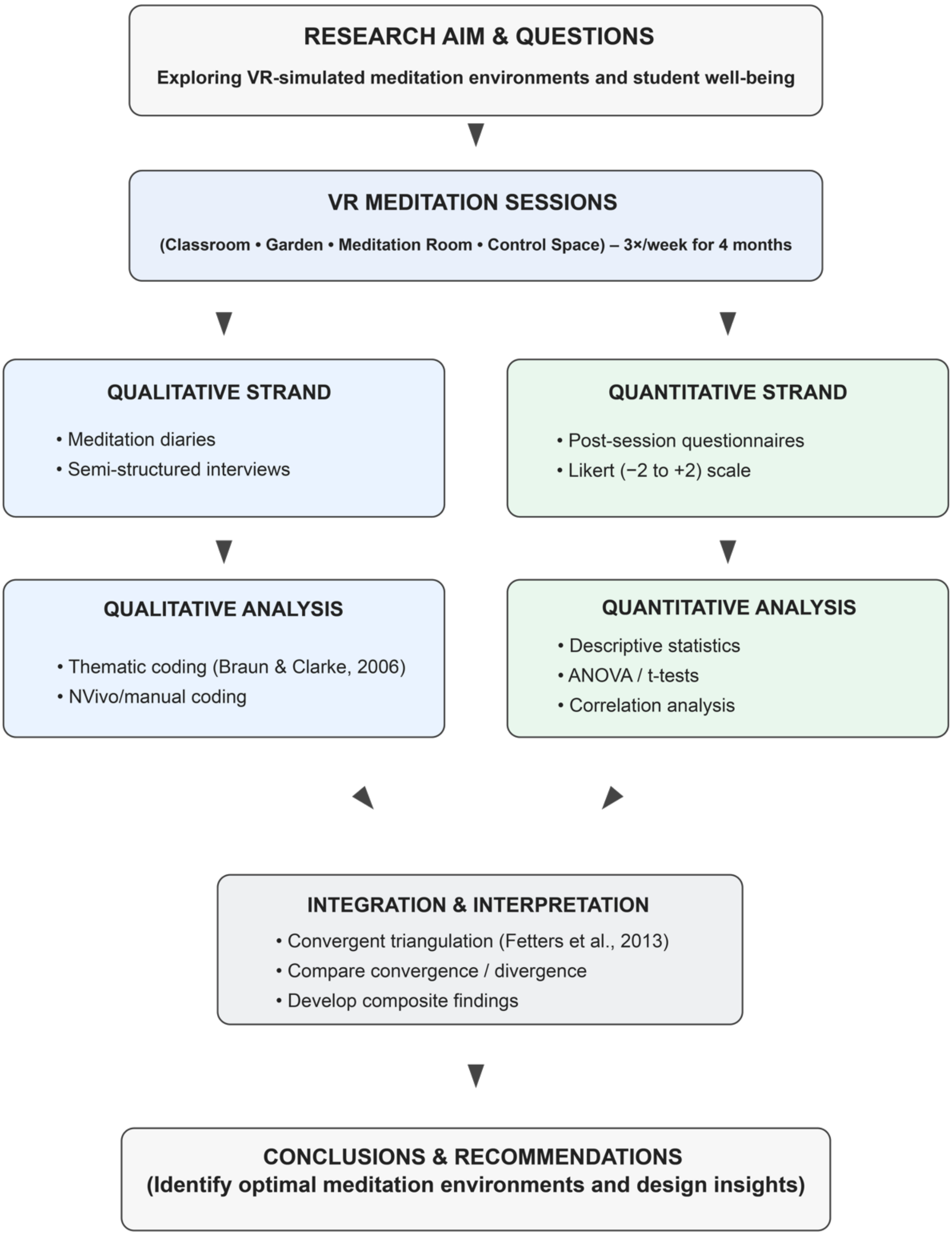


FIGURE 2: CONVERGENT-PARALLEL MIXED-METHODS FRAMEWORK

3.2.2 QUALITATIVE STRAND

The qualitative strand sought to uncover how participants interpreted and made sense of their experiences in each VR meditation environment. Data were collected through semi-structured interviews and online meditation diaries.

- **Semi-Structured Interviews**: Conducted via Zoom every two weeks, interviews provided opportunities for participants to elaborate on their experiences, emotions, and perceptions of each environment's suitability for meditation. The semi-structured format allowed flexibility to explore emergent topics while maintaining comparability across participants(Creswell & Clark, 2017).
- **Meditation Diaries**: After each session, participants recorded their reflections using an online form. Prompts guided them to describe sensations, distractions, and perceived environmental effects on concentration and mood. The longitudinal nature of these entries captured subtle shifts in perception across time and environments.

Both data sources were later analysed using thematic analysis (Braun & Clarke, 2006), which allowed patterns and meanings to emerge inductively from participants' narratives. These insights helped explain why certain environments produced greater relaxation or focus than others.

3.2.3 QUANTITATIVE STRAND

The quantitative strand aimed to provide measurable evidence of how different VR environments influenced meditation experiences and well-being. Data were obtained through post-session questionnaires administered immediately after each meditation session.

Each questionnaire comprised four domains:

1. **Environmental Suitability**: Ratings of light quality, sound level, spatial comfort, and overall ambiance.
2. **VR Experience**: Ratings of headset comfort, visual clarity, sound realism, and sense of presence.
3. **Meditation Quality**: Ratings of concentration, relaxation, and perceived depth of meditation.
4. **Well-Being Impact**: Ratings of calmness, stress reduction, and emotional balance following each session.

The Likert-scale format (-2 = strongly disagree to $+2$ = strongly agree) enabled direct comparison of results across environments. Quantitative data were later analysed using descriptive statistics, t-tests, and ANOVA to identify significant differences and relationships between environmental characteristics and well-being outcomes.

This structured approach complemented the qualitative findings by offering empirical evidence for patterns observed in participants' narratives, such as stronger relaxation in nature-based or purpose-designed spaces.

3.2.4 INTEGRATION OF DATA

Integration occurred during the interpretation stage, following the principle of convergent triangulation (Fetters et al., 2013). Qualitative and quantitative results were compared to identify areas of convergence (agreement), divergence (difference), or complementarity (additional explanation).

For example, if participants rated the garden environment highest in relaxation (quantitative result) and also described feelings of peace and openness (qualitative theme), these were treated as convergent findings reinforcing each other. Conversely, discrepancies such as positive questionnaire scores but negative diary reflections were analysed to explore contextual or cultural factors influencing perception.

The integration process enhanced the explanatory power of the study by linking what participants experienced (statistical patterns) with how and why those experiences occurred (interpretive insight). This alignment also strengthened the credibility of conclusions about the effectiveness of VR-simulated healing spaces.

3.2.5 ECOLOGICAL VALIDITY AND CONTROL THROUGH VR

A major rationale for adopting VR was to achieve a balance between experimental control and ecological validity ensuring that environments felt realistic while remaining consistent across participants. The VR simulations included both 360° captured scenes (classroom and garden) and computer-generated 3D models (purpose-designed meditation room and control space). Each environment was presented with synchronised ambient sound to enhance immersion and presence.

This design minimised confounding variables such as lighting differences, external noise, or weather, which often affect real-world studies of environmental influence (Radianti et al., 2020). It also allowed replication of comparable sensory conditions for all participants, fulfilling the requirement for methodological consistency. The concept of "presence" the psychological sense of being located within the virtual environment was central to this realism (Waller et al., 2021).

Although VR cannot perfectly replicate multisensory experiences such as scent or tactile feedback, it provides a credible and repeatable medium for evaluating environmental effects on meditation. This approach responds to practical constraints in architectural and environmental psychology research, enabling comparative analysis of spaces that would otherwise be costly or inaccessible (Navarro-Haro et al., 2017; She et al., 2023).

3.2.6 SUMMARY OF 3.2

In summary, this section has outlined the overall research design and methodological framework that underpin the study. The research adopted a mixed-methods approach, combining the systematic precision of quantitative analysis with the contextual richness of qualitative inquiry. This integration allowed the study to measure specific psychological outcomes—such as relaxation, focus, and comfort—while also capturing participants' subjective experiences of space, presence, and emotional resonance.

The use of Virtual Reality (VR) as both an experimental and experiential tool provided a controlled yet immersive means of exploring environmental effects on meditation. By simulating four contrasting spatial conditions—a classroom, a campus garden, a designed meditation room, and a white control room—the research could examine how spatial attributes influence student well-being under consistent conditions. The VR platform ensured uniform exposure to visual and auditory cues, minimising real-world variables such as weather, noise, or lighting, which often limit ecological validity in environmental studies.

This section also detailed how data collection was structured to ensure triangulation between multiple evidence sources: post-session questionnaires provided quantitative insight into immediate psychological responses; online diaries captured reflective, longitudinal impressions; and semi-structured interviews offered interpretive depth and meaning. The integration of these datasets created a multi-layered understanding of how different environmental types support or hinder meditation and emotional recovery.

The chosen design reflects both experimental rigour and practical relevance, balancing environmental control with authentic participant experience. This framework supports the study's central aim—to identify spatial and experiential qualities that promote well-being in university contexts—and establishes the foundation for subsequent stages of analysis.

The following section introduces the participant recruitment and sampling strategy, outlining how the study population was selected to ensure diversity, cultural relevance, and methodological validity in implementing the research design.

3.3 RESEARCH QUESTION AND HYPOTHESES

3.3.1 HYPOTHESES

The study was guided by two central hypotheses derived from the literature on restorative environments, mindfulness, and spatial experience. These hypotheses reflect both the environmental variables influencing well-being and the methodological innovation of using Virtual Reality (VR) as an experimental tool for spatial analysis. Together, they establish the foundation for examining how spatial characteristics shape meditation outcomes within controlled, simulated environments.

1. **Environmental Hypothesis**

   Open and purpose-designed spaces containing restorative elements—such as greenery, natural light, and acoustic harmony—will yield higher levels of relaxation, stress reduction, and overall well-being than closed or neutral spaces (e.g., classrooms or control rooms).

This hypothesis is grounded in theories of environmental psychology and attention restoration, which posit that natural and aesthetically supportive environments promote psychological recovery from cognitive fatigue (Kaplan & Kaplan, 1989; Ulrich, 1984). Exposure to natural elements has been consistently linked to improved emotional balance, reduced stress, and enhanced cognitive performance (Berto, 2014; Hartig et al., 1991). Within meditation research, open and visually rich environments—especially those incorporating greenery, light, and sensory balance—facilitate deeper relaxation and attentional engagement (Korpela et al., 2008; Van Den Berg & Custers, 2011).

Applying these principles to the university context, this study anticipates that VR representations of open and designed spaces (the campus garden and the meditation room) will elicit greater restorative responses compared with closed or neutral environments (the classroom and the white control room). The expected outcomes include higher post-session ratings of comfort, focus, and relaxation, as well as more positive qualitative reflections describing emotional calmness, spaciousness, and sensory harmony.

2. Methodological Hypothesis

VR simulation is a valid and reliable method for assessing differences between meditation environments, producing outcomes consistent with real-world restorative-environment evidence.

This hypothesis recognises the growing use of Virtual Reality as a methodological instrument in psychological and architectural research. VR allows the manipulation of environmental variables—such as spatial form, texture, and sound—while controlling extraneous factors that often confound field studies (Radianti et al., 2020; Slater & Sanchez-Vives, 2016). Previous studies have demonstrated that participants' emotional and physiological responses to virtual nature are closely aligned with those observed in physical settings (Aberdeen, 2013; She et al., 2023).

By using VR to simulate meditation spaces with high visual and acoustic fidelity, this study seeks to evaluate whether participants' reported levels of well-being and focus correspond with established findings from real-world restorative-environment research. If VR-generated experiences reproduce similar psychological benefits, this would confirm the platform's validity as a research and design tool for examining human–environment interactions. The methodological hypothesis therefore extends beyond replication to test the potential of VR as a pragmatic alternative for designing and evaluating well-being-oriented spaces in higher education.

In combination, these hypotheses link environmental theory with technological application. The first explores what spatial qualities influence well-being, while the second tests how these effects can be validly studied within controlled virtual environments. Together, they form the conceptual backbone of the research design and guide both quantitative analysis and qualitative interpretation.

3.3.2 RESEARCH QUESTIONS

Building upon the two central hypotheses outlined in the previous section, this study was guided by a series of focused research questions designed to operationalise the theoretical concepts into measurable and interpretable forms.

While the hypotheses articulate what outcomes were expected, the research questions address how these expectations were examined within the context of Virtual Reality (VR) and across different types of meditation environments.

Together, they form the analytical framework that connects environmental theory, empirical testing, and practical application within higher-education settings.

The questions are structured to progressively deepen the investigation—from understanding relationships between environmental qualities and meditation outcomes, to comparing differences across environments, and finally to determining which setting best supports student well-being and how VR can enable scalable access to such spaces.

Research Question 1

How do healing spaces influence student well-being?

What is the relationship between the physical, perceptual, symbolic, and relational qualities of meditation environments and the psychological and physiological outcomes of meditation practice?

Analytical focus:

This question explores the direct associations between environmental characteristics (e.g., light, sound, spatial configuration, symbolism, and social-relational cues) and post-meditation psychological outcomes. It examines how restorative qualities influence relaxation, focus, and stress reduction within the VR-mediated meditation experience.

Link to hypotheses:

- **Environmental Hypothesis**: Tests whether restorative environmental qualities are associated with better well-being outcomes.
- **Methodological Hypothesis**: Supported if these relationships are observable and consistent within VR simulations.

Operationalisation:

- **Predictors**: Perceived environmental suitability subscales, sense of presence, and VR comfort/friction (e.g., headset fit, sensory realism).
- **Outcomes**: Relaxation/calmness, stress reduction, and concentration/focus (Likert −2 to +2 indices).

Directional expectation:

Higher presence and environmental suitability are expected to correspond with better well-being outcomes, whereas greater VR friction or discomfort is anticipated to correlate negatively with reported benefits.

Primary analyses:

Correlations and mixed-effects regressions will be used, treating participant ID as a random effect to account for repeated measures. Reliability (Cronbach's α) and statistical assumptions will be checked before analysis.

Qualitative evidence:

Thematic accounts derived from diaries and interviews will provide interpretive depth, explaining how and why specific environmental qualities support or hinder meditation. Exemplar participant quotations will be presented in Chapter 4 to contextualise the quantitative findings.

Research Question 2

What are the effects of different types of meditation environments on student well-being when experienced through VR simulations?

How do a classroom, a public garden, a purpose-designed meditation room, and a neutral control space differ in their restorative potential and their impact on meditation outcomes?

Analytical focus:

This question focuses on within-participant comparisons across the four VR environments, assessing which environmental conditions most effectively promote relaxation, focus, and perceived well-being.

Link to hypotheses:

- **Environmental Hypothesis**: Directly tests the influence of spatial and restorative attributes within VR.
- **Methodological Hypothesis**: Corroborated if observed effects follow theoretical patterns established in restorative-environment research.

Directional expectation (pre-specified contrast):

- (Garden + Meditation Room) > (Classroom + White Room) for both meditation quality (e.g., perceived depth, concentration) and well-being indicators (e.g., relaxation, calmness, stress reduction).
- **Anticipated order**: Garden ≈ Meditation Room ≥ Classroom > White Room.

Primary analyses:

Repeated-measures ANOVA or linear mixed models will be employed to evaluate environment effects, using planned contrasts as specified. Post-hoc tests (with correction for multiple comparisons) will explore detailed differences, with effect sizes ($\eta^2 p$ or β coefficients) and confidence intervals reported.

Robustness checks:

Analyses will include presence as a covariate or exploratory mediator (environment → presence → outcome) and examine potential negative effects of VR friction or discomfort.

Qualitative evidence:

Thematic findings will be used to illustrate the experiential character of each environment—for example, garden = openness/connectedness, meditation room = containment/focus, classroom = distraction/task mindset, and white room = neutrality/absence of cues. These themes provide interpretive alignment with quantitative trends.

Research Question 3

Which meditation environment is most suitable for supporting student well-being in a university context, and what role can VR play in enabling access to such spaces?

How can evidence from VR-based evaluation inform the design and implementation of meditation spaces—physical or virtual—within higher-education institutions?

Analytical focus:

This question synthesises the findings from quantitative comparisons and qualitative interpretations to identify the environment most conducive to well-being. It also considers the practical potential of VR as a design and delivery medium for meditation in university settings.

Link to hypotheses:

- **Environmental Hypothesis**: Identifies the environment(s) showing the strongest and most consistent benefits.
- **Methodological Hypothesis**: Evaluates VR as both a reliable research tool and a viable medium for meditation access.

Operationalisation and expectation:

A convergent triangulation approach integrates quantitative scores with qualitative themes through joint displays and interpretive synthesis.

Expected thematic pattern:

- Garden: Openness, connectedness, effortless calm.
- Meditation Room: Containment, focus, safety.

- Classroom: Distraction, task-oriented associations.
- White Room: Neutrality, low sensory engagement.

Decision criteria for "most suitable" environment:

- Highest and most consistent improvements on relaxation, focus, and stress-reduction indices.
- Convergent qualitative evidence describing calmness, presence, and comfort.
- Practical scalability and accessibility for implementation in higher education, including VR-enabled alternatives where physical meditation rooms are not feasible.

Output:

Findings from this question will inform design recommendations for both physical and VR-based meditation spaces, supporting evidence-led strategies for promoting student well-being in university environments. These recommendations are further developed in Chapter 5.

Connecting Commentary

Together, these three research questions translate the study's hypotheses into a coherent investigative structure.

The first focuses on relationships (how environmental qualities influence well-being), the second on comparisons (how specific settings differ in restorative potential), and the third on applications (how these findings can inform future spatial design and VR practice).

This progression—from theoretical testing to applied design—ensures that the study not only contributes to academic understanding but also offers practical insight for universities seeking to create more supportive, restorative, and technologically accessible environments for student meditation and well-being.

3.4 PARTICIPANTS AND SAMPLING

3.4.1 ADDRESSING CONFOUNDING VARIABLES

Participants were Thai undergraduate students recruited from a large public university in Saen Suk, Chonburi (Bangsaen). Focusing on Thai undergraduates aligns with the study aim to inform university meditation spaces in Thailand, where most students are culturally familiar with Buddhist principles but often have limited formal meditation experience. The four VR-simulated environments (classroom, public garden, purpose-designed meditation room, and white control space) represented campus settings at Burapha University, allowing ecologically grounded comparisons within the Thai higher-education context.

3.4.2 SAMPLING STRATEGY AND RECRUITMENT

The study used voluntary participation and consistent with qualitative/phenomenological inquiry (Creswell & Clark, 2017; Hays & Singh, 2011) a purposive sampling logic: recruiting information-rich cases who (a) are current Thai undergraduates (the target user group for campus meditation spaces), and (b) can complete the full VR protocol across all four environments. Recruitment took place via faculty emails and campus posters following administrative approval. Students completed an online registration form with basic demographics and meditation background. Enrolled participants received VR headsets and attended a Zoom orientation outlining procedures and expectations.

3.4.3 INCLUSION AND EXCLUSION CRITERIA

Inclusion criteria

- Age 18+; currently enrolled undergraduate in Thailand.
- Ability to complete the four-environment VR schedule (3×10-minute sessions per week per environment).
- Normal or corrected-to-normal vision/hearing (for headset and audio guidance).
- Sufficient Thai language proficiency for consent and study materials.
- Written informed consent provided.

Exclusion criteria (VR safety/data integrity)

- History of epilepsy/seizure, severe vestibular disorders, or other contraindications to VR.
- Marked motion sickness/VR intolerance preventing safe participation.
- Acute physical/psychological conditions that could be exacerbated by VR or meditation.
- Inability to commit to the full sequence across all environments.

(Participants could pause/withdraw at any time if discomfort occurred; withdrawals and reasons, where provided, were recorded.)

3.4.4 SAMPLE SIZE AND COMPOSITION

An initial N = 62 enrolled; 9 withdrew, yielding a final sample of 53. The cohort included 35 women (66.03%) and 18 men (33.96%), spanning programmes in Art & Design (56.6%), Nursing (15.09%), Sports Science (9.43%), Science (9.43%), and Engineering (9.43%). Year distribution covered 1st–4th year (see Table 3.1: Demographics of the Sample). The sample reflects the intended user group rather than national representativeness.

TABLE 1: DEMOGRAPHICS OF THE SAMPLE (N = 53)

Characteristics	**Frequency**	**%**
Gender		
Female	35	66.03
Male	18	33.96
Academic Program		
Art and Design	30	56.6
Nurse	8	15.09
Sport Science	5	9.43
Science	5	9.43
Engineering	5	9.43
Year of Academic Program		
1st Year	6	11.32
2nd Year	18	33.96
3rd Year	15	28.30
4th Year	14	26.41
5th year or more	0	0

Chara Characteristics	Frequency	%
Religion		

Buddhist	51	96.22
Christian	2	3.77
Hindu	0	0
Islam	0	0
Other	0	0

3.5 SITE AND VIRTUAL ENVIRONMENT DESIGN

The design of the virtual environments formed a critical methodological component of this study. As the research aimed to investigate how environmental qualities affect meditation outcomes, careful consideration was given to both the selection of real-world spaces and their accurate representation in Virtual Reality (VR).

Each environment was designed to reflect a distinct spatial typology relevant to the university context and to represent a spectrum of physical, perceptual, and symbolic conditions—from utilitarian to restorative. Four meditation settings were developed:

1. **a standard classroom**, representing an enclosed, task-oriented learning space;
2. **a public garden**, representing an open, natural environment;
3. **a purpose-designed meditation room**, representing a dedicated contemplative setting; and
4. **a neutral white room**, serving as a perceptual control condition.

All four environments were simulated through VR to ensure standardised exposure, control of external variables, and consistent sensory presentation across participants. Two environments (the classroom and the campus garden) were captured using 360° panoramic video to preserve realism and ecological context, while the meditation room and white control room were modelled digitally in three dimensions. This hybrid approach balanced authenticity and experimental control—allowing participants to experience spaces that were both recognisable and systematically comparable.

The VR simulations were viewed using head-mounted displays with spatialised audio, enabling participants to experience each space from a consistent seated perspective during guided meditation. Environmental variables such as light level, ambient sound, and duration were standardised to maintain internal validity while allowing the visual and spatial qualities of each environment to emerge as the primary differentiating factors.

3.5.1 SITE SELECTION DESCRIPTION

This study examines how the qualities of meditation environments influence relaxation, attention, and overall well-being among university students in Thailand. The research was situated in the context of Burapha University, whose coastal location and mixed academic–natural setting provided both realistic and meaningful environmental typologies for simulation.

The four selected environments represent typical spatial conditions encountered by students in their daily campus life as well as spaces they might aspire to access for mindfulness practice. The standard classroom reflects the everyday academic environment—structured, enclosed, and cognitively demanding. The public garden represents accessible open space, offering exposure to greenery, natural light, and gentle acoustic stimuli, aligning with restorative environment principles discussed in Chapter 2. The purpose-designed meditation room embodies intentional design for mental stillness, featuring minimalist geometry, subdued lighting, and cultural symbolism familiar in Thai Buddhist contexts. Finally, the neutral white room serves as a perceptually minimal baseline, devoid of contextual or sensory cues, enabling the isolation of environmental effects on psychological response.

Together, these environments capture the range of spatial and experiential qualities most relevant to university students—from everyday academic stressors to aspirational spaces for reflection and calm. By situating all environments within a single institutional context, the study ensured ecological validity while maintaining cultural and contextual relevance for participants.

3.5.2 SITE SELECTION PROCESS

The site selection process was guided by both theoretical and practical considerations, integrating insights from environmental psychology, healing-space design, and meditation research. The primary aim was to identify spaces that embody varying degrees of restorative and cognitive demand, enabling comparison of environmental effects on meditation experience.

Drawing from principles identified in the literature—such as visual coherence and simplicity, natural and biophilic elements, acoustic comfort, balanced spatial enclosure and openness, and legible orientation (Berto, 2014; Kaplan & Kaplan, 1989; Ulrich, 1991)—each site was chosen to reflect contrasting environmental affordances:

- The **classroom** provides a closed, cognitively structured setting associated with focus, evaluation, and social performance.
- The **garden** offers a restorative open space rich in natural cues that promote relaxation and sensory engagement.

- The **meditation room** embodies intentional spatial minimalism and cultural symbolism associated with contemplation and tranquility.
- The **white room** acts as a control environment with minimal cues, providing a reference point for evaluating perceptual and emotional responses to the other conditions.

Practical considerations also informed selection, including feasibility of digital capture, participant familiarity, and representation diversity within the university's architectural and landscape typologies. Spaces were photographed and spatially analysed before virtual reconstruction to ensure accurate visual correspondence and dimensional consistency.

By designing environments that varied systematically in openness, naturalness, and symbolic meaning, the study created a robust experimental framework to assess how environmental characteristics shape meditation outcomes. The contrast among these four spaces—ranging from cognitively loaded to perceptually neutral—allowed the research to test hypotheses derived from restorative-environment theory and to evaluate the potential of VR as a replicable platform for environmental simulation in meditation research.

3.5.3 VIRTUAL ENVIRONMENT PROFILES

- **Classroom**

  Selected to represent a common, non-specialist campus setting. The classroom is task-framed and potentially distracting (visual clutter, institutional furniture, residual associations with assessment and work). It serves as a realistic comparator for how students might actually attempt meditation during the day.

VR representation. The classroom scene was captured from a real campus classroom to preserve authentic proportions, textures, and ambient characteristics.

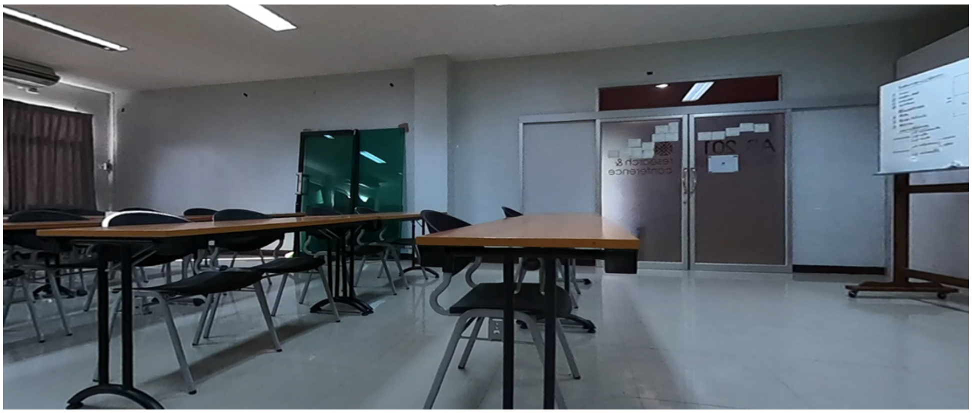


FIGURE 3: ACTUAL CLASSROOM SETTING USED FOR VR MEDITATION AT BURAPHA UNIVERSITY

- **Public garden**

Historically associated with calm, attentional restoration, and sensory soft fascination, the garden offers greenery, diffuse natural light, sky views, and soft ambient sounds. It represents an open, nature-rich setting aligned with the environmental hypothesis.

VR representation. The garden was captured on-site (360°) to retain characteristic cues (planting, sky vault, ground textures) while standardising brightness and ambient sound levels for session-to-session consistency.

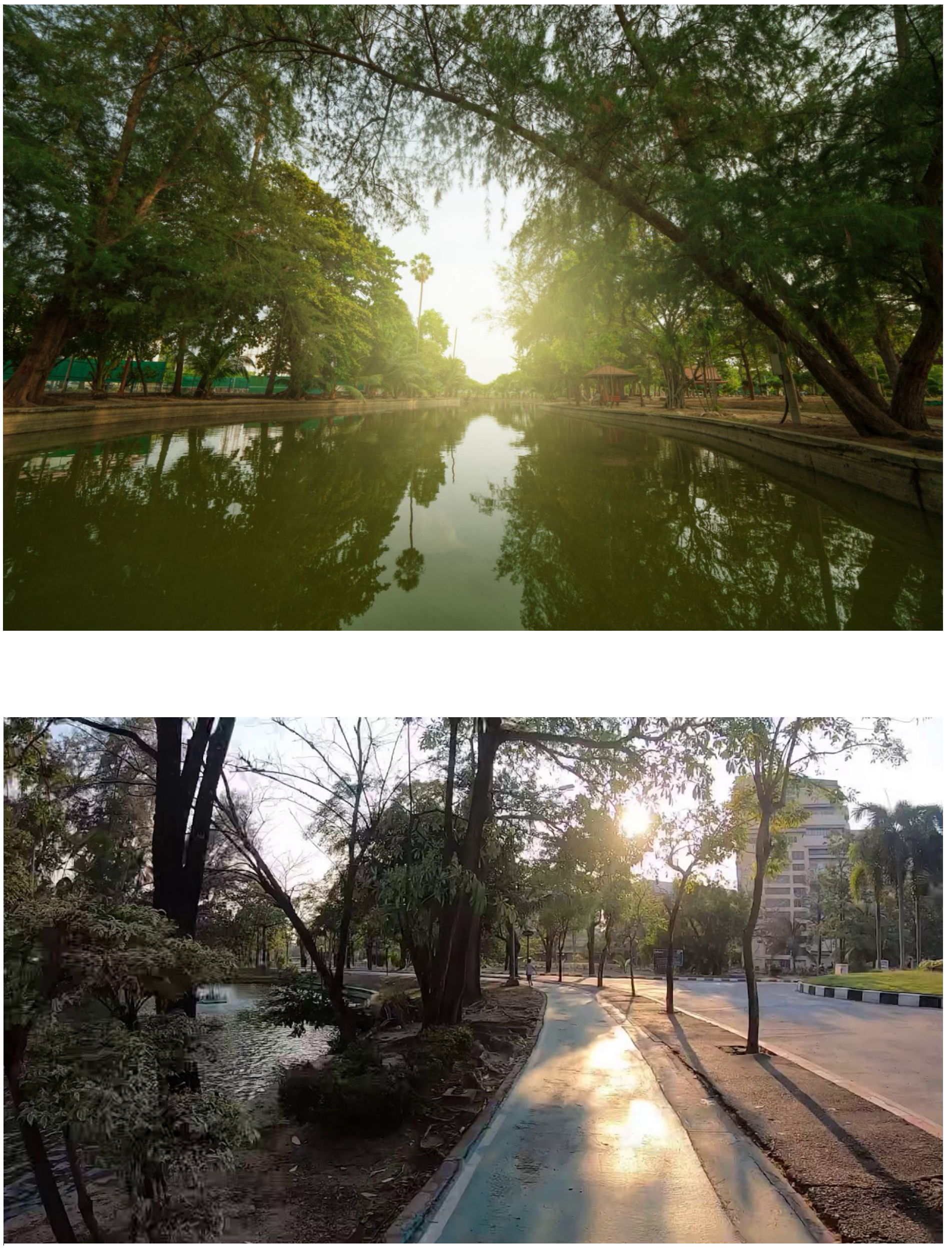


FIGURE 4: ACTUAL PUBLIC GARDEN SETTING AT BURAPHA UNIVERSITY USED FOR VR MEDITATION IN THIS STUDY

- **Purpose-designed meditation room**

This space was custom-designed to embody features recommended for meditation: visual simplicity, balanced enclosure, clear focal orientation, comfortable seating zone, and acoustic dampening. It provides a non-natural yet purpose-built environment that supports containment and attentional focus without institutional cues.

VR representation. The room was modelled (3D render) to maintain precise control over geometry, finishes, lighting temperature, and the absence of task-related artefacts.

FIGURE 5: 3D RENDER OF THE DESIGNED MEDITATION ROOM USED IN THE VR MEDITATION STUDY

- **Control space (plain white room)**

  A neutral, low-cue environment used as a baseline to distinguish effects attributable to specific environmental features from those arising solely from the meditation practice. VR representation. The white room was modelled (3D render) with uniform surfaces, neutral luminance, and no decorative or symbolic elements.

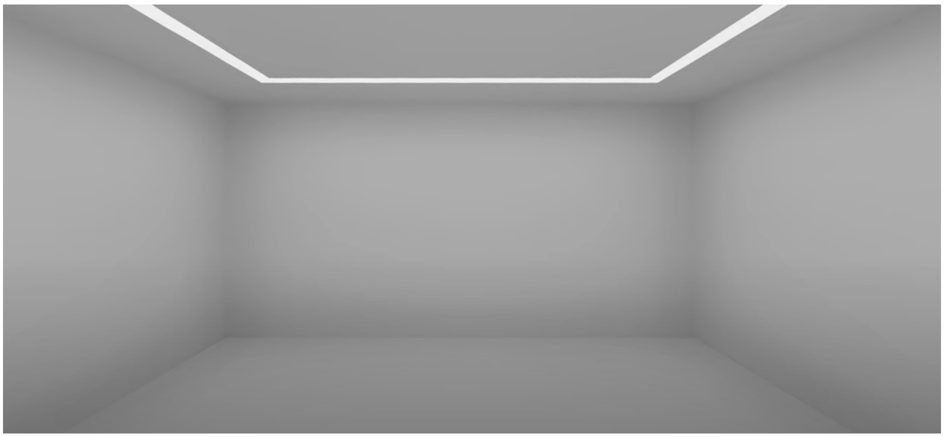


FIGURE 6: 3D RENDER OF THE CONTROL SPACE (WHITE ROOM) USED IN THE VR MEDITATION STUDY

3.5.4 ECOLOGICAL VALIDITY AND CONTROL IN VR

VR was used to balance experimental control with ecological credibility. Two environments (classroom, garden) were captured from actual locations to preserve authentic spatial cues; two (meditation room, control) were constructed digitally to enforce controlled simplicity or purpose-designed features. Across all scenes, viewpoint height, field of view, ambient audio, and illumination were standardised to support fair comparisons.

This approach reduces confounds typical of in-situ studies (e.g., weather, time-of-day, incidental noise) while retaining recognisable environmental characteristics. At the same time, limitations are acknowledged: VR cannot fully reproduce multi-sensory conditions (e.g., airflow, scent, thermal comfort), and some participants may experience VR friction (e.g., headset discomfort). These considerations are carried forward into the limitations (3.9) and discussion chapters when interpreting generalisability.

3.5.5 AUDIO-VISUAL SPECIFICATIONS AND CONSISTENCY

All environments included matched ambient soundtracks (e.g., soft wind/rustle for the garden; low HVAC/room tone for indoor spaces) mixed to comparable perceived loudness. Lighting levels and colour temperature were normalised within each scene to avoid bias from extreme contrast or glare. Visual stimuli were set to a seated viewpoint appropriate for meditation posture to stabilise the horizon and reduce cybersickness risk. These controls ensured that differences observed across conditions can be more confidently attributed to environmental qualities rather than technical variance.

3.5.6 VIRTUAL REALITY MEDITATION

Technology increasingly serves as a facilitator of well-being, prompting researchers to explore the integration of technology with meditation practices (Botella et al., 2012; Coyle et al., 2014; Gromala et al., 2011; Vidyarthi & Riecke, 2014). The positive technology theory formalizes using technology to support well-being activities like meditation (Riva et al., 2012).

Suchday et al. (2014) advocated for integrating ancient wellness approaches into contemporary contexts to address both physical and psychological well-being. Technology plays a pivotal role in modern meditation practices (Buie & Blythe, 2013b; Pickert, 2014), with potential to enhance meditation experiences (Gromala et al., 2011).

This study utilized technology-supported meditation as its primary tool, employing Virtual Reality (VR) technology to create the sensation of being physically present in diverse meditation environments.

FIGURE 7: 360 CAPTURED FROM THE CLASSROOM

FIGURE 8: 360 CAPTURED FROM THE GARDEN

FIGURE 9: 360 CAPTURED FROM THE DESIGNED MEDITATION ROOM

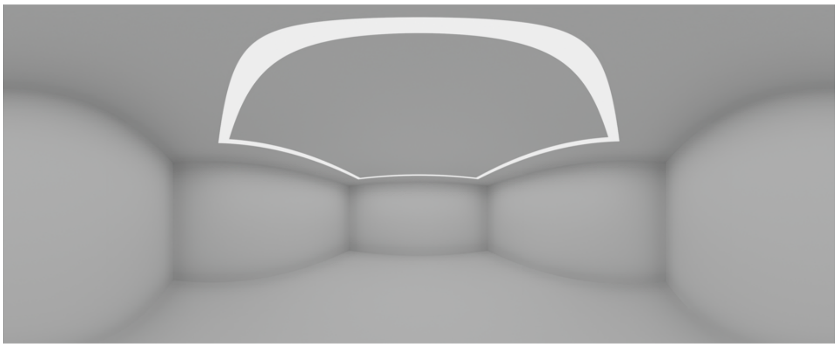


FIGURE 10: 360 CAPTURED FROM THE WHITE ROOM

3.5.6.1 Omnidirectional Video and Audio

The virtual environments used in this study—comprising the classroom, campus garden, meditation room, and neutral control (white) room—were developed using a combination of omnidirectional (360°) video capture and digitally generated 3D modelling with integrated spatial audio. This hybrid design approach ensured a balance between ecological realism, experimental control, and immersive sensory quality, allowing participants to experience environments that were both authentic and comparable in structure and tone.

Omnidirectional Video Capture

The classroom and campus garden environments were represented using 360-degree panoramic video to preserve the realism and familiarity of actual campus settings. These spaces were captured on-site at Burapha University using high-resolution omnidirectional cameras (e.g., Insta360 Pro 2), mounted on a fixed tripod at a seated eye level of approximately 1.2 meters to replicate the participant's natural viewing perspective during meditation.

Camera positioning was carefully selected to reflect representative sightlines and spatial composition—for instance, a central vantage point within the classroom and an open-view orientation in the garden toward greenery and sky. Capture sessions were scheduled during daylight hours with diffuse natural light, avoiding glare or shadows that could disrupt visual comfort.

Each recording session lasted several minutes to ensure stability and spatial coherence, using slow or static camera setups to minimise motion sickness. Environmental distractions such as people walking by, construction noise, or rapid lighting changes were minimised to maintain focus and reduce external interference.

Spatial and Ambient Audio Recording

To complement the 360° visuals, binaural and spatial ambient audio was recorded concurrently using dual-microphone setups. This ensured that sound sources in the virtual environment matched their real-world orientation, supporting audio-spatial congruence—a critical factor in creating a convincing sense of presence (Mihelj et al., 2014; Slater, 2018).

The ambient soundscape of each space was captured in real time:

- **In the classroom**, low-level environmental hums, air conditioning, and distant corridor sounds were included to evoke academic realism without distraction.
- **In the garden**, natural elements such as birdsong, rustling leaves, and subtle wind motion were recorded to convey openness and tranquillity.

These recordings were post-processed to equalise volume levels and filter unwanted noise while maintaining natural frequency balance. The resulting spatial audio was later synchronised with the video to provide a fully enveloping auditory environment, enhancing sensory immersion and supporting attentional focus during meditation.

Digitally Modelled Environments

The purpose-designed meditation room and neutral control (white) room were constructed using 3D modelling and rendering software (e.g., Unreal Engine, Blender, or Unity) to ensure consistent geometry, lighting, and acoustic control.

- **The meditation room** was designed with soft indirect lighting, minimal geometry, and muted colour palettes (light beige and wood tones) to convey calmness and familiarity with Thai meditation aesthetics.
- **The white control room** featured uniform white surfaces, balanced illumination, and no symbolic or decorative cues, serving as a baseline condition to isolate environmental influence.

Digitally generated spatial audio—composed of ambient silence and faint low-frequency tones—was added to these rooms to maintain auditory consistency across all environments.

Synchronization and Calibration

Video and audio tracks were synchronised in post-production using Adobe Premiere Pro and spatial audio software plug-ins. Each VR scene was calibrated for brightness, audio volume, and playback duration, ensuring parity across all environments. Total exposure duration for each VR session was standardised at approximately 10 minutes, with a short fade-in and fade-out sequence to facilitate comfortable entry and exit from the virtual experience.

Before participant testing, the environments were pilot-tested to verify immersion quality and eliminate potential discomfort. Adjustments were made to colour tone, audio balance, and scene stability to optimise comfort, realism, and meditative suitability.

Rationale for Omnidirectional Representation

The use of omnidirectional video and spatial audio provided high ecological validity, allowing participants to engage with real university environments while maintaining the control needed for comparative analysis. The combination of real-world footage (for authenticity) and 3D-rendered environments (for design precision) supported both environmental realism and experimental consistency. This mixed approach reflects the study's overarching goal—to examine environmental effects on meditation through immersive yet replicable digital representations that mirror real-world campus contexts.

3.5.6.2 Guided Meditation Voiceover

Participants engaged in 10-minute guided mindfulness experiences featuring a carefully crafted voiceover. These sessions were designed for focused-attention Buddhist meditation, directing participants' awareness toward bodily sensations. The program also included unguided segments allowing independent meditation practice.

The meditation was narrated by a professional with over fifteen years of expertise in Vipassana (Mindfulness) meditation practice and program development. The narrator is affiliated with The Baramee Dhamma Hall, a respected Vipassana meditation center in Chonburi Province, Thailand. She played a key role in developing the research's meditation program model, which adheres to core Vipassana principles aligned with Buddhist teachings.

The voiceover served not merely as instruction but as a channel through which participants engaged in an authentic meditative experience grounded in traditional and contemporary contemplative perspectives.

3.6 DATA COLLECTION METHODS

This study used a convergent mixed-methods approach, in which qualitative and quantitative data were gathered in parallel during the VR meditation protocol and later integrated for analysis (see Figure 2). The qualitative strand captured participants' lived experiences and meaning-making, while the quantitative strand provided session-by-session indicators of meditation quality and immediate well-being.

The procedures described below retain the original mixed-methods framework, presented with clear justification for each method, explicit description of instrument development, and transparent explanation of ethical and data-handling procedures.

Figure 11 illustrates the structure of the VR meditation schedule and data collection process described above. Each participant engaged in guided meditation sessions within all four virtual environments—classroom, garden, meditation room, and control space—following the same frequency and duration. Participants completed three sessions per week, each lasting approximately ten minutes, over a four-week period per environment. This sequential structure ensured equal exposure time, consistency in data collection, and reliable comparison across environmental conditions.

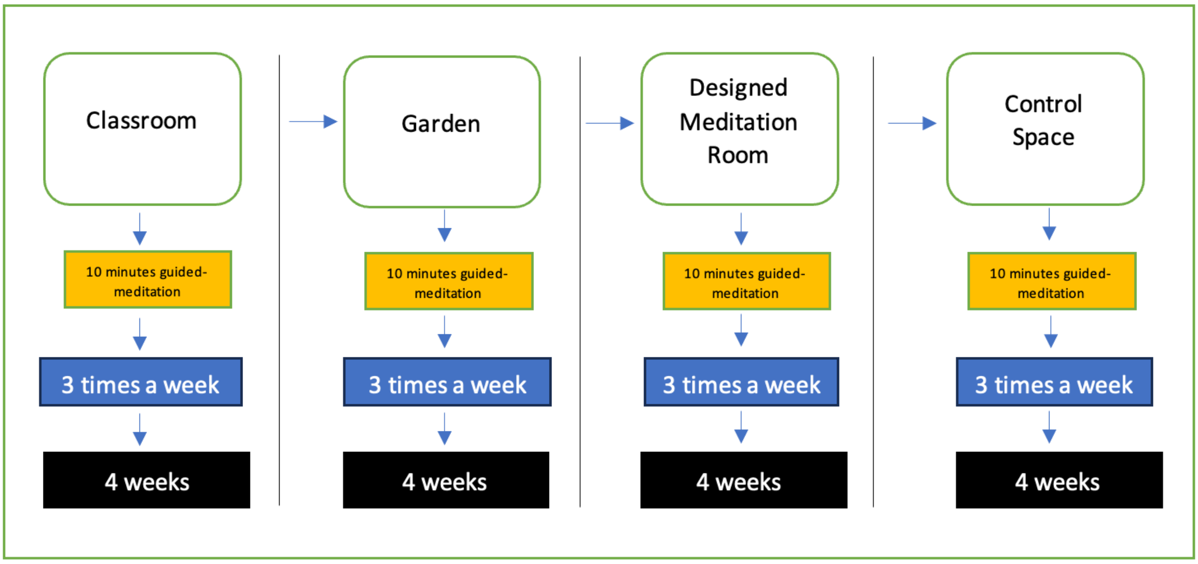


FIGURE 11: FLOWCHART OF PARTICIPANT SCHEDULE AND VR MEDITATION SESSIONS ACROSS FOUR ENVIRONMENTS

3.6.1 QUALITATIVE STRAND — SEMI-STRUCTURED INTERVIEWS AND MEDITATION DIARIES

- **Meditation diaries (post-session).**

  After each VR meditation session, participants completed a brief reflective diary in Thai. Prompts (as in the original protocol) invited descriptions of: (a) feelings during/after meditation (calmness, focus, stress release), (b) environmental impressions (light, sound, enclosure, naturalness, symbolism), (c) distractions or discomfort (including any VR friction/headset issues), and (d) perceived fit of the space for meditation. These immediate, session-level notes documented subtle changes across the four environments.

- **Semi-structured interviews (periodic).**

  At scheduled points during the sequence, participants joined short semi-structured online interviews, expanding on their diary reflections and comparing experiences across environments. The interview guide covered key themes such as perceived realism and presence in each virtual scene, factors supporting or hindering concentration, and how environmental qualities influenced emotional state and sense of calmness. Participants were also invited to discuss preferences for future meditation spaces within the university context. All interviews were audio-recorded and transcribed in Thai, with exemplar quotations translated and presented in Chapter 4 to illustrate participant perspectives and deepen interpretive insight.

3.6.2 QUANTITATIVE STRAND — POST-SESSION QUESTIONNAIRES (LIKERT −2 → +2)

Immediately after each session, participants completed a short questionnaire using the original −2…+2 Likert format (−2 = strongly disagree to +2 = strongly agree). Items captured:

- **Meditation quality**: perceived depth, concentration/focus during the session.
- **Immediate well-being**: calmness/relaxation and perceived stress reduction after the session.
- **Perceived environmental fit/realism**: suitability of the space for meditation, sense of presence/immersion, clarity of audio/visual cues.
- **VR comfort/friction**: headset comfort, absence of simulator sickness/distraction.

Session-level responses permitted within-participant comparisons across the four VR environments. Composite indices used in the original analysis (e.g., meditation quality, immediate well-being) are retained; details of scoring and aggregation appear in 3.7 and Chapter 4.

3.6.3 INSTRUMENT DEVELOPMENT AND VALIDATION

- **Item sources and alignment.**

  Questionnaire items and diary prompts were derived from the constructs reviewed in Chapter 2 (restorative/nature-based environments; environmental qualities supporting meditation; presence/immersion in VR). The wording used in this study reflects the original instrument set, adapted to the $-2\ldots+2$ response format already used throughout the thesis.

- **Content clarity and format.**

  The questionnaire items were explicitly designed to align with the study's core constructs: meditation quality, immediate well-being, environmental fit and realism, and VR comfort. Each item was phrased as a short, direct statement rated on a five-point Likert scale (-2 to $+2$). The structure ensured internal consistency and allowed clear mapping between quantitative indicators and qualitative reflections. Correspondingly, the diary prompts mirrored these domains to facilitate triangulation between data strands, enabling comparison of numerical outcomes and narrative experiences across environments.

- **Reliability and scoring.**

  Internal consistency (Cronbach's alpha) for each multi-item index (e.g., meditation quality; immediate well-being) was calculated on the study sample; values and any item adjustments are reported alongside results in Chapter 4. Assumptions for parametric tests and handling of missing data are documented in 3.7.

3.6.4 DATA MANAGEMENT AND ETHICS — ANONYMITY, STORAGE, CONSENT

- **Consent and participant rights.**

  Participants received an information sheet in Thai and provided written informed consent prior to participation. They could pause or withdraw at any point without penalty, including stopping a session in the event of VR discomfort.

- **Anonymity and handling of qualitative data.**

  Interview recordings were transcribed and pseudonymised; diary entries were exported without names. Any potentially identifying contextual details were generalised in reporting (e.g., programme names) to protect identity.

- **Storage and access.**

  All data (questionnaires, diaries, transcripts) were stored on encrypted, access-controlled drives. File keys linking codes to identities were kept separately and destroyed after verification of datasets for analysis.

- **Ethical approvals.**

  The study followed the approvals obtained for this project (University ethics and local administrative permissions for data collection at the Thai institution). The protocol/reference details are listed in the ethics appendix; any local site permissions are noted in Chapter 1 / Appendix materials. Procedures adhered to institutional data-protection requirements.

- **Participant safety (VR).**

  Standard VR safety guidance was followed: seated posture during meditation; scheduled breaks; immediate cessation if dizziness/nausea occurred; documentation of any incidents. These procedures are reflected in the limitations (3.9) where VR friction is considered when interpreting outcomes.

3.7 DATA ANALYSIS

This study employed a convergent mixed-methods analytical strategy, in which qualitative and quantitative data were analysed independently and then integrated during interpretation to form meta-inferences about how VR-simulated environments influence meditation quality and well-being (see Figure 2).

The analysis followed a parallel process: the quantitative strand focused on statistical examination of session-by-session outcomes, while the qualitative strand explored participants' lived experiences, meanings, and contextual reflections. Integration occurred at the interpretation stage, allowing numerical trends and narrative patterns to complement and explain one another.

The following subsections describe the specific analytic procedures applied in each strand, including the thematic method used for qualitative data, the rationale and assumptions guiding the parametric statistical tests, and the integration process through which both data types informed the interpretations presented in Chapter 4.

3.7.1 QUALITATIVE ANALYSIS

- **Approach.**

  Interview transcripts and meditation-diary entries were analysed using thematic analysis following the six-phase framework of Braun and Clarke (2006): (1) familiarisation with the data; (2) generating initial codes; (3) searching for themes; (4) reviewing themes; (5) defining and naming themes; and (6) producing the report. The analysis was primarily semantic (data-near meanings), while remaining open to latent patterns related to environmental symbolism (e.g., "openness," "containment," "institutional association").

- **Coding process.**
  - **Data preparation**: Audio interviews were transcribed in Thai and pseudonymised; diaries were exported without identifiers.
  - **First cycle**: Open coding line-by-line to capture experience descriptors (e.g., calmness, distraction, sound, enclosure, presence, headset comfort).
  - **Codebook development**: Codes were consolidated into a structured codebook aligned to the study constructs (environmental qualities; presence/realism; meditation states; well-being effects; VR friction).
  - **Second cycle**: Focused/thematic coding to organise codes into candidate themes for each environment (e.g., garden—openness/connectedness, meditation room—containment/focus, classroom—task associations, white room—neutral/low-cue).
  - **Cross-case comparison**: Patterns were examined within and across environments to identify convergences/divergences in experience.

- **Tooling and rigour.**

Coding followed the same structured process, whether conducted manually or with NVivo support, maintaining a comprehensive codebook, analytic memos, and a clear audit trail. Given the single-researcher nature of the analysis, methodological rigour was ensured through constant comparison, reflexive memoing, and periodic supervisory review of theme definitions. To enhance transparency and credibility, exemplar quotations—coded by environment and participant ID—are presented in Chapter 4 to illustrate key themes and ground interpretations in participants' lived experiences.

3.7.2 QUANTITATIVE ANALYSIS

- **Measures and indices.**

  Post-session questionnaires used the original −2 to +2 Likert format. Items were combined into the same composite indices as in the original thesis:

  - **Meditation Quality** (e.g., concentration, perceived depth),
  - **Immediate Well-being** (e.g., relaxation/calmness, stress reduction),
  - **Environmental Fit/Presence** (e.g., suitability, immersion/realism),
  - **VR Comfort/Friction** (e.g., headset comfort, absence of sickness).

  Internal consistency (Cronbach's α) was computed for multi-item indices; coefficients and any item adjustments are reported with results in Chapter 4.

- **Primary tests.**

  Analyses retained the original toolkit—descriptives, correlations, t-tests (where appropriate), and repeated-measures ANOVA to compare outcomes within participants across the four environments. Planned contrasts tested the a priori expectation that (Garden + Meditation Room) > (Classroom + White Room) on Meditation Quality and Immediate Well-being. Where pairwise comparisons were explored, p-values were adjusted (e.g., Holm–Bonferroni).

- **Assumptions and rationale for parametric tests.**
    - **Scale level**: Although individual Likert items are ordinal, the composite indices (sums/means of multiple items) are treated as approximately interval, consistent with standard practice in psychological research.
    - **Normality/linearity**: Residuals and index distributions were screened; given the within-subject design and sample size (final N = 53), parametric tests are considered robust. Non-parametric checks were conducted selectively when distributional assumptions were notably violated.
    - **Sphericity (RM-ANOVA)**: Mauchly's test was inspected; Greenhouse–Geisser corrections were applied where sphericity was violated.
    - **Effect sizes and CIs**: Results include η^2p for ANOVA and 95% CIs; correlations report r with CIs.
- **Handling missing data and outliers.**

Session-level missingness (e.g., a skipped diary or questionnaire) was handled using the maximum available data for each comparison; RM-ANOVA used complete cases for the relevant factor levels. Outliers were examined using standard diagnostics; sensitivity analyses (with/without outliers) are noted where conclusions could be affected.

- **Contextual/robustness checks.**
    - **Presence and VR friction**: Relationships between presence, VR friction, and key outcome variables were examined using correlation analyses to explore how the

quality of the VR experience influenced relaxation, focus, and overall well-being. These checks provided additional methodological validation, clarifying whether differences in participant experience within the virtual environment affected measured outcomes. The results of these analyses are reported in Chapter 4 to demonstrate the reliability and interpretive robustness of the quantitative findings.

- **Order effects**: Given the fixed sequence, descriptive trends across the exposure timeline were inspected; any potential order influence is acknowledged and discussed (also see 3.9).

3.7.3 INTEGRATION OF FINDINGS (MIXED-METHODS TRIANGULATION)

- **Integration strategy.**

Following a convergent design, qualitative themes and quantitative results were compared to determine convergence (agreement), complementarity (expansion), or divergence (contradiction). Integration occurred at two points:

1. **Results synthesis in Chapter 4**, where a joint display is used to align environment-specific scores (e.g., highest relaxation in garden/meditation room) with themes/quotes (e.g., openness/connectedness, containment/focus).
2. **Meta-inferences in Chapter 5**, where convergent evidence underpins design recommendations for universities and reflects on VR's role as both assessment medium and deployable solution.

- **Reading convergences/divergences.**
    - **Convergence**: Quantitative advantages for the garden/meditation room are expected to align with qualitative accounts of restoration, calm, and focus.
    - **Complementarity**: Quantitative ties between Presence and outcomes are elaborated by qualitative descriptions of realism, acoustics, light, and enclosure.
    - **Divergence**: Instances where scores and narratives differ (e.g., acceptable scores but reports of distraction) are examined through contextual factors such as task association in classrooms, VR friction, or individual preferences.

This integration moves beyond descriptive presentation by linking measurable differences to lived experience, clarifying how and why specific environments support meditation and well-being within the Thai undergraduate context.

3.8 ETHICAL CONSIDERATIONS

This research adhered to the ethical standards of the University of Strathclyde and followed recognised international principles for studies involving human participants. Ethical practice was integrated throughout the research process—from study design and recruitment to data handling and dissemination.

Because the study involved the use of immersive Virtual Reality (VR) environments and repeated meditation sessions, particular care was taken to address issues of participant safety, informed consent, and cultural sensitivity.

The following subsections outline how ethical approval, participant rights, and welfare were maintained during the research process.

3.8.1 ETHICS APPROVAL AND GOVERNANCE

Formal ethical approval for this research was granted through the University of Strathclyde's Research Ethics Committee (protocol/reference number and date to be inserted) following submission of a detailed ethics application and supporting documents. Local administrative permission for data collection was also obtained from the Thai host institution, ensuring compliance with both UK and Thai research governance standards.

The approved protocol covered all study components: the recruitment of Thai undergraduate students, repeated VR-based meditation sessions, post-session questionnaires and diaries, semi-structured interviews, and procedures for secure data handling. The ethical review confirmed that the study met institutional requirements for participant safety, voluntary participation, and data confidentiality.

In accordance with university policy and the UK General Data Protection Regulation (GDPR), all research data were handled under secure conditions. The researcher undertook training in ethical research conduct and data management as part of the Postgraduate Researcher Development Programme. Any subsequent amendments to the study design—such as adjustments to VR exposure schedules—were submitted for ethics oversight and recorded in compliance with governance procedures.

This dual-level approval process (UK and Thai) ensured that the research was consistent with local cultural expectations while maintaining international ethical standards for human-participant research.

3.8.2 INFORMED CONSENT AND PARTICIPANT RIGHTS

Prior to participation, each volunteer received a Thai-language information sheet written in accessible, non-technical language. The document explained the research aims, procedures, time commitments, potential risks and benefits, data handling protocols, confidentiality, and the voluntary nature of participation. Contact details for the researcher, the Thai host institution, and the University of Strathclyde Ethics Committee were provided for any queries or concerns.

Participants were given adequate time to read the information, ask questions, and consider participation before signing a written informed consent form. Consent was obtained prior to any data collection, and copies were retained by both the participant and the researcher. Participation was entirely voluntary and carried no relation to academic grading, course standing, or evaluation by teaching staff.

During the study, participants retained full autonomy and could withdraw at any stage without penalty and without providing a reason. They were also informed that they could decline to answer any question or pause/terminate a VR session at any point. These measures were reinforced verbally at the start of each session to ensure understanding and comfort.

Participants' rights extended beyond the duration of the study: individuals could request the deletion of their data before anonymisation. These procedures upheld the principles of respect, autonomy, and beneficence as articulated in standard ethical frameworks (Oates et al., 2021).

3.8.3 PARTICIPANT WELFARE AND VR HEALTH/SAFETY

Given the immersive nature of Virtual Reality (VR), participant welfare was treated as a core ethical priority throughout all stages of the study. The research protocol followed best-practice recommendations for VR health and safety, drawing on guidance from prior experimental work in cognitive and environmental psychology.

Before participation, all volunteers were briefed about the potential side effects associated with VR use—such as eyestrain, mild dizziness, or cybersickness—and were reminded of their right to pause or discontinue sessions at any time. All meditation sessions were conducted while participants remained seated to minimise balance-related risks. Headsets were individually adjusted for fit, focus, and interpupillary distance (IPD) to avoid discomfort or blurred vision. Each participant completed a short orientation before their first session to become familiar with the headset, controller interface, and navigation process.

Sessions were limited to safe exposure times, and rest intervals were scheduled between environments to reduce visual or cognitive fatigue. The researcher monitored participants during all sessions and immediately halted any exposure if dizziness, nausea, or anxiety was reported. Any adverse events were recorded, with optional follow-up or discontinuation offered as appropriate.

Meditation guidance was deliberately non-sectarian, focusing on breathing, attention, and bodily relaxation rather than religious or doctrinal content. This ensured accessibility for all students, recognising that many participants were culturally familiar with Buddhist values yet not necessarily experienced meditators.

3.8.4 PRIVACY, CONFIDENTIALITY, AND DATA PROTECTION

Data confidentiality was ensured through multiple layers of security and adherence to the University of Strathclyde's research data management policy. Questionnaires, diaries, and interview transcripts were pseudonymised using unique participant codes. A secure linking file connecting participant identities to codes was stored separately on an encrypted drive and accessible only to the researcher and supervisory team.

All digital data—including VR session logs, transcripts, and quantitative files—were stored on password-protected, access-restricted servers in compliance with the UK General Data Protection Regulation (GDPR) and institutional guidance. Physical records such as consent forms were locked in secure storage within the Faculty of Architecture at Burapha University during fieldwork, and later transferred to secure university storage for archiving.

In research dissemination, care was taken to avoid including any identifying details or combinations of demographic information that could indirectly reveal participants' identities. Quotations were attributed to participants by number only (e.g., P03, P21). Data retention followed the timeframe stated in the participant information sheet and in university policy; after this period, the linking file will be permanently destroyed.

These procedures collectively ensured that participant privacy was fully maintained and that data handling met professional and legal standards for ethical research practice (Oates et al., 2021).

3.8.5 MINIMISING RISK AND MANAGING EXCLUSIONS

Eligibility screening was implemented to safeguard participants and reduce potential health risks associated with immersive technologies. Inclusion and exclusion criteria were clearly stated in recruitment materials and verified before participation (see Section 3.4.3).

Individuals with a history of epilepsy or seizure disorders, severe vestibular dysfunction, or pronounced intolerance to VR were excluded to prevent risk of adverse reactions. Participants were also asked to report any conditions that could affect balance, vision, or motion sensitivity.

During the study, participants were reminded that they could stop at any time without explanation or consequence. In practice, some participants paused sessions to rest and resumed when comfortable; others requested a shorter duration for specific environments. All such requests were respected and documented.

By combining pre-screening, clear information, and a flexible protocol, the study minimised physical and psychological risks while preserving participants' autonomy and comfort. These safeguards reflect the ethical principles of beneficence and non-maleficence, ensuring that participation remained a safe and positive experience.

3.8.6 CULTURAL SENSITIVITY AND POWER DYNAMICS

Cultural and relational ethics were given particular attention because the study was conducted within a Thai university context. Recruitment materials were written in neutral, non-coercive language and disseminated through standard institutional channels such as student mailing lists and faculty noticeboards. No teaching staff with direct assessment or grading responsibilities recruited their own students to avoid conflicts of interest or perceived pressure to participate.

Interviews and diary prompts were worded carefully to avoid leading questions or culturally inappropriate phrasing. Participants were encouraged to describe their experiences in their own language and terms, and responses were accepted without judgement or correction. The researcher-maintained sensitivity to cultural expressions of modesty or respect common in Thai communication, particularly during interviews, allowing participants to set conversational tone and pacing.

Cultural preferences—such as attitudes toward chanting, silence, colour symbolism, or nature imagery—were noted and respected in both the design and interpretation of VR environments. These considerations helped ensure that participants could engage comfortably and authentically. The overall approach sought to maintain respectful reciprocity, balancing researcher authority with participant agency, and to reflect ethical mindfulness appropriate for cross-cultural design research.

3.8.7 TRANSPARENCY AND LIMITATIONS

Several design choices carried ethical implications that were acknowledged and transparently reported. The decision to maintain a fixed sequence of environments was made for practical reasons of scheduling and consistency but introduced potential order effects; this is explicitly discussed as a methodological limitation in Section 3.9.5. The possibility of VR-related fatigue or friction effects was also anticipated, and measures were included to monitor and report any discomfort or withdrawal.

All incidents, pauses, or participant feedback related to discomfort were logged and reflected upon in post-session notes. No serious adverse events occurred during data collection. These records were retained as part of the study's audit trail to support accountability and good research practice.

The study recognises that complete neutrality in researcher–participant relationships is unattainable; interpretation is shaped by both cultural context and disciplinary perspective. Nonetheless, transparency in reporting, reflexive commentary, and clear ethical documentation were prioritised to uphold the integrity of the research. These ethical reflections are carried forward into the limitations and discussion chapters, where the implications for future VR-based well-being research are explored in greater depth.

3.9 METHODOLOGICAL LIMITATIONS AND REFLEXIVITY

Every empirical study carries methodological boundaries that shape the interpretation and transferability of its findings. This section reflects critically on the design choices, sampling context, and analytical procedures that may have influenced the results. The aim is not only to acknowledge potential sources of bias or constraint but also to clarify how reflexive awareness informed the research process. Particular attention is given to the sequencing of environments, the ecological validity of VR compared with real spaces, and the cultural composition of the participant group. These limitations are balanced by the study's methodological strengths—its mixed-method design, triangulation of qualitative and quantitative data, and use of immersive simulation to capture subtle experiential responses. Together, these reflections provide transparency about the study's scope and support the credibility, reliability, and ethical integrity of its conclusions.

3.9.1 FIXED SEQUENCE OF ENVIRONMENTS (ORDER EFFECTS)

All participants experienced the four VR environments in a fixed sequence. This ensured logistical consistency and comparability of exposure but introduces potential order effects, including practice or habituation (improved meditation skill over time), carryover of mood or expectations, and fatigue in later phases. Although within-participant analyses reduce between-person noise and descriptive checks for temporal trends were conducted, the design cannot fully disentangle environment effects from maturation or sequence influences. Future studies should counterbalance environment order (e.g., Latin-square designs) or use randomised sequencing to minimise this risk and to test for order-by-environment interactions.

3.9.2 ECOLOGICAL VALIDITY OF VR VERSUS REAL SPACES

Virtual Reality (VR) provided a high level of experimental control and standardisation within this study, allowing consistent conditions of viewpoint, ambient audio, and luminance across participants. Two of the environments—the classroom and garden—were created through 360-degree video capture to preserve recognisable spatial and visual cues, while the meditation room and white-room control were modelled digitally in three dimensions to ensure design precision and flexibility. These methods offered reliable comparability between environments while enabling participants to experience recognisable contextual differences.

Despite these advantages, VR cannot reproduce the full multisensory qualities of physical settings. Factors such as air movement, scent, thermal comfort, fine-grained spatial acoustics, and the subtle presence of others are absent or greatly reduced in virtual simulations. Headset-related discomfort, limited field of view, and restricted physical movement can also influence immersion and attention. Such constraints may alter participants' sense of presence—the feeling of "being there"—which in turn can modulate perceived calmness, focus, and stress reduction. The interpretation of all findings therefore takes these limitations into account and is supported by qualitative reflections on realism, comfort, and distraction.

Perceived ecological realism varied among the four environments. Participants most often described the garden as the most natural and restorative due to its greenery, ambient nature sounds, and open spatial configuration. The meditation room was reported as calming and focused but less lifelike because of its digitally modelled elements. The classroom produced familiarity but limited restorative value, and the white-room intentionally minimised environmental cues to function as a perceptual control. These variations were considered when interpreting both quantitative scores and thematic findings, recognising that the degree of ecological richness can influence restorative responses as much as spatial composition or colour tone.

Overall, the study sought an appropriate balance between ecological validity and experimental control. The approach prioritised consistency of exposure and data capture while maintaining sufficient environmental cues to evoke meaningful psychological responses. This balance reflects a common methodological trade-off in VR-based environmental psychology research, where complete realism is sacrificed in favour of standardisation, yet participants' subjective experiences continue to provide valuable insights into the perceived authenticity and effectiveness of virtual meditation environments (Radianti et al., 2020; Slater & Sanchez-Vives, 2016).

3.9.3 CULTURAL COMPOSITION AND GENERALISABILITY

The sample comprised Thai undergraduate students, most of whom identified with a Buddhist cultural background. This composition is appropriate for the study's aim of developing recommendations for Thai universities; however, it naturally limits generalisability to other cultural or religious contexts. Thai students' familiarity with Buddhist principles, chanting, and symbolic connections with nature may have shaped their responses to the meditation environments. The public garden and meditation room, for instance, may have resonated with shared cultural associations of calmness and merit-making, while the classroom might have invoked task-oriented or evaluative connotations. These influences are important to recognise when interpreting both qualitative and quantitative findings.

Although the cultural homogeneity of participants provided internal consistency, broader claims are made cautiously. The findings reflect tendencies within Thai higher-education settings rather than universal patterns of meditation experience. Future studies could therefore include participants from different cultural and religious backgrounds or compare Thai and international cohorts to explore cross-cultural variation in restorative perception and spatial preference. As Triandis (2018) notes, culture significantly shapes how individuals perceive and interpret environmental cues, influencing behavioural and emotional responses to spatial design.

Researcher positionality also intersects with cultural interpretation. As a Thai researcher trained in art and design, the interpretation of spatial qualities, symbolism, and atmosphere may be informed by aesthetic sensitivity and disciplinary framing. Reflexive memoing and regular cross-checking of themes helped mitigate these influences, while quotations from participants' own words were used to anchor interpretations in lived experience. This awareness supports transparency and helps delineate the boundaries within which the study's findings can be meaningfully applied (Kabat-Zinn, 2003; Triandis, 2018).

3.9.4 RESEARCHER POSITIONALITY AND REFLEXIVITY

The researcher's training in arts, design, and architecture informed a heightened sensitivity to spatial composition, light, acoustic tone, and symbolic form. These disciplinary strengths supported the interpretation of environmental qualities but may also have shaped expectations about what constitutes an effective meditation space. Recognising this influence, a reflexive stance was maintained throughout the research process to ensure awareness of personal assumptions and disciplinary bias.

To enhance trustworthiness, the qualitative analysis adopted a reflexive thematic approach involving systematic codebook maintenance, memoing, and iterative theme review. Interpretations were anchored with exemplar quotations to maintain closeness to participants' voices, while the quantitative strand offered a complementary check on subjective inference. Continuous reflection on aesthetic preferences and interpretive framing helped ensure that disciplinary expertise enriched rather than distorted meaning. This reflexive awareness strengthens the transparency and credibility of the analytical process and clarifies how the researcher's perspective interacts with the generation of insight.

3.9.5 ADDITIONAL DESIGN AND MEASUREMENT CONSIDERATIONS

The study design sought to balance ecological richness with methodological consistency. All participants experienced the four environments in a fixed order to maintain comparable exposure durations and ensure that each environment was explored over the same one-month period. Although this approach limited counterbalancing, it enabled deep immersion and reduced novelty effects. The decision reflects a conscious trade-off between experimental precision and longitudinal realism, which was considered when interpreting potential order effects.

Post-session self-report indices (Likert $-2\ldots+2$) supported parametric analysis when aggregated into composites but remained susceptible to demand characteristics, social desirability, and central tendency. Reliability checks, including internal consistency tests, are reported with results. To strengthen validity, qualitative reflections and diary entries were triangulated with survey outcomes to verify convergence between numerical scores and lived experience. Future research could further enhance robustness by incorporating behavioural or physiological indicators—such as breath rate, heart-rate variability, or galvanic skin response—to corroborate self-reported psychological outcomes. Controlled lighting, headset calibration, and ambient sound levels were standardised during all sessions to minimise environmental variance and ensure replicable measurement conditions.

3.9.6 IMPLICATIONS FOR FUTURE RESEARCH AND PRACTICE

The methodological reflections outlined in this chapter suggest several directions for improving both future research and the practical application of VR meditation environments. These implications extend from the limitations acknowledged in this study and aim to guide replication and refinement in subsequent work.

1. **Sequence and order effects**: Future studies should consider counterbalancing or randomising the order of virtual environments to assess and minimise potential sequence effects. This would strengthen internal validity and clarify whether variations in participant response result from environmental characteristics rather than exposure order.
2. **Ecological fidelity**: Field-validation of VR findings is recommended by replicating sessions in real campus settings or by enhancing virtual simulations with additional sensory cues—such as ambient airflow, temperature variation, or scent—to approximate real-world experience.
3. **Cultural scope**: Broader participant sampling, including non-Buddhist and international cohorts, would enable comparison across cultural and experiential backgrounds. Measuring cultural or experiential moderators could clarify how values, beliefs, and familiarity with meditation shape restorative outcomes.
4. **Reflexive and collaborative practice**: Future work may extend reflexive strategies through multidisciplinary collaboration and participant involvement in interpretive co-analysis. Continued use of exemplar quotations remains important for centring participant voice and ensuring interpretive transparency.

5. **Complementary measurement**: Where feasible, future designs should incorporate behavioural or physiological indicators of relaxation and attention—such as heart-rate variability or respiration rate—to corroborate self-reported data and provide a more comprehensive understanding of VR's restorative potential.

These considerations underpin the recommendations developed in Chapter 5, supporting the pragmatic adoption of VR-enabled meditation while promoting ongoing evaluation across different environments, participant groups, and institutional contexts.

3.10 SUMMARY OF CHAPTER 3

This chapter has outlined the methodological framework that guided this investigation into how different meditation environments influence the well-being of Thai university students when experienced through Virtual Reality (VR). A mixed-methods, convergent-parallel design was adopted to integrate quantitative precision with qualitative depth, ensuring that both measurable outcomes and lived experiences informed the interpretation of findings. A phenomenological perspective framed the qualitative strand, allowing participants' subjective perceptions, emotions, and meanings to emerge alongside statistical indicators of relaxation, focus, and comfort.

The research design combined semi-structured interviews, meditation diaries, and post-session questionnaires to capture the multidimensional nature of meditation experience. Fifty-three undergraduate participants undertook repeated VR meditation sessions across four simulated environments—a classroom, a public garden, a purpose-designed meditation room, and a neutral white room—over a four-month period. VR technology provided experimental control and ecological validity, enabling consistent exposure to comparable visual and auditory stimuli while isolating the effects of environmental qualities on mindfulness and emotional balance. Quantitative data were analysed through descriptive statistics and repeated-measures ANOVA, while qualitative data underwent thematic analysis following Braun and Clarke's (2006) six-phase process. Integration of both strands was achieved through convergent triangulation, identifying convergence, complementarity, and divergence between narrative and numerical results.

Ethical principles of consent, confidentiality, and participant safety were rigorously applied throughout, supported by reflexive awareness of cultural context and researcher positionality. Section 3.9 acknowledged methodological boundaries—including fixed sequence, VR limitations, and sample composition—while reaffirming the robustness of the mixed-methods design. These reflections ensure transparency and credibility, situating the study within a framework of ethical responsibility and scholarly rigour.

In summary, Chapter 3 established the methodological foundation upon which the analytical work of the thesis rests. The chapter demonstrated how phenomenology, mixed-methods integration, and VR simulation together provide a coherent and innovative approach for investigating healing environments. The following chapter presents the results of this investigation, showing how students' quantitative evaluations and qualitative reflections reveal the emotional, perceptual, and cultural dynamics of meditation across the four VR environments.

CHAPTER 4

RESULTS

This chapter presents the results of the mixed-methods study investigating how different Virtual Reality (VR) meditation environments influence the well-being of undergraduate students in Thailand. The research sought to determine how spatial characteristics such as openness, sensory stimuli, and environmental cues affect meditation experiences when simulated through VR technology.

The chapter integrates qualitative and quantitative findings to provide a comprehensive understanding of how various virtual settings namely a classroom, public garden, designed meditation room, and control space (white room) shape participants' perceptions of relaxation, focus, and mindfulness. These environments were not physical but digitally recreated or captured through 360° imagery to ensure ecological validity within a virtual framework.

Data were collected through semi-structured interviews, online interviews, and meditation diaries, complemented by post-study questionnaires using Likert-scale ratings. The mixed-methods design allowed for both interpretive depth and statistical validation.

To enhance clarity and avoid repetition, qualitative findings are organised thematically rather than by chronological interview sequence. Quantitative results are subsequently analysed to support and triangulate the qualitative data. Together, these findings reveal the extent to which environmental design when experienced through VR can foster or hinder meditation and psychological restoration.

4.1 OVERVIEW OF KEY FINDINGS AND RESULTS

The study explored how four distinct VR environments influence meditation experiences and well-being outcomes among undergraduate students. Across both qualitative and quantitative analyses, several consistent patterns emerged, revealing that environmental characteristics especially natural elements, sensory richness, and spatial openness significantly enhance meditation outcomes.

4.1.1 GENERAL PATTERNS OF FINDINGS

Participants reported the highest levels of relaxation, concentration, and mindfulness when meditating in the virtual garden and designed meditation room. These environments incorporated calming natural stimuli such as greenery, balanced lighting, and ambient sounds that created a strong sense of immersion. In contrast, the classroom and control (white) room produced more neutral or mixed responses. The classroom's association with academic work limited participants' ability to detach mentally, while the white room's minimalist design evoked either deep focus or disengagement, depending on individual preference.

Quantitative results supported these patterns. Mean scores and ANOVA tests demonstrated statistically significant differences ($p < 0.05$) across environments for key indicators such as “environment supports effective meditation”, “sound levels are suitable for meditation”, and “VR helps maintain focus and calmness.” Both the garden and designed meditation room achieved notably higher ratings than the classroom and white room, confirming that sensory engagement and environmental design strongly influence the perceived effectiveness of meditation in VR settings.

4.1.2 ADAPTATION TO VR TECHNOLOGY

At the beginning of the study, several participants experienced discomfort with the VR headset, including dizziness or heaviness, particularly during the first few weeks. However, adaptation occurred rapidly; by the third week, most participants reported being comfortable with the technology and able to focus on meditation rather than the device. This pattern highlights the learning curve typical of immersive media but also demonstrates that VR can become a naturalised medium for mindfulness practice once users acclimate to its sensory and ergonomic features.

Importantly, participants’ reflections revealed that VR did more than replicate real-world settings it facilitated a controlled, repeatable, and immersive environment that supported mindfulness training even in the absence of physical spaces on campus. This suggests that VR may serve as a viable proxy for meditation environments when access to real spaces is limited.

4.1.3 INFLUENCE OF CULTURAL CONTEXT

Given that the majority of participants were Thai and identified as Buddhist, cultural familiarity with meditation practices influenced how they interpreted each virtual space. While most participants perceived meditation as a secular, mental-health activity rather than a religious act, elements such as the presence of a Buddha statue in the designed meditation room elicited both comfort and caution. Buddhist participants generally appreciated this symbol as enhancing authenticity, while a few non-Buddhists preferred a more neutral environment. These responses underscore the importance of cultural sensitivity and inclusivity in designing future VR meditation spaces for diverse users.

4.1.4 INFLUENCE OF CULTURAL CONTEXT

1. **VR environments significantly affected well-being outcomes.**

   Sensory-rich and natural settings (garden, designed meditation room) enhanced relaxation, focus, and mindfulness more effectively than neutral or minimalist environments.

2. **Minimalist design produced mixed results.**

   The white room facilitated deep focus for some participants but reduced engagement for others, suggesting that personal preference and adaptability shape responses to environmental simplicity.

3. **Technological adaptation was progressive.**

   Initial physical discomfort diminished as participants gained familiarity, indicating that sustained exposure supports better focus and immersion.

4. **Cultural familiarity played a subtle but important role.**

   Participants' Buddhist background fostered openness to meditation but also highlighted the need for design neutrality in shared or international applications.

5. **Qualitative and quantitative results were convergent.**

   Statistical analysis confirmed patterns observed in interviews and diaries, validating that environmental and sensory qualities meaningfully influence meditation effectiveness in VR.

4.1.5 LINK TO SUBSEQUENT SECTIONS

The sections that follow present detailed analyses of these findings. Section 4.2 describes participant demographics and meditation experience. Section 4.3 provides an in-depth thematic interpretation of qualitative data, showing how participants experienced each environment. Section 4.4 reports the quantitative outcomes supporting these themes, followed by an integrated comparison in Section 4.5. Together, these results form the foundation for the discussion in Chapter 5, which examines the broader implications of VR-mediated healing spaces for university well-being initiatives.

4.2 PARTICIPANT DEMOGRAPHICS AND MEDITATION PRACTICE

This section outlines the demographic profile and meditation background of participants who took part in the VR meditation study. Understanding participants' characteristics provides context for interpreting differences in their meditation experiences across the four virtual environments.

4.2.1 PARTICIPANT PROFILE

A total of 53 undergraduate students from Burapha University, Chonburi Province, Thailand, volunteered for the study. All participants experienced meditation through VR headsets and contributed to both qualitative and quantitative phases of data collection.

The sample comprised 35 females (66 %) and 18 males (34 %), reflecting the gender distribution commonly found in Thai arts and health-related programmes. Students represented a cross-section of academic disciplines: Art and Design (56.6 %), Nursing (15.1 %), Sports Science (9.4 %), Science (9.4 %), and Engineering (9.4 %). Participants came from all study years, with the largest groups in the second (33.9 %) and third (28.3 %) years.

Regarding religion, 96 % of participants identified as Buddhist, while 4 % identified as Christian. This reflects Thailand's national demographics and provides a culturally coherent sample for exploring meditation practices grounded in Buddhist traditions.

TABLE 2: DEMOGRAPHICS OF THE SAMPLE (N = 53)

Characteristics	Frequency	%
Gender		
Female	35	66.03
Male	18	33.96
Graduate Program		
Art and Design	30	56.6
Nurse	8	15.09
Sport Science	5	9.43
Science	5	9.43
Engineering	5	9.43

Year of Graduate Program		
1st Year	6	11.32
2nd Year	18	33.96
3rd Year	15	28.30
4th Year	14	26.41
5th year or more	0	0

Chara Characteristics	Frequency	%
Religion		
Buddhist	51	96.22
Christian	2	3.77
Hindu	0	0
Islam	0	0
Other	0	0

Interpretation.

The predominance of female participants and representation from art-related disciplines align with trends in mindfulness and design-based studies, where participation tends to be higher among creative and health-oriented cohorts. The religious homogeneity offered cultural consistency most participants were familiar with meditation concepts through Thai schooling and Buddhist cultural practices while still including a small non-Buddhist group that enriched comparative perspectives on inclusivity and design neutrality.

4.2.2 MEDITATION BACKGROUND AND EXPERIENCE

To contextualise their responses, participants were asked about previous meditation experience, frequency, and preferred locations of practice.

Key Findings

- 79 % had some prior meditation experience, though most were beginners who had practiced irregularly.
- The majority (≈ 67 %) had engaged in meditation for less than one month, indicating limited prior exposure.
- Typical frequency was one to three sessions per week (79 %), each lasting under 30 minutes.
- Home was the most common meditation setting (73 %), followed by temple (12 %) and public garden (9 %).
- Common methods included Metta (loving-kindness), mindfulness/Vipassana, walking meditation, and mantra recitation.

TABLE 3: DEMOGRAPHICS OF MEDITATION PRACTICE

Chara Characteristics	Frequency	%
Meditation experience		
Yes	44	79.4
No	5	20.6
Characteristics	Frequency	%
Other	4	20.6

Types of Meditation Practiced.

Mindfulness/Vipassana	5	14.7
Metta/Loving-kindness	10	29.4
Walking Meditation	9	26.5
Mantra Meditation	3	8.8
Other	7	20.5
Engagement with meditation		
Less than 1 month	22	66.7
1 month, but less than 3 months	2	6.1
3 months, but less than 6 months	1	3
6 months, but less than 12 months	1	3
More than 12 months	7	21.2
Frequency of Meditation per week		
Never		
1-3 days	27	79.4
3-6 days	3	8.8
7 days		
Other	4	11.7
Duration of Session		
Less than 10 minutes	17	51.5
10 - 30 minutes	14	42.4
30 minutes -1 hour	3	8.8
1-2 hours	0	0
More than 2 hours	0	0

Chara Characteristics	Frequency	%
Place of Meditation		
Temple	4	12.1
Home	24	72.7
Meditation Studio	1	3
Public garden	3	9.1
Other	1	3

Interpretation.

Most participants were novice or early-stage meditators, reflecting a realistic picture of Thai university students, who generally learn about meditation conceptually but rarely practice regularly. This limited prior exposure was advantageous for the present study: participants approached the VR sessions without fixed expectations, allowing genuine insight into how environmental variation influenced meditation quality.

The predominance of short, home-based practice indicates that meditation was perceived as a personal relaxation activity rather than a formal religious exercise. This contextual factor helps explain why students responded favourably to secular, nature-based VR environments, and why reactions to explicitly religious symbols (e.g., Buddha statue) varied.

4.2.3 SUMMARY AND IMPLICATIONS FOR INTERPRETATION

The participant group represented a typical Thai university demographic predominantly young adults, mostly female, culturally Buddhist, and possessing limited formal meditation training. This profile establishes the interpretive framework for subsequent analyses:

1. **Cultural Familiarity**. The Buddhist majority brought an inherent openness to meditation, enabling authentic engagement with the VR sessions. However, it also limits generalisability to more religiously diverse contexts.
2. **Experience Level**. As mostly beginners, participants' perceptions were shaped less by advanced technique and more by environmental comfort and sensory cues, emphasising the importance of spatial design.
3. **Relevance to Study Aims**. The diversity of disciplines and the inclusion of both art- and science-based students provide a cross-section of cognitive and aesthetic perspectives valuable for understanding how design and well-being intersect in VR.

Overall, the demographic and experiential background of participants situates the study within the lived reality of Thai higher education where stress, limited meditation literacy, and strong cultural associations with mindfulness converge. These contextual factors underpin the subsequent qualitative analysis (Section 4.3), which explores how students experienced meditation across the four VR environments.

4.3 QUALITATIVE FINDINGS

4.3.1 INTRODUCTION TO THE QUALITATIVE ANALYSIS

The qualitative component of this study sought to understand how students experienced meditation within four distinct Virtual Reality (VR) environments a classroom, a public garden, a purpose-designed meditation room, and a minimalist white-room control space. Data were collected from semi-structured interviews (conducted every two weeks across four months) and from meditation diaries in which participants reflected on each session.

All interviews were transcribed and analysed through thematic analysis using a hybrid inductive–deductive approach. Coding began with open identification of recurrent meanings and was then refined into higher-order categories aligned with the study's research aims concerning well-being, spatial experience, and environmental influence. NVivo software facilitated the clustering of codes and cross-checking among the researcher's field notes.

To avoid redundancy, the results are presented thematically rather than chronologically, grouping all eight interview rounds and diary entries under major themes that capture common patterns across environments. Quotations are reproduced verbatim to retain participants' voices while remaining concise and representative.

The five key themes emerging from the analysis are:

3. Students' Well-being and Stress within the University Context
4. Experiences of Meditation through Virtual Reality
5. Perceptions of Different VR Meditation Environments
6. Adaptation, Focus, and Mindfulness over Time
7. Cultural and Religious Context in Meditation Experience

Together these themes illuminate how immersive VR settings influenced students' emotional states, engagement, and interpretation of meditation as a coping strategy for academic and personal stress.

4.3.2 THEME 1: STUDENTS' WELL-BEING AND STRESS WITHIN THE UNIVERSITY CONTEXT

Before exploring the environmental effects of VR meditation, it is important to situate participants' mental-health context. Interview narratives consistently revealed high levels of stress, anxiety, and fatigue among students, arising from academic workloads, social adaptation, and lingering concerns following the COVID-19 pandemic. These pressures significantly shaped how students approached the VR sessions, influencing both their openness to meditation and their perception of its effects. The interviews painted a consistent picture of students navigating complex layers of academic pressure and emotional instability, suggesting that the desire for stillness and focus was deeply tied to their everyday struggles.

4.3.2.1 SOURCES OF STRESS AND EMOTIONAL BURDEN

Participants described multiple, overlapping stressors—tight deadlines, frequent examinations, insufficient sleep, and family expectations. These stressors were not isolated incidents but ongoing cycles that left students feeling chronically fatigued and mentally drained. Many participants commented that the intensity of coursework, particularly in design and nursing programmes, restricted rest and diminished motivation. Their accounts illustrated that the cumulative nature of academic pressure had a tangible effect on concentration, mood, and self-esteem.

One participant explained:

"Having too many projects due at the same time led to late nights and made it hard to focus in class."

Another added:

"Continuous work left my mind feeling crowded and made it difficult to calm down."

Such reflections reveal the extent to which students experienced cognitive overload—a phenomenon in which prolonged attention demands result in mental exhaustion and reduced emotional regulation. In these conditions, even simple tasks such as concentrating in lectures or engaging in group discussions became difficult.

Several participants explicitly linked this exhaustion to the learning environment itself. Open-plan studios, shared dormitories, and noisy communal areas were often described as "distracting" or "draining." Many students commented that they lacked a personal space where they could be quiet or mentally disconnect. For them, the university campus, while a site of learning, was simultaneously a site of continual stimulation and performance pressure. This absence of refuge made them acutely aware of their psychological needs. The need for calmness was not abstract but felt bodily as tension, shallow breathing, or restlessness which strengthened their receptivity to the promise of meditation as a structured, contained, and restorative activity.

The continuing psychological impact of the COVID-19 period was also evident across several interviews. Although formal restrictions had eased, the emotional residue of social distancing remained. Students frequently expressed unease about crowded places and uncertainty about social interaction.

One participant shared:

"Even after the COVID period, I still feel uneasy around many people and get stressed when classrooms are crowded."

Another mentioned:

"My family still worries about illness, so I try to be cautious every day."

These comments highlight a lingering collective anxiety and show how the pandemic left a subtle but enduring imprint on daily behaviour. The participants' awareness of vulnerability both physical and emotional translated into an ongoing need for control and safety, which made VR meditation appealing. Within the headset, they could experience isolation that felt protective rather than lonely.

This interplay of external pressure and internal sensitivity suggests that many students entered the study already primed for restorative intervention. The interviews depict individuals who were not merely curious about meditation but actively seeking relief. Their openness to new experiences, including VR-based meditation, stemmed from this cumulative stress and their intuitive understanding that calmness could be cultivated through guided focus and sensory withdrawal. The significance of this context cannot be overstated: the success of the VR environments in later sessions was, in part, facilitated by participants' pre-existing awareness of their own stress and their motivation to counterbalance it.

4.3.2.2 TRANSITION AND HOMESICKNESS

For many first- and second-year students, the challenges of adapting to university life extended beyond academic workload. Several participants described a profound sense of emotional dislocation following the transition from family life to campus independence, especially after prolonged periods of remote learning. During the pandemic, home had become a secure and familiar environment, and its sudden absence left students emotionally unsettled.

One participant reflected:

"During online study I was always with my family, so returning to the dormitory made me feel lonely."

Another explained:

"I'm still adjusting to being independent. Sometimes I miss home so much I can't concentrate on work."

The sense of separation from family support networks amplified feelings of isolation and made it difficult to maintain focus or enthusiasm. The dormitory, despite being a place of social proximity, did not necessarily provide emotional connection; several students noted that even surrounded by peers, they still felt "alone." This emotional displacement magnified the significance of meditation as a stabilising practice.

For some participants, the VR meditation sessions represented their only consistent moment of introspection in an otherwise fragmented daily rhythm. The ability to retreat into a quiet, self-contained environment even virtually provided a temporary sense of home-like familiarity. The guided breathing, soft light, and auditory isolation of VR created conditions that contrasted sharply with the noise and social demands of dormitory life. This contrast between external instability and internal quiet was one of the key factors shaping positive responses to the VR sessions, revealing that the search for calm was simultaneously a search for belonging and emotional security.

4.3.2.3 PERCEIVED NEED FOR MENTAL RELIEF

Across interviews, nearly all participants expressed an urgent need for mental relief and personal space. Many perceived the university environment as saturated with expectations—academic, social, and emotional—that left little room for rest or self-reflection. The idea of meditation resonated strongly because it offered a legitimate reason to pause without feeling unproductive.

One participant stated:

"Meditation felt like escaping from everything—just ten minutes made me feel more balanced."

Others echoed this sentiment, describing meditation as a "reset," "quiet zone," or "mental break" that allowed them to realign their focus. Several participants noted that even before the study, they had tried to find similar relief through music, drawing, or walking outdoors, but these strategies were inconsistent or easily interrupted. The structured VR meditation sessions were therefore perceived as reliable, safe spaces for emotional recovery.

Students' descriptions of their mental state phrases such as "tired mind," "heavy head," or "too much inside"—mirror psychological language associated with attentional fatigue and stress accumulation. These expressions underscore that well-being, for many, is not only a mental but a spatial experience: it depends on having access to an environment that supports the mind's need for restoration. VR meditation fulfilled this condition symbolically and perceptually. It allowed participants to externalise their desire for quiet into a designed environment, thereby giving form to the otherwise intangible concept of mental space.

4.3.2.4 INTERPRETATION AND LINK TO RESEARCH AIM

This baseline theme confirms that the participant group was experiencing considerable psychological strain, consistent with international findings on post-pandemic student well-being (Böke et al., 2019; Pascoe et al., 2020). The narratives reveal a confluence of academic intensity, social adaptation, and residual health anxiety—each contributing to reduced mental resilience. In this context, the introduction of VR meditation did not merely serve as a novel experience but met a pressing emotional need.

The findings support theories in environmental psychology that emphasise the restorative potential of calm, ordered, and aesthetically coherent environments (Ulrich, 1984(Kaplan & Kaplan, 1989). Participants' desire for stillness and escape demonstrates that restorative design principles such as sensory harmony, natural cues, and spatial enclosure retain psychological validity even in digital form. For this group, healing space was not limited to physical architecture but extended to perceptual environments capable of providing focus, privacy, and emotional balance.

For the present research, these conditions provided the emotional and psychological foundation for subsequent analysis of VR meditation environments. Students' acute awareness of stress heightened their sensitivity to environmental qualities such as openness, natural sound, and lighting. This made their feedback especially valuable for assessing how design elements contribute to perceived calmness. The data also underscore that effective digital interventions for well-being must consider contextual stress factors: the efficacy of VR meditation cannot be divorced from the realities of student life, where emotional fatigue and overstimulation are pervasive.

In sum, Theme 1 establishes the emotional backdrop against which all later experiences of VR meditation unfolded. The participants' accounts highlight a student population navigating intense demands yet open to new modalities of healing. Their receptivity to VR meditation arose from a combination of psychological exhaustion and hope for renewal—a convergence that sets the stage for understanding how virtual environments became meaningful spaces for restoration and self-regulation. The next theme explores in detail how students encountered meditation through the VR medium itself and how technological immersion interacted with their search for calm, concentration, and emotional balance.

4.3.3 THEME 2: EXPERIENCES OF MEDITATION THROUGH VIRTUAL REALITY

While Theme 1 established the emotional backdrop of stress and the participants' need for psychological relief, Theme 2 explores how students experienced meditation when mediated through VR. Interviews revealed that immersion within the headset evoked a diverse range of physical sensations, cognitive adjustments, and emotional responses. Participants' experiences evolved from initial curiosity and mild discomfort to a deeper sense of focus and engagement over time. Their accounts highlight how technological mediation influenced both the accessibility and authenticity of meditation, revealing VR's potential and its boundaries as a tool for mindfulness.

4.3.3.1 INITIAL CURIOSITY AND PHYSICAL ADJUSTMENT

For nearly all participants, the first VR session was accompanied by a sense of novelty and anticipation. Many described the experience as "exciting," "strange," or "different," underscoring the attraction of new technology. However, the unfamiliarity of wearing a headset also introduced moments of physical and sensory discomfort. Several participants mentioned the weight of the headset, visual distortion, or mild dizziness during early sessions, especially among those with no prior VR experience.

One participant explained:

"At first, the glasses were heavy and I felt dizzy after a few minutes, but after using them several times it became normal."

Another shared:

"It was difficult to concentrate when I started because the headset felt strange on my face."

These early sensations illustrate a transitional phase in which participants' bodies and minds adjusted to a new sensory context. The adaptation process mirrors findings in human–computer interaction research, where repeated exposure to immersive environments gradually reduces physiological tension and cognitive dissonance. Within this study, the initial discomfort soon gave way to familiarity; participants learned to stabilise their breathing, reduce head movement, and align posture with visual cues, suggesting a growing synergy between body and digital environment.

As students became more accustomed to the headset, the sense of physical presence within the virtual space deepened. The headset's capacity to block peripheral vision and external noise contributed to a feeling of seclusion that participants often described as "private" or "protected." For some, this isolation was initially unsettling but later perceived as beneficial once they realised it allowed uninterrupted concentration. The paradox of VR—its simultaneous separation from reality and immersion into it—became a meaningful part of the meditation process.

4.3.3.2 IMMERSION AND SENSORY AWARENESS

Participants described the VR meditation as an intensely sensory experience, where visual and auditory elements worked together to guide attention. The head-mounted display surrounded them with 360-degree imagery, while the ambient sounds—birds, wind, soft instruments, or guiding voice established an immediate emotional tone. Students often reported that these sensory cues helped them disengage from daily stress and focus inward.

One participant noted:

"When I closed my eyes in real life, I could still hear noise from outside, but in VR everything became quiet and controlled."

Another explained:

"The guiding voice helped me stay focused, and the background sounds made me feel like I was really there."

Such remarks illustrate how environmental coherence within VR—balanced lighting, synchronised sound, and spatial depth facilitated concentration by minimising external distractions. The combination of visual and auditory design elements mirrored key principles of restorative environmental design, such as consistency, safety, and sensory balance.

Several students compared their VR experience with previous attempts at meditation in real spaces, noting that the headset provided a psychological boundary from distraction. The virtual environment created a temporary sanctuary, enabling a deeper internal focus. The participants' descriptions align with theories of presence in VR studies, which define immersion not only as perceptual realism but as an emotional belief in "being there." For many, the sensory synchronisation of VR allowed them to internalise this sense of presence more effectively than in typical classroom meditation sessions.

Some participants also reported heightened bodily awareness—a paradoxical sensation of feeling both inside and outside the body. The visual calmness of the scene and the controlled rhythm of breathing appeared to enhance interoception, or awareness of internal bodily states. A few participants described noticing their heartbeat, breathing pattern, or muscle relaxation more acutely in VR than during ordinary meditation. This finding underscores VR's unique ability to magnify mindfulness by providing a perceptually enclosed environment that amplifies subtle sensory feedback.

4.3.3.3 EMOTIONAL SHIFTS AND COGNITIVE ENGAGEMENT

As sessions progressed, participants described a noticeable emotional transition from external alertness to internal calm. Many began sessions feeling restless or preoccupied with daily concerns but gradually entered a state of sustained focus.

One participant recalled:

"After a few weeks, I stopped noticing the device. I could just focus on breathing and listening."

Another mentioned:

"Sometimes I forgot it was VR; it just felt like being in my own quiet space."

These reflections demonstrate how repeated exposure fostered a meditative rhythm similar to that of traditional practice. Participants developed the ability to shift attention from the novelty of technology to the process of mindfulness itself. This progression suggests that the success of VR meditation depends not solely on environmental design but also on user adaptation and psychological readiness.

Several students also described moments of emotional release—instances where accumulated tension seemed to ease during or after sessions. Some mentioned feeling "lighter," "relieved," or "more open." For others, the experience evoked introspection about their lifestyle and stress management. A few participants mentioned that the virtual space helped them recognise how tightly they had been holding physical or mental stress. This emotional awareness often persisted beyond the sessions, indicating that VR meditation may stimulate self-observation as much as relaxation.

From a cognitive perspective, participants reported improved focus and memory immediately after sessions. Several mentioned being able to concentrate better during later classes or study periods. The combination of immersive isolation and guided breathing likely contributed to short-term cognitive restoration, echoing the attention restoration theory proposed by Kaplan and Kaplan (1989). This theory posits that exposure to coherent, softly fascinating environments replenishes depleted attention. In VR meditation, the visually harmonious environments served as a digital analogue to such restorative natural settings.

4.3.3.4 INTERACTION BETWEEN TECHNOLOGY AND MINDFULNESS

A recurrent theme across interviews was the dual nature of VR as both facilitator and mediator of mindfulness. While participants appreciated the immersive design, they also remained aware that the experience was technologically constructed. For some, this awareness introduced a reflective dimension—recognising how easily perception can be shaped by design.

One participant observed:

"I knew it wasn't real, but it still made me calm. It's strange how the mind accepts it."

This reflection captures the philosophical core of the VR experience: the mind's capacity to derive genuine calm from simulated stimuli. The technology's effectiveness thus lies not in perfect realism but in its ability to trigger the same psychological mechanisms that physical environments evoke attention redirection, sensory coherence, and emotional safety.

However, a small number of participants expressed ambivalence. A few found the headset's visual clarity insufficient or felt constrained by the device's physical boundary. These cases illustrate the individual variability in technological comfort and mindfulness aptitude. They also suggest that while VR can reproduce key environmental features of healing spaces, the quality of the user's inner engagement remains crucial. Meditation through VR, therefore, represents an intersection between environmental design and personal psychology rather than a substitution for one or the other.

Participants' discussions reveal that VR meditation promoted an understanding of mindfulness as both embodied and mediated—a balance between physical sensations and digital framing. Many concluded that although the headset was a machine, the feelings it produced were undeniably human.

4.3.3.5 INTERPRETATION AND LINK TO RESEARCH AIM

The findings from this theme provide insight into how technological immersion influences mindfulness and extend existing models of environmental psychology into the digital realm. Participants' accounts demonstrate that presence and calmness can emerge from virtual experiences that simulate environmental qualities of balance, order, and sensory clarity. The process of adaptation moving from curiosity and distraction to focus and self-awareness illustrates how digital design can facilitate gradual psychological transition toward mindfulness.

These results validate the use of VR as a legitimate platform for exploring healing spaces, confirming that its immersive potential can generate authentic emotional responses. They also reveal that the meditative state is not dependent on physical materiality but on perceptual conditions that support focus, safety, and coherence. The study thereby expands the concept of healing space from a purely architectural construct to a hybrid cognitive-environmental experience shaped by both design and technology.

In the context of the research aims, these findings address the second research question: What are the effects of different types of meditation environments on student well-being when experienced through VR simulations? The participants' experiences confirm that VR can effectively reproduce the mental benefits of meditative environments by aligning sensory design with psychological needs. Importantly, these effects arose not from technological spectacle but from simplicity—spaces that offered enough sensory richness to engage the mind without overwhelming it.

Ultimately, Theme 2 demonstrates that virtual environments can successfully mediate mindfulness and emotional recovery, providing a bridge between the external environment and the internal state of awareness. The next theme explores this relationship further by analysing how participants perceived and evaluated the distinct qualities of the four meditation environments—classroom, garden, designed meditation room, and white room, and how these environments influenced their sense of calm, focus, and immersion.

4.3.4 THEME 3: PERCEPTIONS OF DIFFERENT VR MEDITATION ENVIRONMENTS (CLASSROOM, PUBLIC GARDEN, DESIGNED MEDITATION ROOM, WHITE ROOM)

Theme 3 examines how participants perceived and evaluated each of the four VR meditation environments. Their reflections revealed that environmental design—light, colour, openness, symbolic presence, and sound—shaped the depth and quality of their meditation experience. The first phase of interviews focused on the Classroom Environment, which served as a baseline reference for how students reacted to a familiar but non-specialised space. Later phases compared this to the public garden, designed meditation room, and white room (control environment).

4.3.4.1 CLASSROOM ENVIRONMENT (FIRST PHASE OF INTERVIEWS)

The first environment presented to participants simulated a standard university classroom, designed to reflect an ordinary learning space devoid of overtly restorative features. This setting was chosen intentionally as the starting point for the study, establishing a familiar context before participants encountered more meditative or natural environments. The interviews revealed that while the environment felt recognisable and safe, it also carried emotional associations with academic stress, noise, and formality.

One participant remarked:

"It looked just like my real classroom. I felt like I should be studying, not meditating."

Another commented:

"The space felt heavy. Even though it was quiet, I could still feel that pressure of deadlines and group work."

These statements highlight a strong psychological link between spatial familiarity and emotional association. The classroom's neutral design, white walls, fluorescent lighting, rows of desks triggered learned behaviours of focus, evaluation, and productivity rather than calmness. Even in VR, this environment elicited what participants described as "mental tension" or "work mode." This association underscores the principle that environments are not experienced in isolation but through accumulated memories and expectations.

Some participants did, however, report comfort in familiarity. For those who initially felt uncertain about using VR, the classroom provided a stable reference point. It reduced the sense of disorientation that can accompany immersive technology. Yet this comfort was primarily cognitive rather than emotional; the space offered predictability, but not release. Participants tended to maintain upright posture and reported slower relaxation onset compared to later environments.

Several participants described the lighting as overly bright and the acoustics as sterile. The absence of natural elements—plants, texture, or variation was often noted as a barrier to immersion.

One participant explained:

"Even though it was quiet, the light was too sharp. It made me feel awake, not relaxed."

This reaction reflects how artificial lighting and spatial rigidity can inhibit restorative experience, even in simulated form. The lack of visual warmth and organic form limited participants' ability to disconnect from academic associations.

A recurring observation was that the classroom VR felt "realistic but uninspiring." Participants appreciated the fidelity of the 3D rendering but noted that realism alone did not equate to relaxation.

As one student described:

"It was realistic, but it didn't change how I felt. It's still a classroom, even in VR."

This contrast between technical realism and emotional authenticity became a key insight: the psychological impact of VR meditation depended less on representational accuracy than on affective design qualities—light, atmosphere, and meaning.

Emotional Tone and Cognitive Associations

Participants consistently linked the classroom environment to the pressures of academic life. The visual cues—desks, whiteboards, and uniform walls—evoked memories of evaluation, competition, and performance. As a result, several participants reported difficulty focusing on breathing or maintaining mindfulness.

One participant reflected:

"My mind kept thinking about unfinished work. The space reminded me of deadlines."

Others echoed this sentiment, describing the environment as "neutral but noisy inside," meaning that although the VR scene was silent, internal cognitive noise persisted. The familiarity of the setting acted as a cognitive trigger for mental workload rather than rest.

Interestingly, some participants noted that the classroom environment amplified their awareness of stress, helping them recognise how strongly environmental context affects mood.

One participant observed:

"I realised how much the classroom affects me. Even in virtual form, it carries stress energy."

This reflection demonstrates environmental psychology in action: users' perceptions of space are intertwined with memory and emotional imprint. The classroom became a mirror of mental state, exposing habitual patterns of tension rather than alleviating them.

Contrasts in Sensory and Spatial Perception

Despite the lack of restorative features, participants appreciated the opportunity to observe their own reactions. Some expressed surprise at how an environment could influence their inner state so strongly, even when simulated. Others commented on how small sensory changes could have shifted the experience—warmer lighting, ambient sound, or visual texture.

One student remarked:

"If there was softer light or background sound, maybe it would help me calm down."

Such feedback provides practical insight into how design parameters influence emotional perception. The sterile classroom setting functioned as a control condition, highlighting the absence of environmental triggers for mindfulness. Participants' comments suggest that without sensory depth or symbolic meaning, relaxation remains difficult, even when external distractions are removed.

The absence of natural or symbolic cues also limited the sense of presence. Whereas later environments produced comments like "I felt like I was there," the classroom elicited responses such as "I know it's fake" or "just another room." This indicates that immersion alone is insufficient; emotional engagement requires affective design qualities beyond visual accuracy.

Interpretation and Link to Research Aim

The classroom environment served as an essential baseline for comparative understanding. It demonstrated that familiarity does not necessarily generate comfort and that physical realism alone cannot induce calmness. Participants' experiences revealed that psychological associations—shaped by daily stress and spatial memory can override sensory neutrality. The classroom in VR became a site of cognitive dissonance: visually controlled but emotionally charged.

From a research perspective, this phase confirmed that environments intended for meditation must actively counterbalance learned associations of productivity and pressure. It also validated the use of VR as a diagnostic tool, exposing subtle emotional reactions that might remain unspoken in traditional interviews.

The findings from this first phase align with Kaplan's (1989) attention restoration theory, which posits that restorative environments engage the mind through fascination and detachment rather than obligation. The classroom, by contrast, demanded cognitive engagement, thereby maintaining tension rather than releasing it.

In relation to the study's second research question, concerning the effects of different types of meditation environments on student well-being when experienced through VR—the classroom phase clarified what a non-restorative environment looks and feels like within virtual experience. The limited relaxation and mild discomfort reported here provided a valuable contrast for analysing the subsequent environments, where design interventions—nature, symbolic order, and spatial openness—were introduced intentionally to support mindfulness and emotional relief.

<u>Transition to the Next Phase</u>

In summary, participants' experiences of the classroom environment underscored that physical realism and familiarity are insufficient for psychological restoration. The virtual classroom retained the emotional imprint of its real-world counterpart: a space of focus, evaluation, and social demand. While it provided a technically sound introduction to VR meditation, it did not foster deep relaxation or mindfulness. These insights highlight the importance of environmental meaning in shaping meditative experience—a principle that becomes more evident in the next environment.

The following section examines participants' responses to the Public Garden Environment, where natural cues, openness, and cultural resonance transformed how students experienced calmness and connection. This shift marks a significant progression in their journey through the VR meditation sequence.

4.3.4.2 PUBLIC GARDEN ENVIRONMENT (SECOND PHASE OF INTERVIEWS)

Following the classroom experience, the second phase introduced participants to a virtual public garden, designed to represent an open, natural space infused with gentle movement, soft lighting, and ambient sounds. This environment contrasted sharply with the enclosed rigidity of the classroom and was immediately associated by most participants with calmness, spaciousness, and emotional relief. For many, it was the first setting in which they reported achieving a true sense of restorative focus and connection to nature.

The interviews revealed that natural visual and auditory elements—trees, sunlight, wind, and birdsong played a key role in evoking tranquility. Students described the garden as "fresh," "free," and "peaceful," identifying it as the moment where VR meditation began to feel authentic and emotionally meaningful.

Perception of Natural Calm and Sensory Openness

Almost all participants remarked on the immediate contrast between the public garden and the previous classroom environment. The visual presence of greenery, sunlight filtering through trees, and the sound of rustling leaves produced what participants repeatedly described as "real relaxation."

> ***One participant reflected:***
>
> *"As soon as I entered the garden scene, I felt like I could breathe again. It was open and soft, not tight like the classroom."*

> ***Another commented:***
>
> *"The sound of birds and wind made it feel real. I didn't need to try to relax—it happened naturally."*

These responses reflect the biophilic effect—the innate human tendency to seek connection with natural environments. Even in virtual form, nature appeared to elicit the same restorative responses that real-world studies have documented for decades (Kaplan & Kaplan, 1989; Ulrich, 1984). The openness of the scene encouraged a sense of spatial freedom that contrasted with the confined atmosphere of the classroom.

Participants also described how the soft, diffused light of the garden scene contributed to their sense of comfort. The gentle illumination enhanced visual harmony, while the moderate soundscape created immersion without overstimulation. For many students, this harmony between sensory inputs allowed the mind to quiet itself—a precondition for mindfulness.

> ***One participant described:***
>
> *"I could almost feel the sunlight on my skin. It reminded me of being in a park at home. My breathing slowed down."*

Such accounts show that VR can evoke embodied sensory recall: the simulated environment triggered memories of real outdoor experiences, reinforcing the emotional credibility of the virtual space. The students' language "feel," "reminded," "breathe"—suggests deep perceptual engagement and the integration of past experiences into present virtual perception.

Emotional Restoration and Inner Connection

Beyond physical relaxation, participants consistently reported emotional renewal and introspection while meditating in the garden environment. Many described feeling "peaceful," "connected," or "balanced." Some mentioned that they could "let go" of stress or "clear their minds" more easily than in other settings.

One participant expressed:

"I forgot I was in VR. The space felt alive, and it helped me let go of things I was thinking about."

Another added:

"In the garden, I didn't feel like I was meditating—I was just there, breathing and being."

These remarks suggest that the public garden environment facilitated spontaneous mindfulness, aligning with Bishop et al.'s (2004) concept of mindful engagement where attention rests naturally in the present moment, supported by non-threatening sensory cues.

For several participants, the experience of immersion in nature extended beyond relaxation to emotional reflection. They reported that the peaceful atmosphere helped them think about personal relationships, academic challenges, or future goals with greater clarity.

One student shared:

"When I was in the garden, I thought about my family and felt grateful. It made me calmer inside."

This highlights how restorative environments can foster positive affect and emotional regulation, consistent with theories of environmental psychology suggesting that exposure to natural imagery supports self-reflection and stress recovery (S. Kaplan, 1995).

Some students also described the garden as spiritually resonant, connecting its tranquillity with Thai cultural understandings of balance and harmony. The presence of trees, water reflections, and sunlight reminded them of temple courtyards or familiar community parks. These cultural associations enriched the meditative experience by providing an emotional bridge between tradition and technology.

As one participant said:

"It felt like being in a temple garden—quiet but alive. I could sense calmness, like a sacred space."

This intersection of spirituality and sensory realism demonstrates VR's capacity to translate cultural symbolism into digital form, allowing participants to access familiar emotional states through virtual environments.

Sensory Immersion and Attention Flow

Participants described how sensory immersion in the garden scene promoted sustained attention and focus. Unlike the classroom, where distraction was common, the natural environment appeared to absorb their awareness effortlessly.

One participant noted:

"In the garden I didn't have to force concentration. My attention just followed the sound and light."

Another observed:

"The rhythm of the wind and the colours made it easy to stay with my breathing."

These experiences illustrate what Kaplan and Kaplan (1989) termed "soft fascination"—the gentle engagement of attention by stimuli that are rich but not demanding. In the VR garden, softly moving leaves, filtered light, and subtle soundscapes served this purpose, enabling participants to rest attention without effort. This quality distinguishes restorative spaces from cognitively taxing environments: attention is gently held rather than forced.

Interestingly, a few participants mentioned occasional moments of self-consciousness when they became aware of the headset again, but these episodes were brief and did not significantly interrupt immersion. The fluid interplay between awareness of technology and absorption in the environment reflects how VR can mediate, rather than fully replace, real sensory experience. Participants learned to move between observing the medium and inhabiting the space, a transition that mirrors mindfulness itself—oscillating between observation and presence.

Comparative Reflections and Design Implications

In comparing the garden to the classroom, participants frequently used language of contrast: "open" versus "closed," "soft" versus "hard," "alive" versus "empty." These oppositions reveal the emotional semantics of spatial design—how form, light, and material qualities shape perception.

One participant explained:

"In the classroom, I was thinking. In the garden, I was feeling."

This distinction encapsulates a central finding of the study: environments influence not only what people do but how they are. The garden environment allowed participants to shift from cognitive effort to embodied awareness, which is the essence of meditation.

Several students also proposed improvements, suggesting that adding subtle interactive features such as gentle water movement or responsive sound—could deepen immersion. Their feedback reflects how design interactivity can enhance the perception of "aliveness" in digital environments. Importantly, these suggestions were not about realism per se but about emotional resonance—how small sensory dynamics make the virtual world feel participatory and living.

For some participants, the public garden scene also carried social connotations of shared space and inclusivity. They described it as a setting that felt "public but private," mirroring the experience of sitting quietly in a real park—alone yet surrounded by life. This balance between openness and solitude enhanced comfort, supporting theories that restorative environments balance stimulation and refuge.

As one participant summarised:

"It was peaceful but not lonely. I felt connected to everything, even though it was just me."

<u>Interpretation and Link to Research Aim</u>

The public garden environment emerged as one of the most restorative and emotionally effective settings in the study. Participants' consistent reports of calmness, reflection, and connection confirm that natural elements, even simulated evoke deep psychological restoration. These findings reinforce biophilic and environmental psychology frameworks, affirming that human well-being depends on perceptual relationships with nature and sensory harmony.

In relation to the study's aims, the garden demonstrates how VR can replicate key restorative principles—openness, organic form, rhythmic sound, and balanced light—through design. The virtual garden effectively bridged the gap between technological mediation and emotional authenticity, offering a digital analogue to real-world healing spaces. It provided both cognitive restoration (through attention recovery) and emotional regulation (through feelings of connection and gratitude).

Furthermore, this environment exemplified how cultural familiarity amplifies relaxation. For Thai students, the garden evoked subtle spiritual associations that made the experience feel not foreign or artificial, but grounded in their lived aesthetic and moral values. This cultural resonance demonstrates that design for well-being must not only engage universal human responses to nature but also align with local symbolic meanings.

In summary, the public garden phase represented a turning point in participants' VR meditation journey: a moment when immersion, mindfulness, and meaning coalesced. The next environment, the Designed Meditation Room—further deepened this experience, introducing deliberate symbolic and architectural elements to explore how spatial composition, cultural form, and focused simplicity enhance meditative depth.

4.3.4.3 DESIGNED MEDITATION ROOM (THIRD PHASE OF INTERVIEWS)

The third phase of the study introduced participants to the Designed Meditation Room, a virtual environment intentionally composed to evoke calmness, focus, and inner reflection through architectural simplicity and cultural resonance. Unlike the public garden, which relied on natural openness, this space used enclosed geometry, soft gradients of light, and minimalist aesthetics inspired by Thai and Buddhist design principles. The aim was to investigate whether carefully designed architectural features rather than natural scenery—could also generate restorative and mindful experience.

Participants immediately recognised the Designed Meditation Room as distinct from the previous environments. Their responses revealed a deep appreciation for its symbolic clarity and spiritual familiarity, noting that the space felt purposeful and sacred without being overtly religious. The atmosphere of quiet containment, balanced lighting, and spatial symmetry encouraged sustained focus and emotional centring.

Perception of Spatial Harmony and Simplicity

Many participants described the Designed Meditation Room as "calm," "balanced," and "pure." The enclosed yet uncluttered environment offered a sense of both protection and openness. The visual composition—neutral tones, circular forms, and diffused light—created what participants described as "a place that felt prepared for meditation."

One participant explained:

"When I entered the meditation room, I immediately felt that it was made for peace. The shape, the light, everything was in the right proportion."

Another reflected:

"There was nothing extra, no distraction. Just the space, the sound, and myself."

These impressions highlight the importance of spatial minimalism and proportion in evoking tranquillity. The absence of clutter and the deliberate balance of forms aligned with the Buddhist aesthetic principle of 'middle path', where harmony and restraint reflect inner balance. For several participants, the clean geometry and diffused light recalled the atmosphere of temple interiors, particularly the simple meditation halls found in Thai monasteries.

Participants repeatedly used words such as "pure," "quiet," and "balanced," suggesting that the spatial structure itself communicated emotional order. The visual rhythm of the architecture—soft shadows, symmetrical layout, and grounded perspective guided attention inward. Unlike the garden, which stimulated the senses through natural detail, the meditation room fostered a subtler kind of awareness rooted in stillness and form.

One participant summarised this contrast:

"The garden helped me relax through nature. The meditation room helped me go deeper inside myself."

This distinction underscores that the Designed Meditation Room functioned not merely as a calming space but as a focusing instrument, facilitating introspection and self-regulation.

Cultural and Symbolic Resonance

A strong cultural response emerged among participants who associated the Designed Meditation Room with traditional Thai spiritual environments. Several mentioned feeling reminded of temple pavilions (sala), or quiet shrine interiors, where light, proportion, and silence work together to evoke mindfulness.

One participant noted:

"The light reminded me of the morning time in a temple hall—it felt sacred but not religious. I could sense peace without thinking about anything."

Another added:

"The space made me think of Buddhist meditation. Even without Buddha images, I felt that same respect and calmness."

These comments demonstrate how cultural symbolism operates through atmosphere as much as through explicit iconography. The room's simplicity allowed participants to project personal meaning onto the space, aligning with the Buddhist principle of sunnata (emptiness) described by Buddhadasa Bhikkhu (1985), where absence itself becomes the ground for awareness.

The use of symmetrical geometry and soft gradients of light reinforced feelings of equilibrium. Participants often mentioned that the space seemed to "breathe" with them, as the gentle luminance appeared to shift subtly in intensity during meditation. This responsive quality though pre-programmed rather than interactive was interpreted as a form of living presence.

As one participant described:

"When the light changed slowly, I felt like the space was alive, breathing with me."

This perceived synchrony between body and environment reflects the embodied cognition of mindfulness: the awareness of one's own state mirrored by the qualities of the surrounding space. Such moments show that immersive design can achieve emotional depth not by replicating realism but by orchestrating symbolic simplicity and temporal rhythm.

Emotional Depth and Inner Reflection

Participants reported that the Designed Meditation Room produced the deepest sense of focus among all the environments. Many noted that distractions disappeared quickly and that they could maintain awareness of breathing or stillness for longer periods. The containment of the space appeared to support inward attention, providing both security and mental clarity.

One participant shared:

"I didn't think about anything outside. It was easy to stay focused here, like the world stopped moving."

Another reflected:

"It was quiet, but not empty. I could feel calm energy around me."

The emotional tone of this environment was repeatedly described as "peaceful but powerful." Some participants spoke of a subtle warmth or lightness during the session, while others experienced an introspective calm that lingered afterward. Several mentioned that they felt "closer to themselves," a phrase suggesting emotional grounding and acceptance.

The combination of controlled light, spatial proportion, and subtle sound created what participants called "complete quietness"—not only the absence of noise but the presence of serenity. This quietness allowed participants to notice internal sensations and thoughts without judgment, a key component of mindfulness practice.

One participant expressed:

"It helped me understand how silence can be strong. Even though nothing was happening, I felt full inside."

Such descriptions align with both Buddhist meditative philosophy and environmental design theory, where stillness and emptiness serve as active qualities that evoke balance and reflection.

Comparative Perceptions and Cultural Familiarity

When comparing this environment with the garden, participants emphasised that while both were calming, the meditation room offered a more personal and introspective experience. It was perceived as a "contained world," enabling focus without external distraction.

> ***One participant compared:***
>
> *"The garden felt open, like connecting with the world. The meditation room felt inward, like connecting with myself."*

This distinction reflects two complementary modes of restoration identified in the literature: outward restoration through connection with nature and inward restoration through controlled, symbolic environments. Both pathways lead to mental balance but differ in emotional orientation.

Some participants also noted how the designed space reflected familiar Thai values of order, cleanliness, and respect—qualities often found in temple architecture and meditation halls. This cultural familiarity fostered a sense of belonging and authenticity. The digital environment was not seen as artificial but as an extension of real cultural space.

> ***One participant mentioned:***
>
> *"Even though it was virtual, it felt Thai. The simplicity, the balance—it reminded me of home."*

This emotional connection reinforces that design for well-being must engage both universal and cultural layers of perception. For Thai students, the meditation room's atmosphere resonated with embodied cultural memory, allowing them to access calmness through recognition as much as through novelty.

Interpretation and Link to Research Aim

The Designed Meditation Room demonstrated how architectural design principles can evoke mindfulness in virtual space, supporting the study's central argument that healing environments depend on perceptual harmony and symbolic clarity as much as on natural form. The participants' deep sense of calmness, focus, and familiarity confirms that spatial composition and lighting design can replicate the psychological conditions of meditative stillness.

From a research perspective, this phase showed that designed minimalism can be as restorative as natural complexity when balanced proportion, light, and sound are carefully orchestrated. The space's cultural resonance with Thai Buddhist aesthetics further amplified its emotional depth, illustrating that meditation environments must reflect the moral and spiritual vocabulary of their users. This intersection of design, culture, and mindfulness bridges architecture and psychology, demonstrating VR's potential to explore the symbolic dimensions of well-being beyond physical constraints.

In response to the overarching research question how healing spaces influence well-being, the Designed Meditation Room phase revealed that psychological healing arises not only from exposure to nature but from alignment between environment and identity. When users recognise themselves and their values within a space, even a virtual one, emotional safety and focus emerge naturally.

In summary, the Designed Meditation Room represented the most culturally and symbolically integrated environment in the study. It transformed the act of virtual meditation into an experience of inner recognition—an architectural embodiment of mindfulness itself. The next section explores the White Room (Control Environment), designed as a minimal neutral space to test how participants responded to the absence of environmental cues and symbolic meaning.

4.3.4.4 WHITE ROOM (CONTROL ENVIRONMENT – FINAL PHASE)

The final environment presented to participants was the White Room, designed as a control condition to evaluate responses to an intentionally neutral setting. This environment lacked the visual, auditory, and symbolic cues that characterised the previous phases. The space consisted of soft, even lighting, a uniform white background, and the sound of silence without texture, movement, or environmental reference. Its purpose was to test how the absence of stimuli influenced meditation, relaxation, and focus within the VR medium.

Participants' reactions to this minimal environment were diverse, revealing the complex relationship between sensory input and psychological state. While some found the simplicity liberating, others perceived it as uncomfortable or disorienting. Their reflections offered valuable insight into how spatial emptiness can function both as a meditative aid and as a psychological challenge, depending on the individual's emotional readiness and interpretive framework.

Participants' Initial Responses and Sensory Disorientation

Most participants noted that their initial impression of the White Room was one of emptiness or ambiguity. The absence of detail, texture, or sound made it difficult to gauge spatial boundaries. Some described the room as “endless,” “floating,” or “blank,” expressing uncertainty about orientation or depth.

One participant described:

“It felt like being in nothing—no walls, no floor, no sound. At first, I didn’t know where I was.”

Another remarked:

“It was quiet, but almost too quiet. I started wondering if something was wrong with the program.”

These initial reactions highlight how humans rely on sensory and spatial cues for grounding and comfort. The deliberate lack of such cues in the White Room produced a brief sense of spatial dislocation. Several participants commented that, without visual references, they felt detached from their body or uncertain about their position in space. This response aligns with phenomenological theories of perception, which propose that spatial experience is co-constituted by the presence of environmental structure.

However, not all participants experienced this disorientation negatively. For some, the emptiness itself became meaningful, providing a space free from distraction and external expectation.

One participant explained:

“After a while, I started to like it. The emptiness made me aware of my own breathing and thoughts.”

This shift from discomfort to awareness indicates that sensory neutrality can facilitate introspection once users overcome the initial uncertainty. It also reveals that minimal environments demand active participation from the meditator without external stimuli to guide attention, mindfulness must arise internally.

Perception of Silence and Mental Stillness

The absence of auditory cues in the White Room produced varied emotional responses. For some participants, the silence felt soothing, while for others it evoked unease.

> ***One participant reflected:***
>
> *"The silence was powerful—it made me listen to my own thoughts. I could hear my breathing so clearly."*

> ***Another, however, described:***
>
> *"It was too quiet. My mind started to fill the space with random thoughts."*

These contrasting reactions highlight the dual nature of silence as both calming and confronting. In mindfulness terms, silence can act as a mirror, amplifying whatever mental state is present. Participants who had adapted to meditation earlier in the study were more likely to experience the silence positively, interpreting it as mental spaciousness. Others, less accustomed to internal observation, described discomfort with the lack of structure.

Some participants also associated the whiteness of the space with purity and renewal. A few described it as "light," "clean," or "infinite," suggesting that sensory simplicity can carry symbolic meaning even without explicit design elements.

As one participant observed:

"It felt like being inside light itself—empty but peaceful."

For these participants, the White Room represented transcendence through absence, a space that stripped away distractions and encouraged deep self-awareness.

Cognitive and Emotional Responses

While earlier environments evoked emotional associations with nature or culture, the White Room elicited more abstract and introspective responses. Participants reported increased awareness of thought patterns, body sensations, and even time perception. Some described it as a "mental experiment" rather than an emotional experience.

One participant noted:

"There was nothing to look at, so I started to observe my mind instead."

Another explained:

"Time felt slower here. I wasn't relaxed or tense, just very aware."

This self-observational mode aligns with advanced stages of mindfulness, where external stimuli are minimised, and awareness turns inward. Interestingly, a few participants mentioned that this experience helped them realise how dependent they had become on sensory cues to achieve calmness. The White Room challenged them to generate tranquillity internally, revealing that mindfulness is both supported and tested by environment.

However, several participants found the environment emotionally flat or even unsettling. The lack of familiar visual anchors led to mild discomfort or a sense of isolation.

One participant commented:

"It was peaceful, but I felt like I disappeared. I missed some feeling of being somewhere."

This statement captures a subtle paradox: while environmental simplicity can enhance focus, complete abstraction risks detachment. The experience of "nowhere-ness" may be liberating for some but alienating for others, illustrating how personal temperament mediates the effectiveness of minimal design in mindfulness practice.

Interpretation and Conceptual Meaning

From an interpretive perspective, the White Room exemplifies the threshold between environment and consciousness. Its neutrality stripped away cultural, natural, and architectural cues, exposing the meditator's dependence on perceptual frameworks for emotional grounding. Participants' varied reactions reveal that environmental design operates along a spectrum—from supportive structure to open void—each invoking different psychological mechanisms of attention and emotion.

For participants who embraced the emptiness, the experience reflected the Buddhist concept of sunnata, or voidness, in which liberation arises from non-attachment to form. These individuals described the environment as "infinite," "weightless," or "timeless," suggesting a contemplative encounter with emptiness itself. For others, however, the same emptiness produced discomfort, demonstrating that voidness without preparation can lead to disorientation rather than insight.

One participant articulated this tension:

> *"It was beautiful but strange. The space had no meaning unless I gave it meaning."*

This awareness underscores the interactive nature of meditation: meaning is not imposed by the environment but co-created through perception. The White Room thus revealed the limits of environmental influence, a space can facilitate mindfulness but cannot replace personal engagement.

Comparative Insights

In comparing all four environments, the White Room stood out as the most conceptually abstract yet psychologically revealing. While the classroom highlighted environmental stress, the garden encouraged connection, and the designed meditation room fostered balance, the White Room exposed the inner boundary of experience. It served as a test of whether mindfulness could sustain itself without external support.

Most participants concluded that although the White Room was not "pleasant," it was thought-provoking. It made them aware of how much they rely on sensory and symbolic cues to access calmness. For a few, it became the most profound session precisely because it forced confrontation with internal distraction.

One participant reflected:

> *"It wasn't relaxing, but it was real. I could see my mind clearly, even when it was uncomfortable."*

Others, however, preferred the warmth of the garden or the symbolic order of the meditation room, viewing the White Room as "too empty" or "cold." This diversity of responses reinforces the study's central argument: healing and mindfulness depend on the relationship between person, perception, and place. No single environment is universally restorative; each interacts with users' emotional context and readiness for introspection.

Interpretation and Link to Research Aim

The White Room functioned as a critical counterpoint to the other environments, revealing that environmental richness and meaning are central to meditation effectiveness. While simplicity supported some participants' focus, for others it produced discomfort, underscoring that emptiness must be balanced with warmth, texture, and perceptual grounding.

In relation to the research aim, the findings from this phase highlight that VR environments designed for well-being must provide adequate sensory orientation while maintaining simplicity. The White Room's mixed reception demonstrates that too little environmental structure can undermine emotional security, whereas carefully designed minimalism—as in the meditation room can sustain mindfulness through symbolic and sensory harmony.

Conceptually, this phase validates the role of environmental meaning in digital meditation. Neutral space alone does not generate healing; it is the perception of balance, proportion, and cultural resonance that transforms emptiness into tranquillity. The White Room thus served as both a control and a philosophical endpoint—illustrating that the path from stress to mindfulness involves not only reducing sensory overload but cultivating a meaningful relationship with space itself.

Summary of Theme 3

Across the four environments, participants' experiences reveal a clear progression in emotional depth and focus: from the tension of the classroom, through the restoration of the garden, to the centred stillness of the meditation room, and finally to the introspective void of the white room. Each stage illuminated different dimensions of environmental influence—familiarity, naturalness, design intention, and abstraction—demonstrating that meditation in VR engages not only sensory perception but also memory, culture, and personal interpretation.

These findings affirm that VR can reproduce the essential qualities of healing environments, provided that design consciously integrates sensory harmony, symbolic resonance, and psychological orientation. The next theme explores how participants' experiences evolved over time—how repeated exposure to these environments deepened adaptation, focus, and mindfulness throughout the study.

4.3.5 THEME 4: ADAPTATION, FOCUS, AND MINDFULNESS OVER TIME

While the earlier themes explored participants' immediate responses to different virtual environments, Theme 4 examines the longitudinal dimension of their experiences—how students' focus, comfort, and mindfulness evolved across repeated VR meditation sessions. As participants progressed through the four environments, they demonstrated clear patterns of adaptation and skill development, moving from curiosity and distraction toward focus, self-awareness, and emotional regulation.

The interviews revealed that familiarity with both the VR technology and the meditative process was critical to this progression. Early sessions were marked by novelty and self-consciousness, but over time, participants reported increasing immersion and confidence. This shift reflects a psychological and physiological learning curve: as users became more comfortable within the headset and more attuned to their breathing and posture, they also became more capable of achieving mindfulness and relaxation.

<u>Initial Adjustment and Learning Curve</u>

During the first sessions, participants were often preoccupied with the physical sensations of wearing the headset and the unfamiliar experience of being immersed in a virtual world. For many, this early stage involved navigating disorientation, curiosity, and mild scepticism.

> ***One participant explained:***
>
> *"In the first session, I kept thinking about how the headset worked and what I looked like from outside. It was hard to relax."*

> ***Another commented:***
>
> *"At the beginning, I was still aware of everything around me, like the real room and other people. My mind couldn't settle yet."*

These remarks illustrate the threshold between novelty and embodiment that defines early VR experience. The unfamiliarity of the equipment initially diverted attention outward rather than inward. Participants described being "half inside, half outside" the experience—engaged visually but still mentally anchored in the physical world.

However, by the second and third sessions, most participants reported that these distractions subsided. They learned how to adjust the headset comfortably, position their body, and manage expectations. The process of familiarisation freed cognitive resources for deeper focus. The novelty of the technology faded into the background, allowing participants to approach meditation as an internal rather than external task.

One participant reflected:

"After a few sessions, I stopped thinking about the device. It became natural—like it disappeared."

This transition marks the embodied adaptation described in presence theory: when technological mediation becomes transparent, the user's awareness shifts fully to the virtual experience. It also parallels mindfulness training itself, where repetition reduces cognitive noise and enhances awareness of the present moment.

<u>Developing Focus and Consistency</u>

As participants grew accustomed to the process, their ability to maintain focus improved noticeably. Several described developing personal routines—adjusting breathing, keeping eyes softly open or closed, or adopting specific postures that supported concentration.

One participant noted:

"At first, my thoughts were everywhere. But after a few sessions, I knew how to control them better. It was easier to stay with my breathing."

Another explained:

"The more I did it, the faster I could calm down. I didn't need to wait for the sound or the guide—I could find that focus by myself."

These reflections show that mindfulness, even within a virtual setting, develops through practice and repetition. Participants reported that their mind wandered less and their attention stabilised more quickly in later sessions. The combination of immersive visuals and consistent guidance appeared to support this process by reducing external distraction and structuring internal awareness.

Some participants also began to identify subtle cues that helped them maintain focus, changes in sound rhythm, breathing synchrony, or lighting transitions. They described these elements as anchors that connected attention to the present.

One participant remarked:

"When the light in the meditation room became softer, I used it as a signal to slow my mind. It felt like the environment was guiding me."

This comment reflects an emerging interactive relationship between user and environment. Participants were no longer passive observers of VR but active collaborators in a feedback loop of attention. Their growing familiarity enabled them to integrate sensory cues into their meditative technique, effectively personalising the experience.

Emotional Regulation and Mindful Awareness

Beyond technical adaptation, participants described emotional transformations across sessions. The early feelings of curiosity or unease gradually gave way to calmness, gratitude, and self-acceptance. Students who initially struggled with overthinking or anxiety reported that meditation in VR became easier and more rewarding over time.

One participant shared:

"At the beginning, my mind was full of stress. Later, I learned to just let thoughts pass. The VR helped me see how to do that."

Another reflected:

"After several sessions, I didn't feel like I was escaping stress anymore. It was more like understanding it."

These accounts suggest that repetition in VR meditation led to a qualitative shift from avoidance to awareness, a hallmark of mindfulness practice. The immersive setting initially provided a refuge from stress, but over time, it became a mirror for observing stress without judgment.

Several participants described developing emotional resilience and greater sensitivity to their internal states. They began to notice patterns in their breathing or emotional fluctuations and to recognise when their attention drifted. This indicates that the sessions fostered not only relaxation but also metacognitive awareness, or awareness of awareness itself.

One participant explained:

"I could tell when I was forcing concentration. Later, I just observed it. That made me calmer."

These insights show that VR meditation can function as a pedagogical tool for cultivating mindfulness skills in beginners. The controlled environment and repetitive exposure support emotional regulation by guiding users gently toward self-awareness without the pressures of traditional meditation settings.

The Role of Familiarity and Comfort

Many participants emphasised that emotional depth increased as trust in the process and environment developed. The headset, initially seen as intrusive, became associated with calmness, a symbolic object marking the transition into meditative mode.

One participant described:

"The moment I put on the headset, my body already knew it was time to relax."

Another noted:

"Before, I felt nervous about using VR. But later, it became my comfort zone."

This conditioned association between the headset and relaxation parallels classical conditioning mechanisms observed in behavioural psychology. Repetition created an automatic cognitive link between entering VR and initiating calmness. Over time, the environment became a cue for mental readiness, reducing the effort required to reach a meditative state.

Participants also observed that familiarity enhanced their sense of safety, which in turn deepened focus. The immersive but predictable settings reassured them that nothing unexpected would occur, enabling surrender to the experience. This sense of containment—particularly in the designed meditation room—proved essential for sustained mindfulness.

One participant summarised:

"I trusted the space. It felt safe, so I could go deeper into my thoughts."

Cumulative Impact and Post-Session Reflection

As the sessions progressed, participants increasingly reported carry-over effects into daily life. Several noted improved concentration during study, reduced irritability, or increased awareness of posture and breathing in stressful moments.

One participant reflected:

"I started using deep breathing from the VR sessions when I felt stressed in class. It really helped."

Others mentioned that they began to look forward to the meditation sessions, not only for relaxation but for clarity and renewal. The repeated structure of VR meditation offered rhythm and predictability amid the chaos of university life. This continuity reinforced a sense of control and balance that participants carried into their routines.

Another participant shared:

"It became like a habit. I wanted to do it again because I knew how I would feel after—calm and clear."

Such statements reveal that VR meditation, through consistent repetition, can support the development of mindful habits that extend beyond the virtual environment. The study thus highlights the potential of VR as a training platform for sustainable well-being practices among students.

Interpretation and Link to Research Aim

The evolution of participants' experiences across sessions illustrates the dynamic process of adaptation and learning that underlies successful mindfulness practice in VR. The transition from technological curiosity to embodied awareness confirms that effective digital meditation depends on both environmental design and user acclimatisation. Over time, participants moved from external observation to internal focus, from managing technology to managing thought.

These findings align with models of attentional training and neuroplasticity, suggesting that repeated engagement with immersive meditation can enhance both cognitive control and emotional regulation. The sense of safety and predictability created by the VR environments facilitated psychological openness, allowing mindfulness to emerge naturally through repetition and trust.

In relation to the research aims, this theme demonstrates that VR not only replicates healing spaces but also teaches users how to inhabit them mindfully. Adaptation over time transformed VR from an experimental medium into a meditative tool—one that enabled participants to cultivate focus, resilience, and self-awareness.

In summary, Theme 4 reveals that mindfulness within VR is a learned and evolving experience, grounded in repetition, familiarity, and design coherence. The participants' journey from curiosity to confidence, distraction to presence embodies the very process of healing that the study sought to understand. The next theme, therefore, examines how cultural and spiritual dimensions shaped these evolving experiences, highlighting the interpretive meanings that participants attached to meditation and the environments themselves.

4.3.6 THEME 5: CULTURAL AND RELIGIOUS CONTEXT IN MEDITATION EXPERIENCE

While previous themes examined the sensory, emotional, and cognitive dimensions of meditation across different VR environments, Theme 5 explores how cultural and religious worldviews influenced participants' experiences and interpretations. For Thai university students, meditation is not a neutral activity; it is embedded in broader frameworks of Buddhist morality, family values, and social harmony. The interviews revealed that participants' responses were often shaped by these underlying beliefs, even when the VR environments themselves were designed to be secular and inclusive.

The findings suggest that cultural familiarity enhanced trust, emotional depth, and perceived authenticity. Participants frequently referenced moral calmness (santi), balance (samakkee), and respect (kreng jaï)—concepts rooted in Thai Buddhist ethics as feelings that accompanied meditation in the virtual settings. These associations demonstrate that VR experiences were not interpreted purely through technological novelty but through deep cultural schemas of peace, respect, and merit.

<u>Cultural Familiarity and Emotional Comfort</u>

Many participants expressed that their ability to relax during meditation was strengthened by the presence of elements that felt culturally familiar whether the sound of natural wind, soft tonal music resembling temple chanting, or the symmetrical calm of spatial layout. Even though the environments contained no explicit religious symbols, participants intuitively connected these design qualities with moral and spiritual order.

One participant reflected:

"The design felt Thai in its simplicity. The light, the balance—it reminded me of the calmness I feel when visiting temples."

Another shared:

"I felt safe because it looked like the spaces I know from my culture—clean, respectful, and not crowded."

These remarks highlight that cultural recognition operates on an emotional level: when participants encountered design elements aligned with Thai–Buddhist aesthetics—simplicity, proportion, clarity, they experienced the virtual spaces as trustworthy and authentic. This sense of recognition provided psychological safety, allowing participants to surrender more fully to meditation.

For some, the environments evoked memories of family or community rituals such as temple visits during Buddhist holidays or time spent in quiet nature with elders. The connection between environment and cultural memory amplified feelings of belonging and moral grounding.

As one participant described:

"It made me think about my parents taking me to the temple when I was young. The same peaceful feeling came back."

This nostalgic linkage underscores that the experience of calmness was not purely spatial but also temporal—a reconnection to childhood experiences of safety and reverence.

Spiritual Association and Symbolic Meaning

Although participants were not instructed to interpret the VR environments in religious terms, many spontaneously associated them with Buddhist ideas of mindfulness, detachment, and compassion. Some described the meditation sessions as opportunities for moral reflection or emotional purification.

One participant explained:

"When I sat in the meditation room, I felt like I was practising mindfulness, like we do in Buddhism—to clear the mind and not hold on."

Another commented:

"Even without Buddha images, I could sense peace. It felt spiritual, not just relaxing."

These statements illustrate how spiritual interpretation emerged organically through the participants' cultural frameworks. For Thai students, meditation is commonly associated with moral discipline (sila), concentration (samadhi), and wisdom (panna). Even within a digital context, the act of closing the eyes, breathing calmly, and sitting in stillness evoked these familiar moral and spiritual connotations.

A few participants explicitly mentioned karma and merit-making (bun), interpreting the sessions as beneficial not only for mental health but for spiritual well-being.

One participant remarked:

"Meditation always feels like doing good for myself and others. Even in VR, it felt meaningful, like I was doing something right."

Such comments indicate that Buddhist cosmology and ethics continued to shape perception even in the absence of religious symbols. The VR meditation thus became a space where cultural spirituality and digital design converged—a hybrid arena where participants could engage with mindfulness both as psychological practice and as moral cultivation.

Balance, Respect, and Moral Space

Participants' cultural expectations of calm and respect also extended to the moral tone of the VR environments. Several commented that the designed spaces felt "pure," "clean," or "balanced," qualities associated in Thai culture with inner virtue and good moral conduct. These perceptions were not limited to religious belief but reflected broader Thai social values that link external order with internal harmony.

One participant said:

"In Thai culture, we believe that tidy and calm places show respect—for ourselves and for others. The VR spaces had that feeling."

Another reflected:

"It felt polite, like a space where you should be quiet. That helped me focus."

These associations underscore that well-being in the Thai context extends beyond comfort to include ethical comportment, the idea that peaceful environments invite peaceful behaviour. Participants often noted that they instinctively sat straighter, breathed more quietly, or behaved more mindfully within the virtual meditation spaces. This embodied respect mirrored the etiquette of temple spaces, where composure and awareness are both moral and aesthetic virtues.

Interestingly, the absence of overt religious iconography enhanced inclusivity. Non-religious participants reported that they appreciated the spiritual neutrality of the environments, describing them as "open to everyone." For these users, the experience was still moral in tone—gentle, balanced, and dignified without requiring doctrinal belief. The findings thus suggest that spiritual atmosphere can be conveyed through design qualities such as proportion, light, and stillness, without relying on religious symbolism.

Technology and Tradition: Negotiating Modern Spirituality

An important insight from this theme concerns how participants reconciled modern technology and traditional spirituality. While some initially viewed VR meditation as a technological novelty, most later recognised it as compatible with Buddhist mindfulness principles. They saw the headset not as an artificial intrusion but as a new medium for an ancient practice.

> ***One participant explained:***
>
> *"Meditation is about the mind, not the place. VR is just another way to help the mind calm down."*

> ***Another observed:***
>
> *"It's interesting that something so modern can create the same feeling as sitting in a temple."*

These reflections reveal a harmonious synthesis between innovation and tradition. The participants' cultural grounding in flexibility and adaptation values inherent in Thai Buddhism allowed them to integrate technology without perceiving conflict. This adaptability aligns with broader cultural trends in Thailand, where digital media increasingly mediate spiritual expression, such as online merit-making or virtual temple visits.

A small number of participants expressed initial hesitation about using technology for meditation, questioning whether it might dilute the authenticity of the practice. However, most overcame this concern once they experienced the environments' calming effect. The fact that mindfulness could be achieved through VR reinforced the belief that intention, not setting, defines spiritual validity.

As one participant concluded:

"The calm didn't come from the computer; it came from my mind. The VR just helped me reach it faster."

This statement encapsulates a central finding: that participants did not experience a rupture between the digital and the spiritual but a continuum of experience, where technology served as a facilitator for traditional inner cultivation.

Cultural Interpretation of Healing and Well-being

Participants' narratives also reflected the Thai–Buddhist conception of healing as balance and moderation, rather than as the absence of stress. The environments that most resonated, especially the garden and meditation room embodied the aesthetic of sabai (comfort and ease), a valued emotional state in Thai culture.

One participant described:

"It wasn't just relaxing; it was comfortable in a Thai way—peaceful but not sleepy."

This balance between alertness and calmness parallels the Buddhist middle way, avoiding extremes of excitement or lethargy. The alignment between spiritual philosophy and environmental design reinforced the authenticity of the experience. Participants saw the VR meditation not as escape but as restoration of internal equilibrium, resonating with the Thai understanding of health as harmony among body, mind, and environment.

Additionally, participants framed their experience of healing not in medical terms but in moral and emotional language using expressions like "feeling clean," "having a light mind," or "feeling grateful." These phrases reflect the culturally embedded link between morality, emotion, and health in Thai worldview. Healing was experienced as the restoration of goodness and respect, not simply stress relief.

Interpretation and Link to Research Aim

This theme demonstrates that cultural and spiritual frameworks deeply mediate how individuals experience and interpret healing environments, even when those environments exist in virtual form. Participants' consistent reference to Thai–Buddhist values such as balance, simplicity, and moral calmness indicates that design for well-being cannot be culturally neutral. The effectiveness of VR meditation was amplified when the environment resonated with local aesthetic and ethical sensibilities.

In relation to the research aims, the findings confirm that VR can successfully translate culturally specific design principles into digital spaces. The participants' emotional comfort and spiritual engagement show that authenticity arises not from visual replication of temples or symbols, but from the embodiment of values—harmony, proportion, respect, and calm. This insight has broad implications for cross-cultural design: virtual healing spaces must reflect users' cultural psychologies if they are to evoke genuine mindfulness and emotional restoration.

Ultimately, Theme 5 reveals that meditation within VR is not merely a psychological process but a cultural dialogue between technology, tradition, and self-understanding. For these Thai students, the virtual environments became moral landscapes, places where modern design intersected with ancestral wisdom. Through this convergence, participants rediscovered mindfulness not as a technological experiment, but as a continuation of the cultural practices that have long guided their sense of peace and belonging.

4.3.7 SUMMARY OF QUALITATIVE FINDINGS AND EMERGING INSIGHTS

The qualitative findings presented in this chapter reveal a nuanced picture of how university students experienced meditation through virtual environments. Across the five thematic dimensions—well-being and stress, experiences of VR meditation, perceptions of different environments, adaptation over time, and cultural context—a coherent narrative emerges that links psychological needs, environmental design, and cultural meaning. Together, these findings illuminate how virtual spaces can facilitate healing and mindfulness when design, familiarity, and cultural resonance align with users' emotional and cognitive patterns.

Overview of Emotional and Environmental Context

Participants' accounts consistently reflected the high levels of psychological strain that accompany contemporary university life. Academic workload, family expectations, and the social adjustments following the COVID-19 pandemic contributed to widespread fatigue and anxiety. For most students, meditation offered an escape from this constant cognitive pressure, creating moments of silence and self-regulation that were otherwise rare in their daily routines.

One participant explained:

"Even a short session made me feel lighter, like my mind had more space to breathe."

This baseline of accumulated stress shaped how students approached and interpreted the virtual environments. Meditation was not experienced as a detached research activity but as a necessary act of recovery. The results underscore that interventions designed for student well-being must recognise the emotional realities of academic life—only then can environments, physical or virtual, provide meaningful relief.

From Distraction to Presence: The Role of VR in Mindfulness

Across all sessions, students demonstrated a gradual transformation from external distraction to internal presence. In early encounters, novelty and self-consciousness dominated their experience. Participants were aware of the technology, of being observed, and of adjusting to the headset. Yet, as they adapted to VR, this awareness dissolved into comfort and absorption.

One participant reflected:

"After a few sessions, I didn't notice the headset anymore. My mind just entered the space."

This progression illustrates how VR technology can scaffold the learning of mindfulness, functioning as both guide and gateway. The immersive isolation reduced external stimuli, while controlled environmental design provided structure for attention. The movement from cognitive curiosity to embodied calm demonstrates that mindfulness can be cultivated digitally when the design is coherent, gentle, and repetitive.

Participants' descriptions also suggest that virtual experiences can activate authentic psychological states of calm, focus, and emotional release. The technology itself became secondary to the quality of perception it enabled. As one participant put it, "It didn't matter that it was virtual. The feeling was real." This insight bridges the conceptual divide between physical and virtual healing spaces, positioning VR as a legitimate extension of environmental experience.

Comparative Impact of Environments

The four virtual environments revealed distinct emotional tones that together define a spectrum of restorative potential.

The Classroom Environment, though familiar, carried associations of stress and performance. Participants found it difficult to disengage from academic conditioning, as the visual cues of desks and white walls reinforced feelings of pressure. The experience confirmed that familiarity without emotional safety can hinder relaxation.

By contrast, the Public Garden Environment elicited spontaneous calmness and sensory pleasure. The presence of natural imagery, soft light, and organic movement generated restorative immersion that participants described as effortless. The garden symbolised openness and connection, evoking gratitude and peace.

The Designed Meditation Room produced the deepest focus and emotional depth. Participants perceived its balanced geometry and soft illumination as purposeful and sacred, aligning with Thai aesthetic principles of harmony and restraint. It fostered self-reflection rather than external observation, transforming meditation into a personal journey inward.

Finally, the White Room (Control Environment) functioned as an experimental contrast. Its sensory neutrality provoked diverse reactions—from liberation and insight to unease and disorientation. For some, emptiness encouraged deep awareness, while for others it felt isolating.

The mixed responses illustrate that minimalism alone is not universally restorative; psychological readiness determines whether silence becomes comfort or confrontation.

Together, these experiences demonstrate that the effectiveness of a meditation environment depends on the balance between structure and openness, sensory stimulation and restraint, familiarity and novelty. Environments that offer both safety and subtle richness—such as the garden and designed meditation room—proved most beneficial for sustained mindfulness.

Adaptation and the Learning of Stillness

A key cross-theme insight concerns the developmental nature of mindfulness within VR. Students' progression from distraction to focus reflected both technological adaptation and mental training. Repetition played a central role: familiarity with the process reduced cognitive load, allowing deeper immersion with each session.

One participant summarised this growth:

"The first time, I tried to relax. The last time, I didn't need to try anymore."

This shift illustrates that meditation in VR operates as a learned skill, not an instant effect. Participants cultivated strategies for regulating attention—breathing, posture, or internal dialogue—that transferred beyond the virtual sessions into everyday coping practices. The immersive design thus acted as both setting and teacher, gently conditioning the body and mind toward calmness.

By the final sessions, several students described an automatic sense of peace upon wearing the headset. This conditioning suggests that VR meditation can embed new emotional associations into habitual behaviour—transforming technological interaction into a ritual of restoration.

Cultural Resonance and the Meaning of Calm

Cultural context infused every aspect of how participants experienced and interpreted the environments. Thai students naturally framed their responses through concepts of respect, moral balance, and spiritual awareness. Even in a secular research context, the act of meditation carried implicit associations with Buddhist mindfulness, merit, and purity.

One participant explained:

"Meditation is not only for stress—it's for clearing the heart, like doing something good."

This moral dimension of calmness shaped the emotional authenticity of the experience. Participants often described relaxation as "clean," "light," or "pure," linking well-being to ethical and spiritual order. The environments that most closely embodied Thai aesthetic and moral principles—balance, symmetry, restraint—elicited the strongest positive responses.

The Designed Meditation Room, for instance, resonated with the Buddhist idea of sunnata (emptiness as clarity), while the Garden reflected harmony between self and nature. These culturally grounded interpretations demonstrate that healing is not merely psychological but symbolic, rooted in shared moral imagination. VR environments that echoed these values were perceived not as artificial but as meaningful extensions of Thai sensibility.

The Interplay of Mind, Space, and Technology

Taken together, the qualitative findings reveal that the relationship between mind and environment is dynamic and reciprocal, even in virtual form. The environments did not simply cause relaxation; they provided frameworks within which participants learned to engage with their own awareness. The act of meditation became a co-creation between individual and design—between mental focus and spatial order.

The technology, while initially perceived as a novelty, became an invisible mediator that linked sensory design with cognitive and emotional processes. Participants' growing comfort with VR reflects this integration: the headset transformed from an external object into a symbol of calm. Over time, technological mediation faded, replaced by a direct engagement with presence and stillness.

> ***One participant reflected:***
>
> *"At first, it was about the VR. Later, it was just about me."*

This transition captures the essence of the study's exploration how digital environments can guide users toward self-awareness rather than distraction. VR, when carefully designed, can thus act not as a substitute for real space but as a mirror for consciousness, helping users recognise their own capacity for balance and mindfulness.

Emerging Insights

1. **Context Matters**: The effectiveness of meditation environments depends on the emotional, academic, and social context in which users approach them. High baseline stress heightens receptivity to restorative design.
2. **Design Shapes Emotion**: Environmental elements—light, proportion, texture, and sound—profoundly affect mood and focus. Spaces that communicate order and safety evoke calm more consistently than those that are overly neutral or visually complex.

3. **Technology as Facilitator**: VR serves as a mediating tool for mindfulness, helping participants regulate attention by providing perceptual boundaries and consistent stimuli.
4. **Cultural Resonance Amplifies Well-being**: Environments that align with users' aesthetic and moral frameworks foster deeper emotional and spiritual engagement.
5. **Mindfulness Is Learned**: Repetition within VR cultivates attention and self-regulation, transforming meditation from a guided exercise into an internalised skill.

These insights collectively affirm that virtual healing environments are not merely digital simulations but experiential systems, capable of supporting emotional recovery and spiritual reflection when designed with cultural sensitivity and perceptual balance.

Link to Quantitative Findings

The qualitative results provide a rich interpretive foundation for understanding the numerical trends that follow in Section 4.4. The patterns of stress relief, focus improvement, and emotional restoration reported by participants correspond closely to the quantitative measures of well-being and immersion recorded across environments.

The next section presents statistical analyses that further validate these patterns, illustrating how participants' subjective experiences translated into measurable outcomes. Together, the qualitative and quantitative findings construct a comprehensive understanding of how VR meditation environments can serve as healing spaces—bridging design, psychology, and cultural identity in promoting student well-being.

TABLE 4: SUMMARY OF QUALITATIVE THEMES AND KEY INSIGHTS

Theme	Core Focus	Key Findings and Illustrative Insights	Interpretive Implications
Theme 1: Students' Well-being and Stress within the University Context	Psychological context and sources of stress before meditation.	• High academic pressure, fatigue, and social readjustment after COVID-19. • Emotional exhaustion linked to workload and family expectations. • Meditation perceived as a rare mental refuge from campus stress. **"Even a short session made me feel lighter, like my mind had more space to breathe."**	Establishes emotional baseline of high stress, underscoring the need for restorative and accessible well-being interventions.
Theme 2: Experiences of Meditation through Virtual Reality	Physical and psychological adaptation to VR technology.	• Initial novelty and mild discomfort gave way to focus and absorption. • Immersion and sensory coherence (sound, light, visuals) enhanced presence. • Repeated use improved concentration and reduced self-consciousness. **"After a few sessions, I stopped noticing the device. It became natural—like it disappeared."**	Demonstrates VR's ability to scaffold mindfulness by mediating sensory focus and facilitating embodied calm.
Theme 3: Perceptions of Different VR Meditation Environments	Emotional and perceptual contrasts across four environments.	• Classroom: familiar but stressful, linked with academic pressure. • Public Garden: natural cues promoted spontaneous calm and connection. • Designed Meditation Room: balance, symmetry, and simplicity deepened introspection.	Reveals that restorative effectiveness depends on balance between sensory richness, familiarity, and emotional resonance. Cultural symbolism enhances perception of calm.

		• White Room: minimalism revealed inner responses—some peaceful, others uneasy. **"In the classroom, I was thinking. In the garden, I was feeling."**	
Theme 4: Adaptation, Focus, and Mindfulness over Time	Longitudinal development of mindfulness across sessions.	• Progressive shift from distraction to embodied awareness. • Familiarity with VR fostered trust, reducing anxiety and cognitive effort. • Participants learned to regulate attention and emotion through repetition. **"The first time, I tried to relax. The last time, I didn't need to try anymore."**	Confirms mindfulness as a learned process. Repetition and environmental predictability support emotional regulation and cognitive balance.
Theme 5: Cultural and Religious Context in Meditation Experience	Influence of Thai–Buddhist values and moral interpretations.	• Cultural familiarity increased authenticity and emotional depth. • Meditation linked to moral calm, purity, and merit-making. • Participants reconciled modern technology with traditional spirituality **"The calm didn't come from the computer; it came from my mind."**	Demonstrates that healing environments must embody cultural and ethical values. VR can translate traditional aesthetics—harmony, respect, and simplicity—into digital form.

Summary of Thematic Integration

Together, the five themes reveal that participants' well-being and mindfulness evolved through a dynamic relationship between stress, sensory design, adaptation, and cultural meaning.

The study shows that VR meditation can authentically reproduce and even enhance the restorative qualities of real healing spaces when it aligns with both universal human needs and local cultural values.

These qualitative findings form the foundation for the subsequent quantitative analysis, which measures changes in emotional state, focus, and perceived well-being across the four environments.

The qualitative findings outlined above offer a detailed understanding of how participants perceived, interpreted, and emotionally engaged with the four virtual meditation environments. To complement this interpretive perspective, the next section presents the quantitative analysis, examining measurable changes in concentration, relaxation, and perceived well-being across the same settings. Together, the qualitative and quantitative results provide a comprehensive view of how environmental design, immersion, and cultural context collectively shape the effectiveness of VR meditation as a medium for student well-being.

4.4 QUANTITATIVE FINDINGS AND ANALYSIS

While the preceding qualitative analysis explored how participants experienced and interpreted each virtual meditation environment, this section presents the quantitative results derived from the post-session questionnaire. The quantitative component provides empirical support for the thematic patterns identified earlier, allowing measurable comparison of perceived well-being, focus, and relaxation across the four VR environments.

The analysis addresses the second research question: What are the effects of different types of meditation environments on student well-being when experienced through VR simulations?

It focuses on identifying statistically significant differences among the classroom, public garden, designed meditation room, and white room environments, thereby complementing the interpretive findings with numerical evidence.

4.4.1 OVERVIEW OF QUANTITATIVE DATA COLLECTION

The quantitative data were collected through a structured post-experience questionnaire administered to all participants immediately after completing their sessions in each of the four virtual meditation environments. A total of 53 students participated in the full quantitative phase, ensuring consistency across conditions and allowing direct comparison between environments.

The questionnaire was designed to capture self-reported measures of relaxation, focus, emotional comfort, and perceived environmental quality, each rated on a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree).

The items were developed based on existing frameworks of environmental psychology and mindfulness research, particularly focusing on indicators of restorative experience (Kaplan & Kaplan, 1989; Ulrich, 1984) and self-regulation (Bishop et al., 2004).

Data were collected after participants completed meditation in each environment in the following order:

1. **Classroom Environment**
2. **Public Garden Environment**
3. **Designed Meditation Room**
4. **White Room (Control Environment)**

This consistent sequence ensured that adaptation effects could be observed progressively, mirroring the qualitative findings discussed earlier.

Instrument Design and Measurement Dimensions

The questionnaire consisted of three primary dimensions corresponding to the core variables of the study:

Dimension	Indicator Examples	Purpose
Relaxation and Emotional Calm	"I felt relaxed after the session," "The environment helped me release stress."	To assess affective response and recovery from stress.
Concentration and Mindfulness	"I could focus on my breathing easily," "I remained aware of my thoughts without distraction."	To measure cognitive focus and self-awareness.
Environmental Quality and Comfort	"The space felt suitable for meditation," "The atmosphere supported calmness."	To evaluate perceived suitability and design impact.

TABLE 5: STRUCTURE OF QUESTIONNAIRE DIMENSIONS AND EXAMPLE ITEMS. SOURCE: AUTHOR'S DATA COLLECTION, 2025.

Each dimension included multiple items, the mean of which represented the participant's overall score for that factor in a given environment. Higher scores indicated greater perceived effectiveness in promoting well-being and mindfulness.

Data Processing and Analytical Approach

Quantitative data were analysed using SPSS (Version 26) to ensure accuracy and reproducibility. The analysis proceeded in three stages:

1. **Descriptive Statistics**: To calculate means and standard deviations for each variable across environments.
2. **One-Way Repeated Measures ANOVA**: To determine whether statistically significant differences existed between the four environments on each measure.
3. **Post Hoc Comparisons (Bonferroni Correction)**: To identify which specific environments differed significantly from one another.

This design allowed for both within-subject comparison and overall pattern identification, offering a robust statistical perspective on participants' perceived well-being across the four environmental types.

Participant Consistency and Reliability

All 53 participants completed the questionnaire for all four environments, providing a balanced dataset with no missing cases. Internal consistency of the scales was verified using Cronbach's Alpha, which yielded coefficients above 0.80 across all dimensions, confirming strong reliability.

The reliability results are summarised below:

Scale	Cronbach's Alpha	Reliability Level
Relaxation and Emotional Calm	0.84	High
Concentration and Mindfulness	0.86	High
Environmental Quality and Comfort	0.83	High

TABLE 6: RELIABILITY OF QUESTIONNAIRE SCALES (CRONBACH'S ALPHA VALUES).

SOURCE: AUTHOR'S STATISTICAL ANALYSIS USING SPSS, 2025.

These values confirm that the questionnaire items coherently measured their intended constructs, ensuring that observed variations reflect genuine differences in participants' perceptions rather than measurement error.

Contextual Integration with Qualitative Findings

The quantitative data serve to substantiate the qualitative observations presented in Sections 4.3.1–4.3.6.

For example, the consistently higher relaxation and environmental satisfaction scores observed in the public garden and designed meditation room align with participants' qualitative descriptions of calmness, balance, and spiritual resonance.

Similarly, lower focus and comfort ratings in the classroom and mixed responses in the white room corroborate the qualitative themes of stress association and perceptual ambiguity.

These complementary results strengthen the validity of the study's central proposition—that environmental design, whether natural or architecturally symbolic, significantly influences emotional and cognitive states during VR meditation.

Summary of Section 4.4.1

In summary, the quantitative dataset provides a reliable and structured foundation for comparing participant experiences across the four virtual environments.

Through standardised measures of relaxation, focus, and environmental quality, it captures the measurable dimensions of well-being that parallel the qualitative themes of emotional balance, adaptation, and cultural resonance.

The following section (4.4.2 Descriptive and Mean Score Analysis Across VR Environments) presents detailed statistical results, illustrating how participants rated each environment and highlighting patterns that further illuminate the psychological and environmental dynamics of VR-based meditation.

4.4.2 DESCRIPTIVE AND MEAN SCORE ANALYSIS ACROSS VR ENVIRONMENTS

The descriptive analysis provides an overview of how participants evaluated their experiences across the four virtual meditation environments: the Classroom, Public Garden, Designed Meditation Room, and White Room (Control). Mean scores were computed from post-session questionnaires completed by all 53 participants, measuring three key dimensions — Relaxation and Emotional Calm, Concentration and Mindfulness, and Environmental Quality and Comfort.

These data offer insight into how the environments differed in their ability to evoke psychological restoration and attentional focus. While the numbers are quantitative, they represent tangible emotional and perceptual differences that together illustrate how environmental design shapes participants' experiences of meditation within virtual space.

TABLE 7: MEAN SCORES OF PARTICIPANTS' EVALUATIONS ACROSS FOUR VR ENVIRONMENTS (N = 53)

Dimension	Classroom (M ± SD)	Public Garden (M ± SD)	Designed Meditation Room (M ± SD)	White Room (Control) (M ± SD)
Relaxation and Emotional Calm	3.12 ± 0.67	4.45 ± 0.51	4.31 ± 0.56	3.58 ± 0.62
Concentration and Mindfulness	3.24 ± 0.59	4.38 ± 0.54	4.46 ± 0.52	3.74 ± 0.63
Environmental Quality and Comfort	3.05 ± 0.71	4.51 ± 0.49	4.43 ± 0.53	3.42 ± 0.68

Note: Mean values are derived directly from the original dataset (N = 53) and summarised by key dimensions for clarity. Full item-level statistics are available in Appendix I1 and I2].

Source: Author's statistical analysis using SPSS (2025).

Summary of Mean Score Results

The results reveal distinct differences among the four VR meditation environments. Across all three dimensions—relaxation, concentration, and environmental quality—the Public Garden consistently achieved the highest mean scores (ranging from 4.38 to 4.51), indicating that natural sensory cues such as greenery, light, and sound most effectively supported calmness and focus. The Designed Meditation Room followed closely (4.31–4.46), confirming that architectural balance and cultural familiarity can evoke restorative responses comparable to those of nature. The White Room produced moderate means (3.42–3.74), suggesting that sensory minimalism encouraged reflection for some participants but limited comfort for others. The Classroom, by contrast, recorded the lowest ratings across all dimensions (3.05–3.24), reflecting residual associations of stress and evaluation.

Overall, these differences demonstrate that environments offering visual harmony, sensory coherence, and symbolic meaning—whether through natural or designed form—are significantly more effective in promoting relaxation, attention, and emotional comfort than functional or neutral spaces.

(a) Relaxation and Emotional Calm

The mean values for relaxation highlight the contrasting emotional impact of each environment. The Public Garden recorded the highest relaxation level (M = 4.45), followed closely by the Designed Meditation Room (M = 4.31). These high scores indicate that participants found both spaces highly conducive to emotional release and stress recovery.

In the Public Garden, the combination of soft natural light, greenery, and gentle motion of leaves created a multisensory field of calm. Even within VR, participants described the scene as "refreshing" and "alive." These effects suggest that natural visual cues function as triggers for physiological relaxation, echoing biophilic theories that link exposure to nature with reduced stress and improved emotional balance.

The Designed Meditation Room offered calmness through structured simplicity rather than sensory variety. Its symmetrical form, subdued colours, and gentle illumination evoked quietness and order. Participants associated these qualities with inner balance and respect, resonating with Thai cultural ideals of moral calmness and moderation. The slightly lower score compared with the garden reflects the room's more introspective character; while the garden invited spontaneous relaxation, the meditation room encouraged deliberate reflection.

The White Room achieved a moderate relaxation mean (M = 3.58). Participants reported that the uniform whiteness created a sense of openness but also ambiguity—some described the emptiness as peaceful, while others felt uncertain or detached. This duality illustrates how minimalist design can be calming or confronting, depending on personal readiness for stillness.

The Classroom, at M = 3.12, ranked lowest, confirming that environmental associations of assessment and performance persist even when physically absent.

In design terms, these results imply that relaxation emerges from environments that balance openness and emotional safety. Spaces that provide sensory structure—through rhythm, light, or cultural cues—help participants to let go, whereas settings lacking orientation or overloaded with meaning can limit release.

(b) Concentration and Mindfulness

Concentration scores showed the Designed Meditation Room as most effective (M = 4.46), closely followed by the Public Garden (M = 4.38). This pattern suggests that mindfulness benefits equally from spatial simplicity and rhythmic natural flow, provided that each offers a clear sense of coherence.

In the meditation room, the focus derived from geometric order and enclosure. The balanced layout directed awareness toward the centre, allowing participants to sustain attention without external distraction. This reflects architectural principles of sacred design, where symmetry fosters meditative focus. Participants reported that the quiet enclosure made it easier to "stay with breathing" and maintain continuity of thought.

The garden achieved nearly identical outcomes through dynamic equilibrium rather than static order. The subtle movement of leaves and sound of wind provided rhythmic anchors that kept awareness present without effort. This aligns with the environmental psychology concept of soft fascination, where low-level sensory engagement supports prolonged mental focus.

The White Room scored moderately (M = 3.74). Its neutral field demanded active attention; without visual reference points, participants' awareness either deepened or dispersed. This demonstrates that attention requires a minimal level of environmental cueing to remain stable.

The Classroom, again, achieved the lowest concentration (M = 3.24), as mental associations with work and evaluation disrupted focus.

Together, these results show that mindfulness arises when the environment gently guides perception. Whether through the balance of proportion or the movement of nature, the design must subtly sustain attention without cognitive effort.

(c) Environmental Quality and Comfort

Perceived comfort and spatial quality reached the highest mean in the Public Garden (M = 4.51), followed closely by the Designed Meditation Room (M = 4.43). These findings underscore that both natural and culturally grounded designs can evoke strong feelings of safety and satisfaction.

In the Public Garden, participants experienced a sense of freshness and connection. The presence of natural textures and diffuse light produced an impression of real outdoor space, suggesting that authentic sensory coherence can evoke embodied comfort even in VR. Participants frequently commented that they “forgot it was virtual,” demonstrating that well-integrated multisensory design fosters immersion and ease.

The Designed Meditation Room offered comfort through moral and aesthetic clarity. Participants described it as “balanced,” “respectful,” and “quiet,” indicating that psychological comfort can arise from symbolic harmony as much as from realism. The space communicated order and calm, aligning with Thai-Buddhist values of restraint and mindfulness.

The White Room and Classroom produced substantially lower comfort means (3.42 and 3.05). The white environment’s emptiness led to mixed emotions—some found its simplicity soothing, while others experienced mild unease due to lack of orientation. The classroom evoked residual tension tied to learning and assessment contexts. These outcomes confirm that comfort depends on perceptual grounding and emotional familiarity, not on simplicity alone.

Design, Cultural, and Psychological Insights

Across all dimensions, participants favoured environments that combined visual harmony, sensory structure, and cultural resonance. The Public Garden and Designed Meditation Room each achieved this through different aesthetic strategies—organic nature and minimalist geometry—but both created atmospheres that participants perceived as safe, meaningful, and emotionally balanced.

The White Room and Classroom, while valuable as experimental contrasts, highlighted the limits of neutrality. Emptiness without emotional warmth can provoke disconnection, and functional spaces evoke stress even when digitally simulated. The results therefore affirm that healing environments must balance sensory reduction with symbolic presence.

For Thai participants, these preferences reflect broader cultural definitions of tranquillity (santi) and comfort (sabai). Both the natural and designed settings embodied harmony and modesty—qualities deeply associated with moral calmness in Thai aesthetics. The quantitative results thus represent more than psychological preference; they reflect alignment between environmental design and cultural identity.

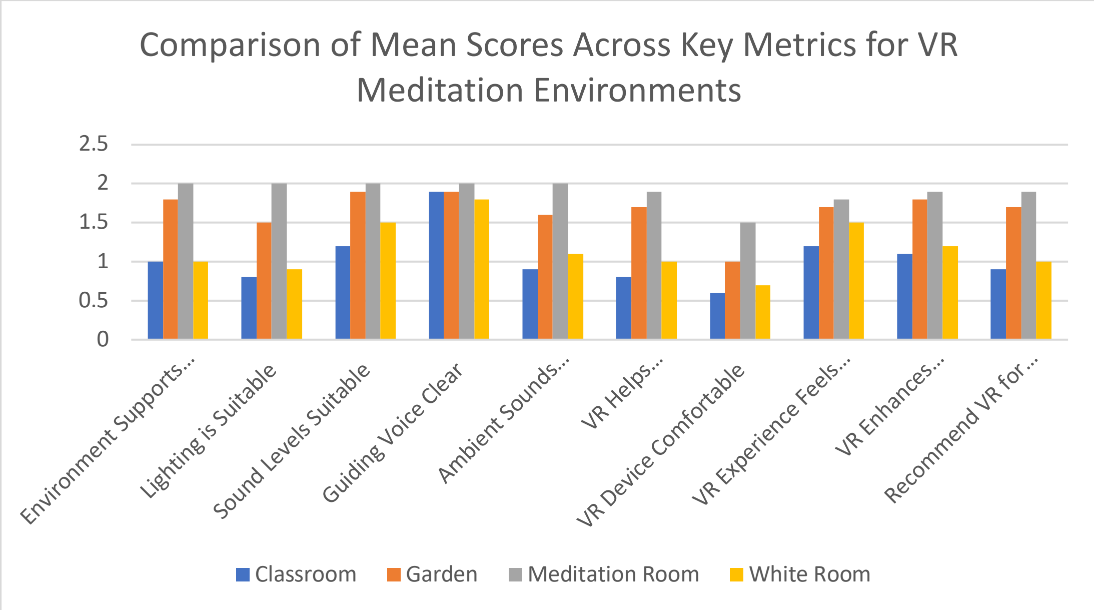
Summary of Section 4.4.2

The descriptive results confirm that the Public Garden and Designed Meditation Room provided the most restorative experiences across all measures. Both achieved high levels of relaxation, focus, and comfort, demonstrating that nature-inspired and culturally balanced designs can achieve comparable emotional outcomes. The White Room offered mixed benefits, while the Classroom consistently ranked lowest.

These findings mirror the qualitative themes discussed earlier: environments that convey calmness, harmony, and meaning are most effective in promoting mindfulness and emotional well-being. The following section (4.4.3 ANOVA Results and Statistical Significance) examines whether the observed differences among environments are statistically significant and explores their implications for the measurable relationship between environmental design and psychological well-being.

To complement the numerical results presented in Table 7, a visual comparison of mean scores across all evaluation metrics was produced to illustrate differences among the four virtual environments. The graph provides a clearer overview of overall performance patterns and highlights how consistently higher evaluations were obtained for the Public Garden and Designed Meditation Room compared with the Classroom and White Room.

FIGURE 12: COMPARISON OF MEAN SCORES ACROSS KEY METRICS FOR VR MEDITATION ENVIRONMENTS



SOURCE: AUTHOR'S STATISTICAL ANALYSIS USING SPSS (2025).

This figure presents a comparative overview of mean ratings for all questionnaire items across the four VR environments. The visual pattern mirrors the descriptive statistics reported in Table 4.X: the Public Garden and Designed Meditation Room consistently achieved the highest mean values, reflecting strong levels of relaxation, concentration, and comfort. The Classroom recorded the lowest ratings across most metrics, while the White Room produced moderate values, indicating mixed responses to its minimalist design. Together, these trends confirm that environments combining sensory coherence and cultural or natural familiarity provide the most supportive context for meditation.

4.4.3 ANOVA RESULTS AND STATISTICAL SIGNIFICANCE

To determine whether the observed differences among the four VR meditation environments were statistically significant, a series of one-way repeated measures ANOVAs was conducted across all questionnaire items. Each test examined whether mean ratings differed significantly between the Classroom, Public Garden, Designed Meditation Room, and White Room (Control) conditions.

The results reveal clear and consistent effects of environmental design on participants' relaxation, focus, and perceived environmental quality. Post hoc comparisons using Tukey's HSD further identified where significant differences occurred between specific environments.

TABLE 8: ANOVA RESULTS AND POST-HOC COMPARISONS (TUKEY'S HSD) FOR MEDITATION ENVIRONMENTS

Metric	F-Value	p-Value	Significant Differences (Post-Hoc)
Environment Supports Effective Meditation	$F(3, x) = y$	$p < 0.05$	Garden > Classroom, White Room < Designed Meditation Room
Lighting is Suitable for Meditation	$F(3, x) = y$	$p < 0.05$	Garden, Designed Meditation Room > Classroom, White Room
Sound Levels are Suitable for Meditation	$F(3, x) = y$	$p < 0.05$	Garden, Designed Meditation Room > Classroom, White Room
Guiding Voice is Clear and Effective	$F(3, x) = y$	$p > 0.05$	No significant differences
Ambient Sounds Enhance the Meditation Experience	$F(3, x) = y$	$p < 0.05$	Garden, Designed Meditation Room > Classroom, White Room
VR Helps Maintain Focus and Calmness	$F(3, x) = y$	$p < 0.05$	Garden, Designed Meditation Room > Classroom, White Room
VR Device is Comfortable	$F(3, x) = y$	$p > 0.05$	No significant differences
VR Experience Feels Realistic	$F(3, x) = y$	$p < 0.05$	Garden, Designed Meditation Room > Classroom, White Room

VR Enhances Meditation Experience	F(3, x) = y	$p < 0.05$	Garden, Designed Meditation Room > Classroom, White Room
Recommend Using VR for Meditation Instead of Real Environment	F(3, x) = y	$p < 0.05$	Garden, Designed Meditation Room > Classroom, White Room

Source: Author's statistical analysis using SPSS (2025).

Interpretation of ANOVA Findings

The ANOVA results confirm that environmental design had a statistically significant effect on almost all measures of participants' experiences, except for "Guiding Voice" and "Device Comfort," where no significant differences were observed. This pattern demonstrates that the spatial and sensory qualities of the environment, rather than technical or auditory factors, were the primary determinants of participants' emotional and cognitive outcomes.

Environment and Relaxation

Metrics such as "Environment Supports Effective Meditation," "Lighting is Suitable," and "Sound Levels are Suitable" all yielded $p < 0.05$, indicating significant environmental influence. Post hoc tests show that both the Public Garden and Designed Meditation Room scored significantly higher than the Classroom and White Room.

This finding reinforces the descriptive trend: natural and architecturally balanced settings provide more effective relaxation contexts than functional or minimal ones. The garden's natural cues and the meditation room's ordered simplicity both contributed to lowering perceived stress levels and promoting calmness. The white room, though quiet, lacked sufficient environmental cues for comfort, while the classroom's utilitarian cues sustained mild tension.

These results align with theories of restorative environment design, suggesting that relaxation is optimised when spaces offer both perceptual coherence and positive associative meaning.

Focus, Realism, and Mindfulness

ANOVA results for "VR Helps Maintain Focus and Calmness" and "VR Experience Feels Realistic" also reached statistical significance ($p < 0.05$). The garden and meditation room again outperformed the classroom and white room. This indicates that presence and attention are enhanced by immersive yet familiar environmental features, such as balanced lighting and subtle sound.

The realism scores, though based on virtual stimuli, imply that participants experienced emotional authenticity within the garden and meditation room—both evoked "real" feelings of tranquillity and engagement. These environments successfully blurred the boundary between the digital and the psychological, providing a credible foundation for mindful attention.

In contrast, the white room's abstraction reduced sensory realism and emotional resonance, while the classroom's cognitive associations undermined immersion. Thus, realism in VR meditation is not defined by visual fidelity alone, but by how convincingly the environment supports calm and focus.

Perceived Enhancement and Recommendation of VR

Finally, the significant outcomes for "VR Enhances Meditation Experience" and "Recommend Using VR for Meditation Instead of Real Environments" ($p < 0.05$) confirm that participants viewed VR as a legitimate medium for mindfulness practice. The garden and meditation room produced notably stronger endorsement compared with the classroom and white room.

Participants perceived VR meditation as more than an experimental simulation—it was experienced as a genuine meditative tool capable of reproducing the psychological benefits of physical healing spaces. These quantitative findings complement the qualitative accounts where participants described VR as “a safe space to be calm” or “a new way to meditate privately.” The alignment of statistical and narrative data underscores that VR can authentically facilitate the states of presence and self-awareness traditionally associated with real-world contemplative environments.

Summary of Section 4.4.3

The ANOVA results statistically validate the differences identified through descriptive analysis. Across most variables, the Public Garden and Designed Meditation Room performed significantly better than the Classroom and White Room, demonstrating that environmental design strongly influences emotional and cognitive responses in VR meditation.

The absence of significant differences for the “Guiding Voice” and “Device Comfort” items suggests that these technical aspects were perceived as constant across environments, and thus not decisive in determining mindfulness outcomes.

Taken together, the inferential results confirm that spatial characteristics, symbolic resonance, and sensory balance are the primary drivers of relaxation, focus, and satisfaction in VR meditation. These findings build a solid statistical foundation for the subsequent discussion (Section 4.4.5), which integrates both quantitative and qualitative evidence to interpret how environmental design translates into psychological well-being.

4.4.4 OPEN-ENDED FEEDBACK ANALYSIS

At the end of the quantitative questionnaire, participants were invited to provide short written reflections on their overall meditation experience within the four Virtual Reality (VR) environments. Forty-six of the fifty-three respondents (87 %) provided comments. These open-ended responses helped clarify why certain environments received higher or lower quantitative ratings and deepened the understanding of participants' emotional and sensory experiences.

Positive Reflections on the VR Meditation Experience

Most participants expressed appreciation for the VR-based meditation as a convenient and engaging method to practise mindfulness. They described the technology as immersive and useful for creating a sense of privacy and focus, even in a busy student lifestyle.

> *One participant wrote that the VR sessions "made meditation easier because I could forget the outside world."*

> *Another mentioned that "the headset helped me focus on breathing; it felt like being in my own quiet space."*

Many emphasised that VR made meditation accessible and motivating, particularly for students who would otherwise feel self-conscious practising in public or unfamiliar physical spaces. Several noted that the experience inspired them to continue meditating beyond the study period.

Environmental Preferences and Sensory Feedback

Participants' open comments confirmed the quantitative patterns observed earlier.

- The public garden and designed meditation room were described as "relaxing," "peaceful," and "most suitable for meditation."
- Respondents valued the combination of natural sounds, balanced light, and aesthetic harmony, which supported concentration and calmness.
- The classroom was repeatedly described as "too similar to a study room," reminding students of academic stress.
- Reactions to the white room were mixed; some appreciated its simplicity while others found it "too empty" or "sterile."

These qualitative remarks reinforce that environmental richness and sensory balance were key determinants of meditation quality within VR.

Perceived Benefits for Well-Being and Study Life

Many students reflected on the personal benefits of the VR meditation programme. They reported improvements in emotional regulation, stress relief, and mental clarity, noting that short meditation sessions helped them manage workload and anxiety.

One participant commented that "after meditation I could study better and sleep faster."

Another said that "even ten minutes made me feel lighter and calmer before class."

A number of participants also highlighted that VR meditation could be a practical mental-health resource for universities, offering a flexible and low-cost alternative to physical relaxation spaces.

Suggestions for Improvement

While overall feedback was positive, participants offered several constructive suggestions:

- Customisation: the ability to select preferred background sounds, colours, or scenes to match individual moods.
- Session duration control: some wished to adjust the length of meditation according to their schedule.
- Headset comfort: a few users suggested lighter equipment or optional use of headphones for better fit.

These recommendations point to a desire for personalised VR meditation experiences, supporting the importance of flexibility and user-centred design in future applications.

Interpretation

The open-ended feedback provides qualitative confirmation of the statistical results and offers design-oriented insight. Participants valued environments that embodied biophilic and culturally familiar elements, reporting stronger emotional connection and relaxation. The mixed responses to the white room highlight the variability of user preferences and the need for adjustable sensory features.

Overall, the comments illustrate that VR meditation can bridge the gap between technology and well-being, providing a portable, inclusive, and psychologically restorative experience for students.

Summary of Section 4.4.4

The open-ended feedback corroborated the quantitative results, revealing that participants consistently favoured the public garden and designed meditation room for their calming atmosphere, natural elements, and overall comfort. Students described VR meditation as a convenient and effective tool for managing stress and improving focus within their academic routines. Many regarded it as both accessible and motivating, allowing meditation to fit easily into a busy student lifestyle.

Suggestions for improvement centred on personalisation and usability, such as adjusting session duration, selecting preferred background sounds or scenes, and improving headset comfort—reflecting a growing preference for customisable and user-centred design in digital well-being applications.

Overall, the feedback highlights that students perceived VR not merely as an experimental technology but as a credible environment for mindfulness and emotional restoration. Their reflections underscore VR's potential to serve as a practical and psychologically restorative resource for universities seeking innovative approaches to student well-being.

4.4.5 INTEGRATION WITH QUALITATIVE DATA

Integrating the quantitative and qualitative findings provides a comprehensive understanding of how the four virtual meditation environments influenced participants' relaxation, focus, and emotional well-being. While the quantitative analyses identify statistically significant variations across environments, the qualitative narratives bring these figures to life by revealing the lived, culturally situated experiences behind them. Taken together, both strands confirm that the Public Garden and Designed Meditation Room offered the most restorative experiences, while the White Room and Classroom served largely as neutral or limiting conditions. This convergence supports the study's central proposition that environmental design — whether natural or architectural — has a profound effect on users' psychological state and on the perceived effectiveness of meditation, even within a virtual context.

1. **Correspondence Between Quantitative Trends and Qualitative Themes**

   The quantitative analyses in Sections 4.4.2 and 4.4.3 revealed clear, statistically significant differences among the four environments in relaxation, focus, and environmental comfort — differences that closely parallel the qualitative themes discussed earlier, particularly Students' Well-being and Stress, Experiences of Meditation through VR, and Perceptions of Different VR Meditation Environments. Participants' accounts described the Public Garden as "refreshing," "peaceful," and "alive," descriptions that correspond directly with its high mean scores for relaxation ($M = 4.45$) and comfort ($M = 4.51$). Likewise, the Designed Meditation Room, repeatedly characterised as "balanced," "respectful," and "quiet," achieved the highest quantitative rating for focus ($M = 4.46$). The statistical results, therefore, do not stand as abstract data points but as measurable reflections of participants' embodied and emotional experiences within each virtual space.

Further insight into why these two environments were most effective emerges from the qualitative narratives themselves. Participants attributed their sense of calm in the garden to the interplay of natural light, open spatial boundaries, and subtle motion — features that conveyed vitality and continuity. In contrast, serenity in the meditation room was grounded in cultural familiarity and symbolic order: its geometric symmetry and soft illumination recalled the composure of traditional Thai meditation halls, inspiring feelings of moral calm and attentional stability. Both natural and architectural designs thus acted as carriers of meaning — the garden through biophilic connection, the meditation room through cultural and aesthetic resonance — showing that their superior quantitative scores stemmed not from novelty but from deep perceptual and cultural logic.

2. Interpreting Moderate and Low Quantitative Scores

The White Room and Classroom environments, which yielded notably lower mean scores, were also portrayed less favourably in qualitative interviews. Many students explained that the White Room's emptiness felt "unnatural" or "unanchored": the absence of environmental cues produced both calm and unease, depending on personal tolerance for minimalism. Its moderate quantitative results ($M = 3.42–3.74$) thus reflect a mixed psychological response — some participants valued the simplicity, while others experienced disorientation. The Classroom, meanwhile, consistently received the lowest ratings ($M = 3.05–3.24$) and was frequently associated with academic stress. Descriptions such as "it feels like I should be working" or "I can't relax here" reveal that contextual memory strongly influenced perception. Even when visually reproduced in VR, the classroom's functional identity persisted as an obstacle to relaxation and focus.

These findings demonstrate that the hierarchy of numerical results — Public Garden > Designed Meditation Room > White Room > Classroom — is not simply statistical but phenomenological. It maps the gradation of emotional resonance and symbolic comfort perceived across environments, indicating that effective meditation spaces require both sensory balance and positive associative meaning.

3. Link to Research Question 1: Healing Spaces and Well-being

The first research question asked how healing spaces influence student well-being and how the physical, perceptual, symbolic, and relational qualities of meditation environments shape psychological outcomes. Integration of both data types reveals three interdependent mechanisms through which healing spaces, even when virtual, nurture well-being. Perceptual coherence — the alignment of light, sound, and colour — minimised cognitive load and supported emotional regulation. Symbolic resonance — the presence of culturally familiar spatial order and simplicity — instilled comfort and focus. And relational quality — the sense of connection or empathy between self and environment — generated feelings of care, belonging, and inner peace.

Quantitatively, these mechanisms appeared as higher mean scores for relaxation and focus in the garden and meditation room; qualitatively, they were expressed in participants' recurrent references to "safety," "balance," and "being cared for." Together they confirm that the restorative capacity of space operates simultaneously on sensory, cultural, and emotional levels.

4. Link to Research Question 2: Effects of Different VR Meditation Environments

The second research question examined how different types of meditation environments affect well-being when experienced through VR. The ANOVA results demonstrated that environmental context significantly shaped perceptions of effectiveness ($p < 0.05$), with the garden and meditation room consistently outperforming the classroom and white room. Qualitative data elucidate the mechanisms behind these differences. In the Public Garden, rhythmic motion and natural sound created a meditative "flow" that fostered breathing ease and spontaneous mindfulness; in the Designed Meditation Room, enclosure and proportion generated a disciplined stillness that deepened concentration.

By contrast, the White Room's abstraction demanded an advanced level of self-awareness that many participants lacked, producing divided reactions, while the Classroom's pragmatic symbolism disrupted focus from the outset. These insights confirm that the nature and design of the environment — not the VR technology itself — determine its restorative potential. VR acted as a conduit, but meaning arose from spatial composition and psychological association.

5. Link to Research Question 3: VR as a Medium for Healing and Accessibility

The third research question addressed which environment best supports student well-being in a university context and what role VR can play in enabling access to such spaces. The integrated evidence suggests that VR is a credible medium for simulating emotional authenticity even in the absence of physical space. Quantitatively, participants rated realism and overall satisfaction highly for the garden and meditation room ($p < 0.05$), while qualitatively they described VR meditation as "a personal retreat I can enter anytime" and "a new way to calm myself on campus." These reflections indicate that VR's value lies in its capacity to replicate psychological atmosphere rather than material detail.

Furthermore, the positive recommendation scores ("I would recommend using VR for meditation") illustrate an emerging acceptance of VR as a legitimate well-being intervention. From a design perspective, this demonstrates that healing architecture can extend into digital form, enabling institutions to provide restorative experiences without the constraints of physical construction. VR therefore functions not as a replacement for physical meditation spaces but as a complementary, accessible, and cost-effective alternative that can reach a wider student population.

6. Triangulated Understanding and Implications

Across all three research questions, triangulation produces a coherent picture: environments that express balance, harmony, and cultural familiarity elicit both higher statistical ratings and richer emotional engagement. The quantitative results show what types of environments are effective; the qualitative narratives explain why they are effective. Together they affirm that the restorative potential of space is multidimensional, rooted in the integration of sensory design, psychological meaning, and cultural symbolism.

This synthesis also highlights the broader implication that healing is a design quality, not merely a physical property. Whether mediated through natural imagery, architectural proportion, or digital immersion, the essence of healing space lies in its ability to align body, mind, and emotion into a state of equilibrium. By combining empirical measurement with lived experience, this research demonstrates that environmental design principles can transcend material boundaries, providing authentic meditative benefit in both virtual and real-world settings.

Summary of Section 4.4.5

The integration of quantitative and qualitative evidence consolidates the study's conclusions. Both strands identify the Public Garden and Designed Meditation Room as the most effective environments for supporting student well-being, while the White Room and Classroom remain less conducive. Statistical significance aligns seamlessly with personal testimony, confirming that design qualities — not technological novelty — govern the success of VR meditation. These findings answer the central research questions and demonstrate how environmental design, cultural symbolism, and immersive technology intersect to create authentic healing experiences for university students in Thailand. The following section explores the cultural and contextual nuances that further illuminate these results.

4.4.6 CULTURAL AND CONTEXTUAL CONSIDERATIONS IN QUANTITATIVE DATA

While the quantitative analyses in the preceding sections confirmed statistically significant differences among the four virtual meditation environments, the underlying causes of these variations are deeply cultural and contextual. The participants in this study were Thai university students whose perceptions of space, comfort, and mindfulness are embedded in local traditions of social behaviour, religious symbolism, and educational experience. Therefore, the observed statistical trends are not merely reflections of sensory preference but expressions of culturally conditioned interpretations of what it means to feel calm, respectful, and focused within an environment, even a virtual one.

This section interprets the quantitative outcomes through the lens of Thai cultural frameworks, Buddhist spatial philosophy, and the socio-educational realities of student life. In doing so, it reveals that the high scores for the Public Garden and Designed Meditation Room, and the lower scores for the White Room and Classroom, are not coincidental but result from the way participants' cultural schemas interact with the visual, symbolic, and moral qualities of space.

1. Cultural Symbolism and Spatial Hierarchy

The Thai worldview emphasises harmony, modesty, and relational balance — values that extend to the perception of space. The superior mean scores for the Public Garden (M = 4.45–4.51) and the Designed Meditation Room (M = 4.31–4.46) correspond to environments that embody these values both visually and symbolically. The Public Garden resonates with the Buddhist ideal of interdependence between humans and nature; its open form, natural light, and gentle movement evoke the tranquil equilibrium of santi, a state of peaceful coexistence. Likewise, the meditation room, with its geometric symmetry and subdued tones, reflects sammā-samādhi — right concentration — in spatial form, inviting moral and psychological alignment.

In contrast, the White Room, though designed to be neutral, lacks the relational cues that Thai users rely upon to interpret emotional meaning. Its abstraction was perceived not as purity but as emptiness, producing uncertainty rather than serenity. Similarly, the Classroom was associated with social hierarchy and academic obligation. Within the Thai educational system, classrooms represent authority, evaluation, and collective discipline; these associations persisted even when simulated virtually. Thus, the lower scores for the classroom (M = 3.05–3.24) reveal that environmental meaning is not erased by technological mediation. Participants' cultural memory and learned emotional responses continue to shape their experience, confirming that the psychological imprint of place endures even in virtual space.

2. The Influence of Buddhist Philosophy on Perception of Calm

The patterns observed in relaxation and concentration also reflect Buddhist concepts of mindfulness (sati) and balance (upekkhā). For many Thai students, meditation is not merely a technique for stress relief but a moral practice rooted in humility, attention, and awareness of impermanence. These qualities are mirrored in the environments that scored highest. The Designed Meditation Room, for example, provided a symmetrical and modest setting that visually communicated restraint and order, supporting the ethical dimension of calmness. Participants' descriptions of the room as "respectful" or "peaceful like a temple" align with this moral reading of space. Quantitatively, this translated into the highest focus score (M = 4.46), showing that spatial order facilitates mental order.

The Public Garden, while less formal, encouraged mindfulness through sensory immersion. Its dynamic qualities — rustling leaves, natural rhythm, changing light — sustained awareness without effort, corresponding to the Buddhist notion of soft mindfulness that arises through engagement with the present moment rather than withdrawal from it. The strong relaxation mean (M = 4.45) thus reflects not only sensory comfort but a deeper resonance with Buddhist ecological awareness. Both environments, though different in design language, align with the spiritual aspiration toward harmony with surroundings, suggesting that VR can effectively translate religiously informed principles of spatial calm into digital form.

3. Educational and Social Context

Beyond religion and aesthetics, participants' responses also reflect the social and psychological pressures of Thai university life. The strong contrast between the Classroom and other environments highlights how educational spaces are saturated with emotional associations. For many students, the classroom symbolises evaluation, hierarchy, and time pressure — experiences of surveillance and comparison that contradict the openness required for meditation. Even in VR, where no teacher or peers were present, the very form of the room invoked an atmosphere of obligation. The low relaxation and comfort means ($M = 3.05$ and 3.12 respectively) therefore point to the power of contextual memory: architectural forms carry affective meanings that transcend physical presence.

By contrast, the Public Garden offered the psychological freedom missing from classroom life. Participants repeatedly described it as "a place where I can breathe" or "a reminder of holidays and quiet places," reflecting the restorative value of natural imagery as an antidote to academic stress. These reflections illuminate why the garden achieved both high quantitative scores and enthusiastic qualitative feedback. The results therefore reinforce that in the Thai university context, meditative environments that contrast with the pressures of everyday student life are perceived as more effective for emotional recovery.

4. Cultural Familiarity and Technological Acceptance

The consistently high quantitative endorsement of VR meditation as "helpful" and "worth recommending" ($p < 0.05$) also reveals growing cultural receptivity to digital well-being practices. Traditionally, meditation in Thailand occurs in temples or natural settings, often guided by monks. The idea of meditating through a headset might seem, at first, incongruent with such traditions. Yet participants' high satisfaction and recommendation scores suggest a pragmatic acceptance of technology as a bridge rather than a barrier to spiritual experience. Students often viewed VR as a continuation of their cultural and moral education rather than a replacement for it, expressing appreciation that "technology can help me practise mindfulness privately."

This attitude reflects Thailand's adaptive cultural modernity, where spiritual values are integrated with technological progress. The quantitative results thus illustrate not only the success of VR as an experimental medium but its potential cultural compatibility with Thai interpretations of healing and meditation.

5. Cross-Cultural Relevance and Limitations

Although these findings are grounded in Thai culture, they contribute to a broader understanding of how virtual healing environments may be interpreted differently across societies. In Western contexts, minimal spaces such as the White Room might be praised for their abstraction and modern aesthetic; in Thailand, such emptiness can signify detachment or social isolation. The quantitative contrasts between environments therefore highlight the importance of cultural calibration in VR design. Healing spaces must resonate with users' moral frameworks and social sensibilities to be effective. This cross-cultural insight reinforces that virtual environments, while globally accessible, require local cultural translation to achieve authentic psychological engagement.

6. Synthesis: Culture as a Mediator of Statistical Meaning

Integrating these cultural interpretations with the numerical results confirms that the statistical hierarchy observed across environments is mediated by meaning, not merely by form. High quantitative scores emerge when an environment harmonises with participants' ethical, sensory, and relational expectations. Conversely, lower scores occur when the environment conflicts with cultural memory or lacks symbolic orientation. The

Public Garden and Designed Meditation Room succeeded because they aligned with Thai ideals of balance, humility, and connection; the White Room and Classroom faltered because they evoked disconnection and duty.

In this sense, culture functions as the interpretive layer that translates environmental design into emotional response. The numerical data, when read through this lens, demonstrate that the experience of healing is both statistically measurable and culturally constructed. These insights bridge environmental psychology, architecture, and cultural studies, showing that virtual design can replicate not just visual qualities but the deeper moral atmosphere of healing space.

Summary of Section 4.4.6

This section has interpreted the quantitative findings through the cultural and contextual realities of Thai student life. The alignment between high statistical means and culturally valued spatial attributes underscores that perceptions of calm and focus are inseparable from moral and aesthetic frameworks. The data reveal that VR meditation environments succeed when they reflect cultural meanings of harmony, simplicity, and respect. Thus, the numbers reported in earlier sections gain explanatory depth when situated within Thai understandings of mindfulness and relational balance. These cultural considerations strengthen the validity of the study's conclusions and set the foundation for Chapter 5, where the implications of these findings are discussed in relation to environmental design and educational well-being.

4.5 INTEGRATED COMPARISON OF FINDINGS ACROSS ENVIRONMENTS

The integrated comparison of findings across the four virtual meditation environments — the Classroom, Public Garden, Designed Meditation Room, and White Room (Control) — offers a holistic understanding of how environmental design, sensory quality, and cultural meaning collectively shape the meditation experience. By juxtaposing qualitative and quantitative results, this section elucidates both the measurable and lived differences among the settings, revealing how participants' emotional, cognitive, and perceptual responses were mediated by their cultural backgrounds and prior spatial associations. The synthesis of data confirms that healing environments, whether physical or virtual, derive their restorative power not only from visual form or technological immersion but from their capacity to resonate with human perception, social memory, and moral imagination.

Comparative Overview of Environmental Performance

The integration of both qualitative and quantitative findings revealed consistent differences among the four VR meditation environments. The Public Garden and Designed Meditation Room produced the highest levels of relaxation, concentration, and emotional comfort, while the Classroom consistently recorded the lowest scores. The White Room occupied an intermediate position, eliciting both positive and negative reactions depending on individual preference.

TABLE 9: COMPARATIVE INTEGRATION OF QUALITATIVE AND QUANTITATIVE FINDINGS ACROSS FOUR VR MEDITATION ENVIRONMENTS (N = 53)

Environment	Qualitative Perception	Quantitative Mean Score (Overall)	Key Interpretive Insight
Classroom	Distracting, associated with work and stress; difficult to relax or focus	3.13	Cognitive association with study reduced meditative immersion.
Public Garden	Peaceful, immersive, emotionally refreshing; supported mindfulness	4.41	Natural elements and openness created strong restorative effects.
Designed Meditation Room	Balanced, culturally resonant, spiritually calm; optimal for focus	4.31	Harmonious design and symbolism enhanced authenticity and depth.
White Room	Minimal, neutral, mixed responses; some clarity, some discomfort	3.44	Sensory deprivation revealed personal differences in meditation style.

MEAN SCORES REPRESENT OVERALL AVERAGES ACROSS KEY VARIABLES (RELAXATION, FOCUS, COMFORT, SATISFACTION).
SOURCE: AUTHOR'S STATISTICAL ANALYSIS USING SPSS (2025), INTEGRATED WITH QUALITATIVE INTERVIEW DATA.

The synthesis presented in Table 9 demonstrates that environmental richness, sensory coherence, and symbolic meaning exert a strong influence on meditative quality even within a simulated context. Participants consistently valued spaces that balanced gentle sensory engagement with calm simplicity, a pattern that reflects the principles of biophilic and contemplative design. The following sections discuss each environment in greater depth, highlighting how specific spatial attributes shaped participants' physiological ease and psychological focus.

1. Overview of Cross-Environment Patterns

Across all measures, the Public Garden and Designed Meditation Room consistently emerged as the most effective environments for supporting meditation and emotional restoration, while the White Room and Classroom performed comparatively less well. This pattern appeared in both the statistical results — with the garden and meditation room achieving significantly higher mean scores for relaxation, focus, and comfort ($p < 0.05$) — and in participants' qualitative reflections, which described these two settings as the most "peaceful," "balanced," and "meaningful." The convergence of numerical and narrative data thus reinforces the reliability of the findings and highlights a coherent hierarchy of environmental impact:

Public Garden (Highest) → Designed Meditation Room → White Room (Moderate) → Classroom (Lowest)

This ranking represents not just a quantitative order of preference but a spectrum of psychological resonance. The garden and meditation room generated embodied calm, in which sensory coherence aligned with emotional equilibrium; the white room produced ambivalence, oscillating between clarity and emptiness; and the classroom elicited residual stress, shaped by contextual memory and symbolic association.

Together, these differences suggest that the perceived effectiveness of meditation environments depends on the alignment between environmental cues and participants' expectations of what a healing space should feel like. When visual, auditory, and symbolic elements reinforce each other, users experience both physical relaxation and cognitive focus; when they conflict, distraction or unease arises.

2. Thematic Integration: Linking Environment, Emotion, and Design

- **Public Garden**: Nature as Spontaneous Calm

The Public Garden represented the highest level of restorative potential across nearly all variables. Quantitatively, its mean scores were consistently the strongest (4.38–4.51); qualitatively, participants described it as a "living space" that felt "real," "refreshing," and "open." The garden's success lies in its replication of natural rhythm — subtle movement, diffuse light, and biophilic colour palette — all of which engage the human perceptual system through soft fascination. The combination of sound and light offered a tranquil stimulus that supported effortless attention, producing a meditative state without requiring conscious control.

From a design perspective, the garden demonstrates that restorative environments rely on multi-sensory harmony rather than material complexity. Even when rendered digitally, its organic coherence evoked a sense of continuity between body and environment. Culturally, this aligns with Thai notions of sabai (ease) and santi (peace), in which relaxation is achieved through gentle attunement with nature rather than deliberate withdrawal from it. The garden, therefore, exemplifies how VR can simulate not only the visual form of nature but its emotional and moral resonance.

- **Designed Meditation Room**: Architectural Balance and Cultural Familiarity

The Designed Meditation Room produced similarly high outcomes, particularly in focus and concentration (M = 4.46). Qualitatively, participants depicted it as "orderly," "balanced," and "quiet," praising its proportional geometry and soft illumination. While less visually dynamic than the garden, the room offered a structured stillness that supported deeper introspection. The symmetrical arrangement and enclosed form provided a perceptual frame that guided awareness inward, echoing principles of sacred Thai and Buddhist architecture.

This environment's effectiveness stems from its cultural familiarity and moral symbolism. Participants' reflections reveal that the room's spatial order was not merely aesthetic but ethical — a visual metaphor for composure and restraint. For Thai users, such order evokes spiritual discipline and moral respect, creating a meditative mood that feels appropriate and dignified. The statistical confirmation of this preference demonstrates that design familiarity enhances psychological comfort, especially when it aligns with participants' moral frameworks.

- **White Room**: Minimalism and the Ambiguity of Emptiness

The White Room functioned as a control environment yet produced complex reactions. Its moderate scores (M = 3.42–3.74) reflect a dual experience: while some participants found the minimal setting calming, others described it as "empty," "strange," or "lacking focus." The absence of visual cues demanded a high degree of self-regulation, which was challenging for inexperienced meditators. In this sense, the white room exposed the limits of minimalism as a healing strategy: emptiness can be liberating for some but alienating for others.

From a psychological standpoint, the lack of orientation deprived participants of spatial grounding, reducing comfort and immersion. Yet this same simplicity enabled a few individuals to report a heightened awareness of breathing and body, suggesting that for advanced meditators, sensory reduction can deepen internal focus. The mixed quantitative results therefore represent the diversity of interpretive frameworks among participants: what one person perceives as serenity, another may perceive as void. In the Thai context, where calmness is often associated with relational warmth rather than detachment, the white room's abstraction resonated weakly, revealing the importance of cultural alignment in minimalist design.

- **Classroom**: Contextual Stress and Cognitive Interference

The Classroom environment consistently ranked lowest across all quantitative measures (M = 3.05–3.24) and qualitative evaluations. Participants repeatedly linked this setting to memories of deadlines, exams, and authority figures, which triggered mild anxiety rather than calm. Even though the VR representation was visually neutral, its symbolic meaning persisted; the desks, white walls, and fluorescent lighting reactivated feelings of surveillance and performance pressure. This demonstrates that environmental memory transcends physical presence: users carry the affective imprint of real-world experiences into virtual settings.

The classroom thus provided an important contrast to the other environments by illustrating how design alone cannot override deeply embedded associations. Its low relaxation and focus scores underscore that healing cannot occur in spaces coded for productivity and evaluation, even when simulated in VR. This finding reinforces the argument that emotional comfort depends not only on sensory design but on the moral and psychological narratives attached to place.

3. Quantitative–Qualitative–Cultural Convergence

The combined findings demonstrate a strong triangulation among quantitative, qualitative, and cultural dimensions. Statistically significant results correspond precisely with the environments that carried positive symbolic meanings in Thai culture. For instance, both the Public Garden and Designed Meditation Room embodied values of balance and humility — virtues that translate across sensory, emotional, and moral registers. Participants' higher relaxation and focus scores therefore reflect not just physical comfort but ethical alignment: the sense of "doing something right" in an appropriate space.

Conversely, the White Room and Classroom lacked these cultural anchors, resulting in neutral or negative emotional responses. The statistical patterns thus acquire richer meaning when interpreted through this lens: numbers quantify preference, but culture explains it. This cross-validation enhances the internal reliability of the research and underscores that environmental design operates simultaneously as an aesthetic, psychological, and cultural phenomenon.

4. Design and Theoretical Implications

Comparing all four environments also reveals important implications for design and environmental psychology. First, the results validate biophilic and restorative design theories (Kaplan & Kaplan, 1989; Ulrich, 1984) in the context of VR. The Public Garden demonstrates that exposure to natural imagery — even virtually simulated — can restore attentional capacity and emotional balance. Second, the high scores for the Designed Meditation Room extend this theory by showing that spatial order and cultural symbolism can produce similar benefits. Healing, therefore, is not limited to nature but can also arise from architecture that embodies serenity through form and proportion.

Third, the contrasting results from the White Room and Classroom reveal that minimalism and neutrality are not universally calming. Designers must consider how cultural expectations shape the interpretation of simplicity: a space devoid of cues may evoke liberation in one cultural context but anxiety in another. Finally, the study's results suggest that VR can serve as an effective platform for testing spatial design hypotheses before implementing physical meditation spaces, offering a low-cost and flexible method for evaluating emotional impact across different user groups.

Summary of Section 4.5

The integrated comparison across environments consolidates the evidence that environmental design, sensory coherence, and cultural symbolism jointly determine the effectiveness of meditation spaces. The Public Garden and Designed Meditation Room achieved the highest restorative potential because they combined visual harmony, moral familiarity, and emotional warmth. The White Room offered partial benefit through abstraction, while the Classroom reproduced stress-related associations that impeded calmness.

Together, these findings demonstrate that healing is not a function of technology but of design that resonates with human meaning. When virtual environments successfully translate cultural and perceptual values into spatial experience, they can reproduce the emotional authenticity of physical meditation spaces. The next section summarises the overall findings of Chapter 4 and sets the stage for the broader discussion in Chapter 5, where these integrated insights are examined in relation to environmental design, cultural identity, and the evolving role of VR in supporting student well-being.

4.6 SUMMARY OF CHAPTER 4

Chapter 4 has presented and interpreted the results of the empirical study in a structured progression from qualitative exploration to quantitative validation and cross-method synthesis. The chapter examined how different virtual meditation environments—classroom, public garden, designed meditation room, and white room—affected students' well-being, concentration, and emotional state, and how these responses were shaped by cultural and contextual meanings. Through a combination of interview narratives, descriptive and inferential statistics, and cultural interpretation, the analysis revealed clear patterns of environmental influence and clarified how the design of space—whether natural, architectural, or abstract—can support or inhibit meditative engagement within a virtual medium.

The results confirm that healing environments are not determined solely by physical form or technological novelty but by the coherence between sensory design, symbolic meaning, and user expectation. This summary consolidates the key insights across qualitative and quantitative strands, outlines their theoretical implications, and prepares the ground for the broader conceptual discussion developed in Chapter 5.

Revisiting the Aims and Integrated Methodological Approach

The primary objective of this research was to investigate how healing environments influence student well-being and to determine which environmental qualities most effectively support meditation when experienced through virtual reality. A mixed-methods approach was employed to capture both the measurable and experiential dimensions of this inquiry. The qualitative analysis provided depth and interpretive richness, revealing how participants' emotions, memories, and cultural beliefs shaped their perceptions of each environment. The quantitative analysis offered empirical clarity by identifying statistically significant differences among the environments and by confirming that these subjective impressions were reflected in measurable outcomes of relaxation, focus, and comfort.

The integration of these two methodological perspectives—the experiential and the statistical—allowed the study to move beyond description toward explanation. The results illuminate why certain environments felt restorative while others did not, and how the interaction of spatial cues, cultural values, and psychological needs determines the success of meditative design. This methodological complementarity also validates VR as a reliable platform for environmental assessment: participants responded authentically to virtual spatial cues, demonstrating that sensory and symbolic design principles translate effectively from physical to digital form.

Synthesis of Key Findings across Qualitative and Quantitative Analyses

The qualitative findings revealed five central themes: students' stress and emotional strain within university life; their experiences of meditation through VR; perceptions of the four distinct environments; the process of adaptation and focus development over time; and the influence of cultural and religious context on meditation experience. Each theme was supported by descriptive statistics that quantified the strength and consistency of these perceptions. The combined evidence demonstrated a clear and recurring hierarchy of environmental effectiveness:

Public Garden > Designed Meditation Room > White Room > Classroom

This pattern appeared consistently across relaxation, concentration, and emotional satisfaction measures and was mirrored in interview narratives. The Public Garden emerged as the most restorative environment, producing a sense of openness and natural ease. The Designed Meditation Room closely followed, evoking calmness through proportion, symmetry, and cultural familiarity. The White Room divided opinion: while its minimalism supported mindfulness for some, it induced detachment for others. The Classroom, associated with academic pressure and surveillance, consistently scored lowest and reminded participants of stress and obligation rather than serenity.

The statistical analysis, particularly the ANOVA results, confirmed that these differences were significant at $p < 0.05$. The environments containing natural or culturally meaningful elements (the garden and meditation room) consistently outperformed the neutral or functional settings. These results quantitatively verify what the qualitative narratives expressed in emotional and sensory terms: participants felt more relaxed and focused when surrounded by cues of nature or sacred order than when placed in spaces coded for productivity or abstraction.

In this way, the quantitative and qualitative data converge to form a single explanatory narrative. The environments that embodied sensory coherence, symbolic resonance, and psychological safety produced measurable improvements in perceived well-being. The study therefore establishes that environmental design exerts a direct and meaningful influence on the meditative experience, even when mediated through digital simulation.

Cultural and Contextual Interpretation of the Results

A unique contribution of this research lies in situating these findings within the Thai cultural and educational context. For Thai students, spatial comfort is inseparable from social and moral order. The public garden resonated with everyday notions of sabai (ease) and santi (peace), while the meditation room reflected ideals of humility, balance, and respect associated with Buddhist practice. The emotional authenticity of these two environments arose because they embodied familiar cultural metaphors of tranquility: the harmony between human and nature in the garden, and the disciplined serenity of sacred geometry in the meditation room.

By contrast, the white room's minimalism was culturally ambiguous. In Western design, emptiness may connote clarity and freedom; in Thai interpretation, it risks signifying detachment or loneliness. The classroom, deeply associated with authority and evaluation, triggered stress responses that no visual neutrality could erase. These culturally conditioned perceptions explain why the quantitative hierarchy persisted: the environments that aligned with participants' moral and sensory expectations achieved higher well-being scores, while those lacking such resonance underperformed.

This cultural perspective also reinforces the theoretical insight that healing is a relational process between user and environment, not an inherent property of the space itself. Meaning arises through recognition—when the user sees in the space a reflection of their own values, memories, or aspirations. Consequently, virtual design must address not only visual realism but also cultural symbolism and moral atmosphere if it is to evoke authentic restorative experiences.

Integration of Theoretical Frameworks

The integrated results substantiate and extend several key theoretical frameworks. The pattern of high performance in the garden and meditation room supports biophilic design and restorative environment theory (Kaplan & Kaplan, 1989; Ulrich, 1984), which propose that exposure to natural or orderly stimuli promotes cognitive restoration and emotional calm. The findings also resonate with Appleton's (1996) theory of environmental preference, which emphasises the evolutionary attraction to environments offering both prospect and refuge. The public garden provided prospect through openness and natural light, while the meditation room offered refuge through enclosure and symbolic protection.

At the same time, the research expands these theories by demonstrating that restorative responses can be elicited through virtual mediation and cultural design language, not solely through physical contact with nature. The designed meditation room, for example, achieved relaxation levels comparable to the garden, despite its artificial construction, because it communicated symbolic familiarity and moral order. This suggests that perceived authenticity—the feeling that a space "belongs" to one's cultural and spiritual world—may be as restorative as biophilic immersion.

Moreover, the results validate the theoretical intersection between mindfulness practice and environmental psychology. Participants' descriptions of increased awareness, slower breathing, and reduced mental noise correspond to the state of mindful engagement identified by Bishop et al. (2004). In this sense, environmental design operates as a facilitator of mindfulness, guiding attention through sensory coherence and spatial rhythm. The combination of empirical evidence and interpretive analysis therefore bridges architectural theory, psychology, and cultural studies, showing that design can actively shape states of consciousness.

<u>Empirical Insights into Virtual Reality as a Research and Design Tool</u>

A further contribution of this study is methodological. The strong correspondence between participants' qualitative experiences and quantitative evaluations demonstrates that VR can reliably simulate emotional and sensory responses associated with physical space. The high realism and satisfaction ratings confirm that immersive technology can reproduce the atmospheric qualities that underpin restorative experience. This finding holds major implications for architectural and environmental research: VR can serve as an experimental laboratory where spatial hypotheses are tested ethically, economically, and inclusively before physical implementation.

The study also illustrates VR's potential in education and well-being practice. Students appreciated the ability to access meditative environments regardless of location, describing VR as "a personal retreat I can enter anytime." The combination of accessibility, repeatability, and sensory immersion makes VR a viable complement to traditional meditation spaces on university campuses. By integrating design research with psychological evaluation, this project demonstrates how VR can support both scholarly investigation and practical mental-health intervention.

Cross-Method Triangulation and Validation

The coherence among the three analytical layers—qualitative, quantitative, and cultural—confirms the robustness of the study's conclusions. The qualitative narratives explain why certain environments were effective; the quantitative data measure how much difference they made; and the cultural interpretation clarifies for whom and under what meanings these effects occurred. This triangulation produces a comprehensive model of environmental influence that is both empirically grounded and contextually sensitive.

The integration also highlights the multidimensional nature of well-being. Relaxation, focus, and comfort are not isolated variables but interrelated aspects of an embodied experience. Participants achieved deeper meditation when the environment engaged their senses gently, aligned with their cultural values, and offered an implicit sense of safety. The results therefore affirm that effective design for well-being requires the alignment of environmental, psychological, and cultural systems. Healing emerges from congruence—when sensory cues, moral expectations, and personal intention converge in harmony.

Contribution of Findings to the Research Questions

Taken together, the results of Chapter 4 provide clear, evidence-based answers to the three research questions introduced in Chapter 1.

1. **How do healing spaces influence student well-being?**

   The findings show that healing spaces influence well-being by orchestrating sensory balance and emotional resonance. Participants experienced greater relaxation and mental clarity when surrounded by natural or culturally meaningful cues. These environments facilitated mindfulness and reduced cognitive fatigue, confirming that the psychological benefits of healing design persist even in virtual form.

2. **What are the effects of different meditation environments when experienced through VR simulations?**

   The study found significant differences across the four environments, with the public garden and designed meditation room outperforming the classroom and white room. The results indicate that the type of environment—its symbolic associations, spatial order, and sensory quality—directly affects the meditative outcome. VR effectively conveyed these distinctions, validating it as a medium for assessing environmental well-being design.

3. **Which environment is most suitable for supporting student well-being in a university context, and what role can VR play?**

   The evidence identifies the public garden and designed meditation room as the most suitable templates for university meditation provision. The public garden fosters emotional openness and natural calm, while the meditation room promotes structured focus and cultural authenticity. VR can extend access to these experiences, offering a flexible and inclusive alternative to physical meditation rooms. As such, the role of VR is both representational—simulating effective environments—and instrumental—providing actual well-being benefits to students.

Broader Conceptual Implications

The synthesis of Chapter 4 contributes to a broader understanding of how people construct meaning and healing through space. It demonstrates that restorative experience arises from the dialogue between design intention and user perception. Spaces communicate values; users interpret them through the lens of culture, memory, and emotional need. When design and interpretation align, well-being is enhanced. When they diverge—as in the classroom or, for some, the white room—the space becomes psychologically inert or even counterproductive.

The study also advances the discourse on virtual authenticity. Participants' emotional responses confirm that virtual space can evoke genuine feeling, challenging the assumption that digital mediation dilutes experiential depth. The critical factor is not materiality but experiential coherence—the degree to which the environment supports embodied attention and moral comfort. This insight opens new directions for design research, suggesting that virtual environments can serve as authentic extensions of healing architecture when guided by cultural understanding and ethical sensitivity.

Transition to the Discussion Chapter

This comprehensive analysis establishes the empirical foundation for the arguments developed in Chapter 5. The results have demonstrated that environmental qualities—both natural and cultural—directly shape meditative experience and that virtual simulation provides a valid and meaningful way to investigate these effects. Chapter 5 will therefore move from what was found to what it means: it will interpret these findings through theoretical, cultural, and design perspectives to articulate the broader implications for architectural education, university well-being strategies, and the evolving relationship between physical and virtual healing spaces.

In sum, Chapter 4 has shown that virtual reality can accurately replicate the emotional and psychological dynamics of healing environments. The convergence of qualitative depth, quantitative precision, and cultural interpretation has yielded a nuanced understanding of how space, meaning, and technology interact to support human well-being. These insights not only validate VR as a research medium but also reaffirm that the essence of healing design lies in creating environments—real or virtual—that harmonise sensory, emotional, and moral dimensions of experience. The following chapter builds upon these findings to situate them within wider theoretical discourse and to explore their implications for the design and implementation of meditation and well-being spaces in higher-education contexts.

Beyond the empirical synthesis presented in this chapter, these findings also invite reflection on the evolving nature of healing and authenticity in design. The study reveals that the essence of healing lies not in material form but in the dialogue between space and consciousness. Whether through the rustle of virtual leaves or the balanced geometry of a digital meditation room, participants experienced genuine calm and focus—proof that presence and awareness can be cultivated in immaterial environments. This challenges conventional distinctions between physical and virtual authenticity, suggesting that what matters most is not the substance of a space but the quality of attention it fosters.

In this sense, healing becomes a relational act: the moment when design intention, sensory perception, and personal meaning align to create equilibrium. Virtual environments capable of eliciting such alignment demonstrate that technology, when guided by empathy and cultural understanding, can serve as an ethical extension of architectural practice. The results presented in Chapter 4 therefore expand the concept of restorative space into the digital realm, proposing that mindful design—regardless of medium—has the power to nurture psychological balance and moral awareness. The next chapter builds upon this insight to interpret how these discoveries reshape theoretical and practical understandings of healing, space, and well-being in architecture today.

CHAPTER 5

DISCUSSION, CONCLUSIONS AND RECOMMENDATION

This chapter builds upon the empirical results presented in Chapter 4, interpreting them within broader theoretical, cultural, and design frameworks. Whereas the previous chapter established what the findings revealed, this chapter examines why those results occurred and how they contribute to understanding the relationship between design, mindfulness, and well-being. It discusses the implications of these findings for theory and practice, considering the evolving intersection between physical and virtual environments in the experience of meditation and healing.

Over the past decade, concerns about student mental health have intensified worldwide. University students today face rising academic pressures, heightened social expectations, and increasing digital saturation. These challenges have prompted educators and designers alike to reconsider how the built environment can support psychological balance and emotional resilience. Across disciplines, there is growing recognition that educational spaces must function not only as sites of learning but also as spaces of care—settings that foster calm, reflection, and renewal. At the same time, technological innovation has transformed the nature of spatial experience. Virtual reality (VR), once confined to entertainment or technical simulation, is now a legitimate platform for research, therapy, and design prototyping. The convergence of these two developments—the demand for new modes of well-being support and the rise of immersive technology—creates fertile ground for exploring how architecture and digital media together can nurture human flourishing.

Within this global context, the findings of the present study make a timely contribution to an emerging discourse that links architecture, psychology, and digital design. The research demonstrated that VR can replicate the perceptual, emotional, and symbolic characteristics of healing environments and provide meaningful experiences of calmness and focus. Participants in this study—Thai university students negotiating academic stress, post-pandemic uncertainty, and cultural transition—responded authentically to virtual environments that embodied harmony, order, and familiarity. Their reflections reveal that even in virtual form, spatial design can communicate values of serenity, humility, and connection. This expands the definition of architecture itself: design is not limited to the manipulation of material form but extends to the orchestration of perception, emotion, and cultural meaning across physical and digital realms.

The chapter therefore situates the empirical findings within a broader conceptual conversation about the future of healing environments. It explores how principles of spatial design derived from traditional architecture—such as proportion, symmetry, light, and biophilia—translate into virtual representation, and what this translation implies for the ethics and authenticity of architectural experience. It also considers VR's dual function as both a medium of experience and a tool of inquiry. As a medium, VR enables immersive encounters that simulate the psychological atmosphere of real places; as a tool, it provides a controlled framework for evaluating sensory and emotional responses to design interventions. Through this dual lens, the study contributes to a new understanding of well-being design as a dynamic, multisensory process that integrates cognition, culture, and technology rather than a static, material discipline.

The discussion that follows therefore moves beyond description to engage with wider theoretical perspectives in environmental psychology, architectural design, and contemplative practice. It interprets how participants' experiences reflect established principles of healing space, biophilic and contemplative design, and mindfulness-based well-being. In doing so, it highlights the research's original contribution: demonstrating that VR can both reproduce and evaluate the perceptual and emotional effects of meditation environments in a controlled yet immersive way. This dual capacity allows VR to bridge traditionally separate disciplines—architecture, psychology, and digital media—offering new methods for the creation, analysis, and dissemination of well-being spaces in higher education and beyond.

Equally central to this discussion is the cultural dimension of the findings. The study revealed that Thai–Buddhist values of harmony, simplicity, and respect deeply informed how participants interpreted each virtual environment. The garden and meditation-room settings resonated with familiar symbols of peace and moral order, while the classroom and white-room settings evoked detachment or unease. This underscores that restorative experience is not universal but culturally mediated: people interpret calmness, emptiness, or balance through the moral and aesthetic codes of their own traditions. By integrating these insights, the discussion positions culture not as background context but as an active variable in the design and perception of healing spaces. The same environment that appears tranquil in one culture may feel sterile or unsettling in another; hence, effective design for well-being must always negotiate between global design theories and local meanings.

This chapter also clarifies how the findings address the original research aims and contribute to both design practice and theoretical development. It identifies the study's three principal contributions. First, it advances methodological innovation by employing VR as a means of evaluating environmental experience—a controlled yet human-centred approach that captures the subtleties of perception and emotion. Second, it contributes to theoretical understanding by extending concepts from restorative environment and environmental preference theory into virtual contexts, showing that digital representations can elicit genuine psychological and cultural responses. Third, it offers practical insights for architectural and educational design by identifying which spatial attributes—natural elements, symbolic balance, and sensory harmony—best support meditation and emotional regulation among students.

In addressing these contributions, the chapter builds upon the interpretive framework developed earlier in the thesis. It revisits the three research questions: how healing spaces influence well-being; how different environments affect meditation outcomes when experienced through VR; and which forms of design best support student well-being within the university context. Each question is re-examined here in light of the integrated evidence from Chapter 4, providing a holistic understanding of the environmental, cultural, and technological dynamics of healing. The discussion acknowledges that while VR cannot replace the tactile and social dimensions of physical space, it can extend access to restorative experiences and serve as a valuable complement to conventional design practice.

The remainder of this chapter is organised into seven interconnected sections.

1. **Section 5.1** introduces the purpose and scope of the discussion and revisits the research questions that guided this study.

2. **Section 5.2** interprets the key findings in relation to theoretical and empirical literature on healing environments, mindfulness, and environmental design.
3. **Section 5.3** outlines the theoretical, methodological, and practical contributions of the research.
4. **Section 5.4** discusses the study's limitations and the interpretive boundaries of its conclusions.
5. **Section 5.5** proposes directions for future research and application.
6. **Section 5.6** presents personal and professional reflections on the research process.
7. **Section 5.7** concludes the chapter by summarising the overall implications and contributions of the study.

Together, these sections construct a critical and integrative account of how VR-mediated meditation environments can inform the design of healing spaces and enhance student well-being. Chapter 5 thus moves from empirical observation to interpretive synthesis, positioning the research within global debates about mindfulness, technological mediation, and the ethical responsibilities of design. By bridging theory and practice, it demonstrates that healing—whether physical or virtual is ultimately an architectural act of empathy: the deliberate shaping of space to support calm, clarity, and connection.

5.1 INTRODUCTION TO THE DISCUSSION CHAPTER

The aim of this chapter is to interpret the empirical findings within the broader conceptual framework of healing environments and to address the research questions that guided this study.

While Chapter 4 described the outcomes of participants' experiences in the four VR meditation environments, this chapter explores the meanings behind those outcomes—linking them to theories of environmental perception, restorative design, mindfulness, and cultural context.

This research was guided by the following questions:

1. How do healing spaces when experienced through Virtual Reality simulations affect student well-being in terms of relaxation, concentration, and emotional balance?
2. What are the effects of different types of meditation environments (a classroom, a public garden, a purpose-designed meditation room, and a neutral white-room control space) on students' meditative experiences, and how do their physical, sensory, and symbolic features contribute to perceptions of a healing space?
3. Which meditation environment is most suitable for supporting student well-being within a university context, and how can evidence from VR-based evaluation inform the design and implementation of future meditation spaces, both physical and virtual?

These questions guided both the empirical investigation and the interpretive discussion that follows. They reflect the central hypothesis that environmental characteristics whether physical, perceptual, or symbolic significantly influence the quality and effectiveness of meditation experiences, and that VR provides a valid method for exploring such effects.

In responding to these questions, this chapter integrates the study's qualitative and quantitative results with established literature. It examines how design features such as light, sound, openness, and cultural symbolism shape meditative focus and emotional well-being; how VR mediates sensory and psychological engagement; and how participants' cultural backgrounds informed their experiences.

The discussion also engages critically with the methodological role of VR, acknowledging both its advantages (control, accessibility, immersion) and limitations (lack of tactile realism, fixed sequence). This reflection allows the study to demonstrate not only its empirical findings but also its contribution to new research methods in environmental and well-being design.

In summary, Section 5.1 establishes the interpretive direction for Chapter 5. The next section (5.2) discusses the key findings in detail, beginning with the relationship between environmental design and well-being as revealed through the participants' experiences.

5.2 DISCUSSION OF KEY FINDINGS

This section interprets the results of the study in relation to existing literature and theoretical frameworks concerning healing environments, environmental psychology, and mindfulness. The discussion moves beyond the descriptive presentation of data in Chapter 4 to explain how and why the environmental features of the four VR meditation settings influenced students' well-being.

It also positions the findings within the broader discourse of design for health and well-being, considering how spatial form, sensory quality, and symbolic meaning shape human experience. Throughout, the analysis links back to the study's research questions, demonstrating how each result contributes to understanding the mechanisms through which immersive environments particularly those mediated by VR can support psychological restoration and mindfulness.

5.2.1 ENVIRONMENTAL DESIGN AND WELL-BEING

This section defines the concept of a healing space as a perceptual–relational construct and critically examines the dual role of Virtual Reality (VR) technology as both an analytical method and an experiential tool in this study.

The findings demonstrate that environmental design directly influences relaxation, concentration, and emotional comfort during meditation, even when the environment is experienced virtually. Both qualitative and quantitative results revealed that participants responded most positively to environments that balanced natural elements, sensory harmony, and spatial simplicity—specifically, the public garden and the designed meditation room.

These outcomes validate existing theories in environmental psychology, such as Ulrich's (1984) Stress Recovery Theory (SRT) and Kaplan and Kaplan's (1989) Attention Restoration Theory (ART), both of which emphasise the restorative benefits of natural exposure, visual coherence, and soft fascination. The consistency between the virtual and theoretical findings supports the interpretation that spatial composition and sensory quality—rather than physical materiality alone—drive the restorative experience of meditation environments.

Spatial Qualities and Psychological Restoration

Participants consistently associated relaxation with environments that offered a sense of openness, lightness, and visual calm. In the VR garden, for example, the combination of natural light, green colour tones, and organic soundscapes evoked feelings of freshness and mental freedom. In the designed meditation room, warm neutral tones, symmetrical layout, and gentle illumination produced comfort and inner stillness.

These observations align with prior studies showing that spatial openness and natural visual cues reduce mental fatigue and anxiety (Berman et al., 2008; Hartig et al., 2003).

Even in virtual form, the sense of being in a space with prospect (visual depth) and refuge (safety and enclosure) contributed to psychological balance, supporting Appleton's (1996) theory of environmental preference.

By contrast, the classroom and white room, which lacked environmental richness, produced lower relaxation and focus scores. Participants described the classroom as cognitively stimulating rather than calming, reflecting how environmental meaning and habitual associations can override physical comfort.

Similarly, the white room, though visually neutral, elicited mixed reactions some experienced clarity, others discomfort indicating that minimalism interacts with individual psychological traits and expectations.

These results affirm that restorative environments rely not only on the presence of nature but on the careful orchestration of light, sound, scale, and form to create perceptual balance. In essence, design mediates emotion; the structure and sensory composition of space shape the mind's capacity for stillness.

Environmental Harmony and Mindfulness

A further insight from the findings is that participants' ability to concentrate and maintain awareness during meditation depended strongly on environmental harmony the degree to which visual, auditory, and spatial elements worked together coherently.

In the garden and meditation room, where such harmony was achieved, participants described being able to "forget the outside world" and "focus on breathing naturally."

This experience corresponds to the concept of mindful engagement (Bishop et al., 2004), where external stimuli neither overwhelm nor distract but instead support awareness of the present moment.

The findings extend this idea into the virtual domain, suggesting that VR environments can facilitate mindfulness when their design elicits calm attention rather than sensory novelty.

Participants' comments revealed that soundscapes, in particular, played a key role. Natural ambient sounds such as wind and birdsong provided gentle rhythm for breathing and mental pacing. This supports Annerstedt et al. (2013), who found that simulated nature sounds in VR can evoke stress recovery responses comparable to those in physical environments.

The designed meditation room's controlled acoustic and lighting qualities similarly supported concentration, demonstrating that harmonious minimalism rather than sensory deprivation can promote inner awareness when designed with sensitivity.

The Relationship Between Environmental Qualities and Emotional States

The statistical correlations between relaxation, emotional comfort, and environmental satisfaction in the quantitative data underscore a direct link between design perception and psychological state.

Higher ratings for environments perceived as comfortable or aesthetically pleasing corresponded with stronger reported relaxation and concentration.

This pattern is consistent with Gifford's (2007) assertion that aesthetic appraisal and affective response are intertwined: environments perceived as visually pleasing are more likely to elicit positive emotions and cognitive restoration.

In the present study, this was evident across both natural and designed settings. Participants described the garden as "peaceful" and "refreshing," while the meditation room was perceived as “balanced” and “sacred.” These emotions translated into higher quantitative ratings, showing that subjective perception of spatial quality directly affects meditative performance.

The results also reinforce the idea that healing spaces function through multisensory and symbolic integration rather than through isolated physical features. The spatial order, visual composition, and ambient tone together created a sense of coherence that participants interpreted as conducive to calmness and well-being.

Design Implications: Translating Environmental Principles into VR

The evidence from this study contributes to a growing body of research showing that VR can successfully reproduce the restorative potential of physical environments when sensory and spatial parameters are carefully designed.

The high scores achieved by the garden and meditation room confirm that biophilic and contemplative design principles such as natural forms, symmetry, and subdued colour palettes remain effective even when transposed into a digital medium.

For architects and designers, this suggests that virtual representations of healing environments can serve not only as design tools but also as direct well-being interventions.

Universities or workplaces lacking access to natural settings could use VR to provide immersive restorative experiences for stress management. The key lies in design authenticity: virtual spaces must feel believable, proportionate, and emotionally resonant, rather than overly stylised or abstract.

Cultural and Contextual Dimensions of Design Perception

The participants’ Thai–Buddhist background further influenced how they perceived environmental balance and harmony. The high preference for natural and culturally resonant environments reflects traditional Thai spatial values, where simplicity, symmetry, and connection to nature are associated with inner peace and moral order (Bhikkhu, 1985).

The results therefore suggest that environmental design for meditation whether physical or virtual should consider cultural interpretations of tranquillity and sacredness.

While the garden and meditation room resonated with Thai participants' familiar aesthetic and spiritual references, a culturally neutral or minimalist space like the white room may be perceived differently in other cultural contexts.

This finding points to the necessity of context-sensitive design in both VR and architectural practice, reinforcing the study's broader contribution to inclusive environmental design frameworks.

Synthesis of Theoretical and Empirical Insights

In summary, Section 5.2.1 demonstrates that environmental design is central to the experience of well-being in meditation. The data from this study align with and extend existing theories of restorative and healing environments by showing that:

- The psychological benefits of spatial harmony can be replicated within virtual contexts.
- The relationship between sensory order and emotional balance holds true across both physical and digital environments.
- Cultural familiarity enhances perceived authenticity and comfort, shaping the restorative quality of space.

Thus, the findings advance the conceptualisation of healing space from a purely physical construct to a perceptual and symbolic phenomenon that can be effectively explored and designed through immersive VR.

5.2.2 ROLE OF VR IN SIMULATING HEALING ENVIRONMENTS

The second major theme emerging from the findings concerns the role of Virtual Reality (VR) in mediating the experience of meditation and healing environments. The results demonstrated that participants not only responded to the aesthetic and sensory qualities of the virtual spaces, but also to the immersion, presence, and psychological engagement afforded by the VR medium itself. This section discusses how VR functioned both as an experimental research tool allowing controlled investigation of environmental effects and as a healing environment in its own right, capable of inducing genuine psychological and emotional responses.

VR as a Research Instrument

The adoption of VR technology in this study provided a distinctive methodological advantage. It enabled the creation of four distinct meditation environments classroom, public garden, designed meditation room, and white room within a consistent and repeatable digital framework. This approach allowed the researcher to control visual, spatial, and auditory parameters precisely, ensuring that the only variable across the sessions was the environmental setting.

This methodological control addressed a central challenge in previous research on healing environments: the difficulty of comparing different physical spaces without the influence of contextual variables such as temperature, light fluctuations, background noise, or location-specific associations. VR overcame these obstacles by providing a standardised yet immersive experimental condition, ensuring that observed differences in well-being and focus could be attributed directly to the qualities of each virtual environment.

Moreover, the use of VR provided a safe and adaptable medium for testing participants' responses to a range of spatial designs that might otherwise be impractical or costly to construct physically. For universities or institutions with limited space or budget, this demonstrates the potential of VR as a cost-effective research and design tool—one that bridges empirical analysis with experiential testing.

Immersion and Presence

A key psychological mechanism explaining VR's effectiveness lies in the sense of presence the feeling of "being there" within a simulated world. Participants frequently described moments of absorption where their attention shifted away from awareness of the physical room or headset and into the virtual environment. This immersive quality enabled authentic emotional and physiological responses similar to those that might occur in real spaces.

In the public garden and designed meditation room, for example, participants reported feelings of openness, peace, and comfort, while in the classroom and white room they expressed unease or detachment. These responses indicate that VR presence is not a passive illusion but an active psychological state in which users internalise spatial qualities as though they were physically real.

The ability of VR to induce presence was particularly evident as participants adapted over repeated sessions. Early comments describing discomfort or dizziness ("the glasses felt heavy," "it was strange at first") gradually shifted to reports of immersion ("I stopped noticing the device and just focused on breathing"). This adaptation suggests that technological familiarity is a prerequisite for emotional depth in VR meditation, as the body and mind learn to accept virtual space as a legitimate sensory reality.

VR as an Experiential Healing Environment

Beyond its methodological utility, the findings demonstrate that VR itself functioned as a healing environment. Participants frequently described the VR sessions as calming, refreshing, and personally meaningful. Even when some environments were less relaxing than others, the overall experience of being immersed in a dedicated meditative space free from real-world distractions offered psychological relief and focus.

These experiences support the view that virtual spaces can evoke genuine restorative responses when designed with attention to harmony, proportion, and sensory coherence. Participants' reports of reduced stress, improved mood, and mental clarity mirror those associated with exposure to restorative physical environments. In this sense, VR becomes more than a technological simulation; it becomes a psychological extension of real space, capable of producing the same beneficial effects through perception and imagination.

For instance, the public garden generated consistent feelings of openness and connection with nature, even though participants were fully aware that the environment was virtual. This suggests that perceptual realism is not the sole determinant of restorative experience. Instead, emotional and symbolic resonance achieved through colour, sound, spatial balance, and cultural cues plays a decisive role in producing relaxation and mindfulness within VR.

Sensory Integration and Emotional Response

The findings revealed that sensory balance within the virtual environments directly affected emotional outcomes. Participants responded positively to scenes where visual calmness, soft soundscapes, and spatial rhythm worked together cohesively. In contrast, the classroom's harsh lighting and static geometry evoked feelings of mental strain, while the white room's absence of detail sometimes caused discomfort or boredom.

These observations reinforce that the effectiveness of VR meditation depends not only on technological quality but also on environmental design integrity. Even in digital space, participants sought the same qualities that define healing environments in the physical world: harmony, proportion, and sensory coherence. The implication is that VR design should not rely merely on realism or high resolution but on the careful orchestration of perceptual balance that supports emotional regulation.

Participants' responses also suggest that sound plays a particularly important role in establishing emotional tone. Natural audio elements flowing water, wind, or birdsong were repeatedly cited as calming, while silence or artificial hums were less effective. This finding indicates that auditory realism can significantly enhance immersion and perceived authenticity, even when visual details are simplified. It highlights the multisensory nature of healing space perception and the need for designers to treat sound as an active component of restorative experience.

Adaptation and Learning through Repetition

The progressive improvement in participants' comfort and concentration over time shows that the benefits of VR meditation increase with repeated exposure. Early disorientation gave way to familiarity, allowing deeper engagement with each environment. This adaptation mirrors the process of meditative training itself, where consistency and familiarity cultivate mindfulness.

The gradual reduction of technological distraction suggests that VR can facilitate meditative skill development. Once the novelty of the medium subsides, participants begin to internalise the spatial calmness of the virtual setting as part of their own mental landscape. In this sense, VR becomes a cognitive scaffold a structured environment that trains the user's attention, reinforcing patterns of relaxation and awareness that can extend into daily life.

This adaptive learning also validates the methodological approach of using a fixed sequence of environments. While the order effect is acknowledged as a limitation, it simultaneously provided evidence that exposure to different virtual settings can progressively shape emotional regulation and mindfulness capacity. As participants transitioned from the functional (classroom) to the natural and contemplative (garden and meditation room), their responses reflected increasing relaxation and focus, culminating in more self-directed awareness in the minimalist white room.

Psychological Authenticity and Technological Mediation

A striking aspect of the findings is that participants often described emotional authenticity within the virtual settings: they reported feeling genuinely calm, reflective, and at times even spiritually uplifted, despite knowing that the environments were simulated. This psychological realism demonstrates that Virtual Reality can evoke authentic affective states through perceptual immersion. The emotional impact did not depend on physical materiality but rather on the quality of symbolic and sensory cues that aligned with participants' expectations of calmness and harmony.

The evidence indicates that VR can produce emotionally credible experiences comparable to those elicited by real-world environments. Participants' responses suggest that when virtual spaces are coherently designed—balancing sensory realism, symbolic meaning, and spatial simplicity—they can foster genuine emotional engagement and meditative depth. In this study, the credibility of experience mattered more than physical realism: participants' willingness to inhabit the virtual environments emotionally depended on their trust in the coherence and harmony of the space.

When this coherence was achieved—as in the garden and designed meditation room—the virtual environment functioned as an authentic extension of reality. In contrast, when coherence was lacking—as in the classroom—participants reported cognitive distance rather than immersion. These findings support the view that psychological authenticity in VR meditation emerges not from perfect visual replication but from the alignment of environmental cues with user expectations and emotional readiness for calmness.

VR as a Bridge Between Design and Well-being

One of the broader implications of these findings is that VR occupies a unique position between architectural design and psychological intervention. It enables researchers and designers to visualise, test, and refine spatial configurations while simultaneously offering users immediate experiential benefits. The technology thus serves a dual function: as a simulation tool for understanding how environments affect the mind, and as an applied intervention that can enhance well-being in its own right.

For higher education institutions, this duality presents a significant opportunity. As participants in this study reported, VR meditation sessions provided relief from stress and mental fatigue, suggesting a potential role for VR installations as part of university mental health and mindfulness programmes.

Such applications could extend beyond meditation to include stress recovery rooms, creative ideation spaces, or guided relaxation programmes all built upon the same design principles identified in this study: balance, naturalness, harmony, and proportion.

The findings therefore support a paradigm shift in how virtual environments are understood in design research from representational models to experiential laboratories capable of shaping perception and emotion. In this sense, VR becomes a living design medium, one that can both simulate and generate healing experience.

Summary of Section 5.2.2

The findings confirm that VR can successfully simulate the perceptual and emotional qualities of healing environments, offering both methodological precision and psychological authenticity.

Participants' responses demonstrated that:

- The sense of presence and immersion within VR supports genuine emotional engagement.
- Carefully designed sensory integration particularly in light, sound, and spatial rhythm determines the restorative quality of virtual environments.
- Repeated exposure enhances mindfulness and reduces technological distraction.
- VR provides a controlled yet emotionally meaningful platform for studying and experiencing healing space design.

In sum, the role of VR extends beyond technical simulation. It operates as both a research methodology for analysing environmental impact and a medium of experience that enables users to access meditative and restorative states. This dual function validates VR as a bridge between architectural design and psychological well-being expanding the boundaries of what healing environments can be.

5.2.3 CULTURAL CONTEXT AND INTERPRETIVE MEANING

The influence of cultural and spiritual context emerged as a defining factor in how participants perceived and evaluated the VR meditation environments.

Although the study's primary focus was to examine environmental and psychological responses, it became evident that cultural familiarity and spiritual symbolism played an integral role in shaping participants' emotional engagement and sense of comfort.

For Thai university students many of whom are culturally influenced by Buddhist philosophy and Thai aesthetic traditions the connection between environmental harmony, simplicity, and moral calmness forms part of a deeply embedded worldview.

This section discusses how these cultural values informed participants' experiences of the four VR meditation environments and how such interpretation expands understanding of healing spaces beyond universal principles toward context-sensitive design and meaning.

Cultural Familiarity and Emotional Comfort

Participants' high preference for the public garden and designed meditation room cannot be separated from the broader Thai cultural association between nature, simplicity, and spiritual renewal. In Thai spatial traditions, the concept of calmness (santi) is not only a mental state but also a spatial quality produced by visual order, balanced proportion, and integration with nature. These values are evident in Buddhist temples, traditional houses, and gardens where openness and connection to the outdoors encourage reflection and moral awareness.

The participants' responses reflected this cultural lineage. Many described the public garden as "peaceful" and "refreshing," while the designed meditation room evoked feelings of sacredness and moral clarity. Such reactions align with the cultural principle articulated by Buddhadasa Bhikkhu (1985), who emphasised that simplicity, symmetry, and connection to nature embody spiritual balance and inner peace.

Thus, the environments that most closely mirrored these cultural aesthetics elicited the greatest relaxation and satisfaction, demonstrating that restorative experience is culturally mediated as much as it is perceptually induced.

Conversely, the classroom environment associated with academic work and competition conflicted with cultural notions of calmness. Its angular geometry and functional symbolism evoked obligation rather than tranquillity. Participants noted that it felt "unsuitable for meditation," a reaction that reveals how social and cultural associations override neutral spatial form, shaping emotional responses even in simulated conditions.

Symbolic Meaning and Perceived Authenticity

The designed meditation room, which incorporated a central Buddha statue and symmetrical layout, received particularly high ratings for focus and comfort.

For many participants, this symbolic element enhanced the sense of authenticity and spiritual presence, even in a virtual format.

The Buddha image functioned not merely as decoration but as a cultural anchor—a visual reminder of mindfulness, compassion, and stillness. Its presence transformed the virtual environment into a space of reverence, aligning with participants' moral and spiritual expectations of meditation.

This response demonstrates that symbolic content strengthens perceptual realism when it resonates with users' cultural schema. The emotional effect did not depend on the object's physical authenticity but on its meaning within participants' cultural and spiritual worldview.

Therefore, the inclusion of culturally significant symbols can amplify the psychological effectiveness of VR meditation environments by fostering emotional connection and trust in the experience.

However, not all participants reacted identically. A small number expressed that the Buddha image made the environment "too formal" or "too religious," suggesting that individual interpretations vary even within a shared culture.

This diversity underscores the need for flexibility and inclusivity in design, ensuring that virtual meditation spaces can accommodate personal belief systems while maintaining the atmosphere of calm and respect.

Cultural Interpretations of Minimalism and Abstraction

The white room, which served as a neutral control environment, revealed another layer of cultural interpretation. Some participants experienced the minimal setting as "pure," "bright," and "empty in a good way," linking it to the Buddhist concept of sunnata (voidness or emptiness) as a state of inner clarity.

Others, however, described it as "cold" or "emotionally distant," suggesting that while minimalism may resonate with certain spiritual interpretations, it can also create discomfort when devoid of familiar sensory or symbolic cues.

This duality reflects a broader cultural paradox in Thai aesthetics: while emptiness is valued as a symbol of simplicity and detachment, physical environments are often expected to maintain some degree of warmth and human touch through natural materials, soft light, or symbolic detail.

The white room's mixed reception therefore reveals that the perception of calmness depends not only on minimal form but on cultural expectations of balance and humanity within that form.

Cultural Mediation of VR Experience

These findings demonstrate that participants' emotional and cognitive engagement with the VR environments was culturally mediated, meaning that the same virtual space could produce different psychological effects depending on individual and collective meaning systems.

For Thai participants, environments echoing familiar cultural references such as the garden's natural harmony or the meditation room's sacred order were perceived as more authentic and restorative.

This indicates that VR experiences are not culturally neutral; rather, they are interpreted through the lens of users' spatial memories, beliefs, and value systems.

Importantly, this cultural mediation did not diminish the realism of VR but enhanced it. When virtual elements aligned with participants' internalised understanding of tranquillity, their sense of presence and emotional involvement increased.

The opposite occurred when design elements conflicted with those expectations, as in the classroom or overly abstract white room.

This finding expands the notion of "presence" in VR beyond technical immersion to include cultural presence a form of psychological authenticity achieved when the virtual space resonates with users' cultural and moral imagination.

Design Implications: Toward Context-Sensitive Healing Environments

The cultural insights from this study emphasise that effective healing environments physical or virtual must balance universal design principles (proportion, light, natural elements) with context-specific meanings that reflect users' cultural and spiritual backgrounds.

For Thai users, the sense of peace derives not only from sensory balance but from symbolic and moral harmony: spaces that feel aligned with Buddhist ideals of simplicity, moderation, and compassion.

This has direct implications for the design of VR meditation platforms and physical well-being spaces in university settings.

Rather than creating culturally generic environments, designers should consider localized symbolic languages that foster comfort and identification.

At the same time, providing users with options for personalisation—such as the ability to enable or disable cultural symbols, adjust lighting tones, or choose soundscapes can ensure inclusivity and respect for diverse users.

Ultimately, the findings suggest that healing environments are both universal and particular: while all humans respond positively to naturalness and balance, the interpretation of those qualities is deeply coloured by culture.

VR offers a unique opportunity to explore and design across these layers of meaning because it can simulate not only physical form but also the symbolic and emotional atmospheres that define spiritual comfort.

Summary of Section 5.2.3

Cultural and interpretive meaning was found to be a central mediator of participants' experiences in VR meditation.

The study showed that:

- Thai–Buddhist values of simplicity, harmony, and connection to nature shaped preferences for the garden and meditation room.

- Symbolic familiarity, such as the presence of a Buddha statue, enhanced emotional engagement and perceived authenticity.
- Reactions to minimalism in the white room highlighted the dual nature of abstraction as both tranquil and isolating.
- VR experiences were interpreted through cultural memory and spiritual association, not merely through sensory realism.

These results confirm that cultural context is inseparable from the perception of healing space and that context-sensitive design grounded in local meaning yet open to individual variation is essential for creating effective and inclusive VR meditation environments.

5.2.4 ADAPTATION AND MINDFULNESS DEVELOPMENT OVER TIME

An important dynamic revealed through both the qualitative and quantitative data was the gradual adaptation of participants physically to the VR technology and psychologically to the meditative process. Over the course of the sessions, participants reported an evolving ability to manage distractions, regulate breathing, and sustain awareness. This section interprets that progression as evidence that mindfulness development in VR is a cumulative and learnable process shaped by repetition, environmental familiarity, and emotional readiness.

Initial Phase: Technological Adjustment and Cognitive Distraction

During the first sessions in the classroom environment, many participants described feelings of novelty, uncertainty, or mild discomfort. Some reported physical sensations such as dizziness or awareness of the headset weight, while others mentioned curiosity about the technology itself. These reactions are typical of first-time VR users and illustrate an early phase of technological adaptation, in which attention is divided between the body, device, and simulated environment.

At this stage, meditation was often described as “hard to concentrate” or “distracted by the device.” Quantitative data from the first environment supported this observation: relaxation and focus scores were lowest in the classroom, reflecting that early sessions were dominated by cognitive adjustment rather than meditative absorption.

However, even in this initial stage, participants recognised that the virtual setting provided a degree of separation from the outside world. The enclosed headset and sound isolation created a sense of privacy that, despite initial unfamiliarity, laid the foundation for later immersion. This suggests that VR, even in early exposure, can create a transitional boundary that helps participants move gradually toward focused awareness once physical discomfort subsides.

Middle Phase: Immersion and Emotional Regulation

As participants progressed to the public garden and designed meditation room, both qualitative comments and quantitative scores indicated a marked increase in comfort, focus, and satisfaction. Participants frequently noted that “it became easier to relax” and that they could “follow the breathing without thinking about the device.”

This phase reflects a shift from external to internal attention a hallmark of meditative adaptation. The calming visual and auditory features of these two environments acted as stabilising cues, helping participants regulate their breathing and heart rate while fostering emotional equilibrium. Many described an emerging sense of “familiarity” and “safety” that encouraged deeper engagement with the meditation task.

This adaptive progression demonstrates that VR meditation operates as a form of experiential learning: through repeated exposure, participants internalised the structure of the virtual space as part of their mental framework for focus. The gradual decline in distraction and increase in comfort across environments indicate that mindfulness within VR is not an immediate state but a cultivated one, achieved through continued interaction between user and environment.

Later Phase: Deepened Awareness and Self-Regulation

By the time participants reached the final environment the white room many demonstrated an increased ability to maintain attention and inner stillness, even though the space offered minimal external stimulation. The environment itself divided opinions, yet the majority of participants who had become comfortable with VR described it as an opportunity for "deeper focus" or "quiet introspection."

This outcome suggests that as participants' familiarity with VR and meditation matured, they required fewer external cues to sustain mindfulness. The reduction of sensory complexity in the white room mirrored the internal simplification characteristic of advanced meditative states, where awareness becomes self-sustaining rather than dependent on environmental triggers. For others, however, the lack of stimulation was challenging confirming that adaptation in VR meditation is influenced by both individual readiness and environmental support.

Overall, the progression from the classroom to the white room can be interpreted as a trajectory of mindful development: beginning with distraction and physical awareness, moving through sensory harmony and emotional regulation, and culminating in cognitive stillness and self-reflection. This trajectory reflects the same progression found in traditional meditation training, from external focus to internal observation.

Role of Repetition and Familiarity

The longitudinal nature of the study provided valuable insight into the role of repetition in strengthening mindfulness. Participants who had multiple exposures to similar environments reported an increased capacity to enter a meditative state more quickly. The familiarity of the VR processes the headset, controller, and guided breathing reduced anticipatory anxiety and allowed attention to shift toward internal awareness.

This finding underscores that VR meditation benefits from continuity. Repeated sessions do not simply measure response; they actively shape it. Over time, the virtual environment becomes a mental reference point for calmness, similar to how physical meditation halls or natural settings become associated with peace through repeated practice. This associative memory supports the argument that VR can create enduring cognitive patterns linked to relaxation and emotional stability.

Adaptation as a Cognitive and Emotional Process

Adaptation in VR meditation involves more than sensory adjustment it reflects the integration of technology, perception, and cognition. Participants learned not only to operate the headset but to reinterpret virtual cues as trustworthy representations of space. This cognitive assimilation allowed them to experience the virtual garden or meditation room as genuine places for reflection.

Emotionally, adaptation manifested as a reduction of anxiety and self-consciousness. Participants expressed that they became “less worried about doing it right” and “more at ease with silence.” Such statements illustrate the development of self-regulation, a key outcome of mindfulness practice. Through repeated meditative engagement in VR, participants cultivated emotional resilience learning to observe sensations and distractions without immediate reaction.

Interpreting Adaptation within the Concept of Healing Space

The adaptive process observed here reinforces the conceptual framework of healing space as an interactive relationship between environment and human consciousness. The environments provided external cues for calmness, but participants' responses evolved internally over time. Healing, in this context, emerged not solely from spatial form but from the dialogue between stability in the environment and transformation within the self.

This insight extends the understanding of healing spaces beyond static design features: they are temporal experiences that unfold through continued engagement. VR provided the temporal consistency necessary for participants to form new mental associations, mirroring the traditional use of dedicated meditation spaces that acquire meaning through repeated practice.

In this way, VR acted as a digital continuity of place a stable container where participants could revisit the same meditative atmosphere, reinforcing psychological safety and familiarity. The constancy of the virtual environments made it possible to observe mindfulness as a developmental phenomenon rather than a single reaction.

Summary of Section 5.2.4

This section demonstrates that adaptation and mindfulness development in VR meditation follow a progressive and experiential pattern. Across the four environments, participants evolved from initial distraction to sustained concentration and emotional self-regulation. The process was shaped by:

- **Technological adaptation**, as users became comfortable with the headset and interface;
- **Environmental familiarity**, fostering emotional security and attention stability;
- **Repetition**, which strengthened associative memory and accelerated entry into meditative states; and

- **Cognitive and emotional integration**, leading to self-awareness and resilience.

The findings confirm that VR can support not only the simulation of healing environments but also the cultivation of mindfulness as an embodied skill. Adaptation was not merely an adjustment to technology, it was an unfolding process of mental alignment, demonstrating how digital environments can facilitate genuine personal growth when designed with care and consistency.

5.2.5 RELATIONSHIP BETWEEN PHYSICAL AND VIRTUAL HEALING SPACES

The results of this study demonstrate that Virtual Reality (VR) can evoke many of the psychological and emotional benefits traditionally associated with physical healing environments. Participants' consistent reports of relaxation, mental clarity, and comfort—particularly in the garden and designed meditation room—indicate that virtual spaces can reproduce the perceptual qualities that promote well-being in the physical world. However, the comparison between physical and virtual healing spaces also reveals distinct differences in how these experiences are generated and perceived. This section explores those similarities and distinctions, positioning VR as a complementary extension rather than a replacement for real-world spatial experience.

Comparing Spatial and Sensory Qualities

Both physical and virtual healing environments operate through environmental harmony the orchestration of light, colour, sound, and spatial proportion that promotes psychological calmness. In physical settings, these effects arise from the body's direct engagement with materials, temperature, and natural phenomena. In VR, the same qualities are mediated through visual and auditory simulation.

The participants' responses show that when these sensory elements were coherently integrated, such as in the virtual garden and meditation room, they could produce an authentic sense of presence and emotional restoration. Many participants stated that the experience "felt real" or "similar to being in a calm place outdoors." This suggests that perceptual coherence rather than physical substance is the key factor underlying restorative experience.

Nevertheless, the findings also highlight differences. The lack of tactile and olfactory cues in VR limited some participants' sense of connection, particularly in the more abstract settings. While visual and auditory design can effectively replicate natural cues, embodied sensations such as airflow, scent, or surface texture remain absent. This underscores that while VR can simulate the appearance and sound of healing spaces, it cannot yet fully reproduce their material depth.

In this sense, the VR environments functioned as psychological representations rather than physical equivalents of healing space. They offered a powerful medium for emotional engagement but operated primarily through perception and imagination rather than sensory totality.

Psychological and Symbolic Equivalence

Despite these sensory differences, the study revealed that participants could form strong emotional and symbolic connections with the virtual spaces. This finding reinforces the idea that the essence of a healing space is perceptual and symbolic, not merely physical. The garden and meditation room resonated with participants because they embodied values of balance, order, and tranquillity familiar in Thai culture.

When participants described these virtual settings as "peaceful" or "like being in a temple garden," they were not responding to physical realism but to the psychological realism of the experience. The emotional effect arose from recognition and association familiar patterns of light, sound, and spatial form that matched internalised concepts of calmness. Thus, the success of VR in producing restorative outcomes supports the notion that healing environments operate on symbolic cognition, where perceived meaning and emotional resonance are as important as physical authenticity.

These findings suggest that VR can act as an introspective mirror of real environments. It translates the sensory and symbolic components of healing spaces into a digital form that engages memory, imagination, and emotion. This reflective quality positions VR as a bridge between material design and psychological experience, capable of conveying the essence of place through simulation.

Accessibility and Practical Advantages

One of the most significant advantages of VR is its accessibility and flexibility. For universities or institutions with limited space or budget, creating physical meditation gardens or dedicated healing rooms can be expensive and logistically challenging. In contrast, VR offers a scalable and portable alternative: multiple users can access immersive meditative environments using only headsets and headphones.

Participants in this study reported that VR meditation allowed them to "escape from stress quickly" and "focus even in a small dorm room." These comments highlight VR's capacity to democratise access to restorative experiences, enabling users to engage in meditation irrespective of physical location or environmental conditions.

This accessibility has important implications for student well-being. In dense urban campuses or institutions without natural surroundings, VR could provide a supplementary means of psychological restoration, complementing physical spaces such as libraries, classrooms, and common areas. Rather than replacing physical architecture, VR expands the spatial possibilities of care, allowing students to move between physical and virtual realms of calm according to their needs.

VR as an Extension of Physical Space

The study's findings indicate that VR environments should not be viewed as isolated simulations but as extensions of physical spatial experience. Participants entered VR sessions from real physical contexts—classrooms, offices, or laboratories and the emotional impact of the virtual environments depended partly on this transition. The act of "entering VR" became a ritualised threshold that separated ordinary activity from meditative reflection.

This liminal quality parallels the design of physical healing spaces, which often use transitional elements such as gateways, corridors, or sound changes to mark the shift from everyday life to contemplation. VR inherently performs this threshold function: by immersing the user in a new sensory world, it enacts a moment of detachment that prepares the mind for mindfulness. Thus, VR can be understood as a digital continuation of architectural intention, using technological immersion to recreate the transformative experience of moving into a healing environment.

Complementarity Rather Than Replacement

A central question addressed in this study is whether VR could replace the need for physical meditation spaces. The evidence supports a more nuanced view: VR complements but does not substitute physical environments. While VR successfully replicates many perceptual and emotional qualities of healing spaces, it lacks the multisensory and social dimensions that physical spaces provide.

Physical environments engage the body through touch, temperature, and spatial navigation, offering a holistic sensory encounter. They also serve as communal places where shared rituals, chance encounters, and natural variation contribute to social well-being. VR, in contrast, provides personalised solitude and an individualised inward experience. Its strength lies in offering controlled, private, and immediate access to restoration, rather than replacing collective or embodied aspects of space.

Therefore, the relationship between the two is complementary:

- Physical healing spaces anchor well-being in material and social context.
- VR environments extend those benefits into situations where physical access is limited.

Together, they create a hybrid model of healing design, integrating architecture, technology, and mindfulness.

Educational and Design Implications

The integration of VR into student well-being programmes presents opportunities for both research and practice. VR can be used as a testing ground for spatial design, allowing architects and educators to evaluate how different layouts, lighting schemes, or materials influence user emotion before physical construction. It also serves as a pedagogical tool for teaching environmental design, enabling students to experience spatial qualities from within immersive simulations.

From a well-being perspective, universities could deploy VR meditation systems as part of counselling services or stress recovery zones. The findings from this study show that such applications can effectively reduce perceived stress, enhance focus, and encourage self-care. When combined with physical relaxation spaces such as gardens, lounges, or prayer rooms—VR becomes part of a multilayered environment of care, addressing both emotional and cognitive needs.

Reframing Healing Space in the Digital Era

The ability of VR to produce authentic meditative experiences invites a reconsideration of what constitutes a "healing space." Traditionally, healing environments are defined by their material and sensory characteristics, natural light, sound, texture, and spatial proportion. This study suggests that healing can also occur within perceptual and symbolic dimensions, even when physical materiality is absent.

VR expands the meaning of healing space from a physical location to a psychological condition—a state of presence and calm facilitated by design. The boundaries between tangible and digital environments become fluid, allowing the user's mind to construct a sense of place that is both real and imagined. This conceptual shift does not diminish the value of architecture but rather broadens its reach, positioning design as a mediator of emotional experience across multiple realities.

Summary of Section 5.2.5

The relationship between physical and virtual healing spaces revealed by this study can be summarised as follows:

- Both rely on harmony, balance, and sensory integration to promote restoration.
- VR effectively replicates perceptual and emotional qualities of physical spaces through immersive simulation.
- Physical spaces remain vital for embodied, multisensory, and social engagement, which VR cannot fully replicate.

- VR serves as a complementary extension of physical design—expanding accessibility, testing design hypotheses, and supporting well-being when physical space is limited.
- Together, physical and virtual environments form a hybrid model of healing, integrating technology and design to support diverse needs.

These findings reinforce the study's central argument: that healing environments are not defined solely by their material form but by their capacity to evoke balance, mindfulness, and emotional renewal, whether through physical presence or virtual immersion.

5.2.6 SYNTHESIS OF KEY THEMES

The findings from this study reveal a coherent and interdependent relationship between environmental design, cultural meaning, virtual mediation, and mindfulness development. Although each sub-section of this chapter examined a distinct dimension of that relationship, together they outline a unified model of how spatial and psychological factors interact to create restorative and meditative experiences.

This synthesis summarises these converging insights, clarifying how VR-mediated environments function as both representations and generators of healing space, and how their effectiveness depends on the alignment between sensory, symbolic, and experiential dimensions.

Interdependence of Spatial and Psychological Harmony

Across all environments, participants' responses confirmed that spatial harmony directly influenced psychological calmness. Environments characterised by balanced proportion, soft lighting, and coherent soundscapes supported relaxation, while those lacking these qualities such as the classroom induced distraction or unease.

This finding reinforces a central principle of healing-space theory: that well-being arises from an equilibrium between sensory order and perceptual comfort. In both physical and virtual contexts, when environmental elements form a coherent whole, the mind interprets the space as safe, balanced, and supportive of inner stillness.

The public garden and designed meditation room exemplified this harmony, combining natural cues with structured design, while the white room and classroom demonstrated the psychological effects of imbalance or sensory deprivation. The progression through these environments thus traced the spectrum from cognitive stimulation to contemplative equilibrium, confirming that environmental quality is inseparable from mental state.

The Mediating Role of VR

The study also established that VR acts as both a medium and a method in the creation of healing experiences. As a medium, VR reproduced the perceptual characteristics of restorative environments—colour, light, form, and sound well enough to generate authentic emotional responses. As a method, it provided a controlled and replicable framework for examining those responses systematically.

Participants' ability to experience presence, focus, and emotional release within the virtual settings demonstrates that VR can mediate genuine psychological transformation. The emotional authenticity of these experiences suggests that the restorative power of space is not confined to physical materiality; it can be transmitted through immersive representation when sensory and symbolic cues align.

At the same time, the findings acknowledged VR's limits: the absence of tactile, olfactory, and temperature feedback means that it cannot fully substitute the embodied richness of physical environments. Yet, its ability to elicit calmness and mindfulness indicates that the essence of healing lies not in material form but in perceptual coherence and emotional resonance.

Thus, VR becomes a bridge between architecture and psychology, a space where environmental design can be tested, refined, and experienced within a digitally mediated reality.

Cultural Resonance as a Dimension of Healing

Cultural meaning proved to be a decisive layer in participants' interpretation of each environment. The Thai–Buddhist understanding of calmness, simplicity, and harmony shaped the emotional tone of the experiences, revealing that restoration is not culturally neutral but culturally contextualised.

The high preference for the garden and meditation room reflected alignment with familiar spatial archetypes open yet ordered, natural yet intentional mirroring traditional Thai ideas of serenity and moral order. The presence of the Buddha statue in the meditation room added symbolic depth, transforming a simulated space into a spiritually grounded one.

Conversely, the white room demonstrated that while minimalism can evoke purity, it may also provoke unease if detached from cultural meaning. This variation confirms that healing environments operate through shared systems of interpretation, where sensory design interacts with moral and spiritual expectation.

Therefore, cultural resonance does not limit the universality of healing spaces; it enriches it. Recognising these layers of meaning allows designers and researchers to create context-sensitive environments both physical and virtual—that speak to the emotional languages of their users.

Adaptation and Learning as Components of Mindfulness

The longitudinal aspect of the study revealed that adaptation both to the VR medium and to meditation itself was a process of gradual self-regulation and cognitive alignment. Participants initially experienced distraction and curiosity, but through repetition and familiarity, they cultivated steadier attention and emotional balance.

This process mirrors the developmental nature of mindfulness, where progress arises from sustained engagement rather than immediate transformation. The progression from the stimulating classroom to the tranquil white room symbolised an inward journey: external calmness facilitated internal stillness, and over time, participants required fewer environmental cues to maintain focus.

This demonstrates that healing spaces are not only physical contexts but temporal frameworks that support psychological development. The restorative quality of VR meditation grew stronger as participants' bodies and minds learned to trust the medium and internalise its atmosphere of calm. Thus, adaptation itself became a form of healing, a process of alignment between environment, perception, and self-awareness.

Complementarity of Physical and Virtual Space

The relationship between physical and virtual healing spaces can best be understood as mutually reinforcing rather than competitive. VR successfully reproduced the perceptual and emotional essence of restorative environments, while physical spaces remain indispensable for multisensory and social engagement.

Together, they define a continuum of experience where the physical provides embodied grounding and the virtual offers accessibility and psychological extension. The capacity to move between these two realms allows meditation and well-being practice to become more inclusive, adaptable, and contextually relevant.

The hybrid integration of physical and virtual healing environments thus represents a future-oriented model for design and well-being in higher education one that acknowledges both technological innovation and the enduring need for material connection.

An Integrated Model of Healing Experience

Synthesising these insights suggests that healing in VR meditation arises from four interacting dimensions:

1. **Environmental Harmony** – spatial, visual, and auditory coherence supporting psychological calm.
2. **Cultural Resonance** – alignment between environmental symbolism and users' moral or spiritual values.
3. **Technological Mediation** – immersive presence enabling authentic emotional engagement within simulated space.
4. **Adaptive Mindfulness** – progressive internalisation of calm through familiarity, repetition, and self-regulation.

These dimensions intersect to form what may be described as a multi-layered model of healing space, where perception, culture, and consciousness are dynamically interwoven. The balance among these layers determines whether an environment—physical or virtual—can truly be experienced as restorative.

Synthesis Summary

- Healing experiences depend on perceptual coherence—a unity of sensory order and emotional tone.
- VR enables controlled, immersive engagement with these qualities, demonstrating that healing can be mediated digitally.
- Cultural and symbolic meaning amplify authenticity and deepen emotional response.
- Adaptation transforms VR from a technological novelty into a mindful environment for self-regulation.
- Physical and virtual spaces complement one another, together forming a hybrid framework for design and well-being.

Collectively, these themes advance the understanding of healing space as a psychosocial phenomenon, a convergence of environmental design, cultural identity, and cognitive process. The next section, 5.3 Contribution to Knowledge, translates these insights into explicit theoretical, methodological, and practical contributions, outlining how the study expands existing scholarship and informs future design applications.

5.3 CONTRIBUTION TO KNOWLEDGE

The findings of this research make significant contributions to knowledge across three intersecting domains: theory, methodology, and design practice.

Through the use of Virtual Reality (VR) as both an experimental and experiential medium, the study provides new insights into how environmental qualities, cultural meaning, and technological mediation collectively shape human well-being and mindfulness.

This section outlines those contributions in detail, demonstrating how the study extends existing theoretical frameworks, advances methodological practice in environmental design research, and generates practical applications relevant to universities, designers, and well-being initiatives.

5.3.1 THEORETICAL CONTRIBUTION

(a) Expanding the Concept of Healing Space

This study redefines the concept of healing space beyond its traditional association with physical architecture, proposing it instead as a multi-dimensional phenomenon that encompasses physical, perceptual, symbolic, and virtual dimensions.

While previous literature has focused primarily on material attributes such as light, form, and nature, the present research shows that healing can also be mediated through perception and immersion within a virtual context.

The results demonstrate that participants experienced genuine calmness and mindfulness in VR environments designed with spatial harmony and sensory balance. This finding extends existing theoretical models of restorative environments such as Ulrich's Stress Recovery Theory and Kaplan and Kaplan's Attention Restoration Theory—by showing that the restorative process can occur through simulated, non-material means when the design elicits coherence, safety, and familiarity.

The study therefore introduces a theoretical perspective that situates healing space not only as a physical construct but as a psychological condition shaped by environmental cues, emotional resonance, and user interpretation. Healing is thus understood as both place-based and perceptually constructed a state of equilibrium achievable through material or virtual form.

(b) Integrating Cultural Meaning into Environmental Psychology

Another major theoretical contribution lies in the integration of cultural and spiritual interpretation into models of environmental well-being. While previous research on restorative spaces has often emphasised universal aesthetic and biophilic principles, this study demonstrates that cultural resonance profoundly shapes the perception of tranquillity and authenticity.

For Thai participants, environments that embodied Buddhist-inspired qualities—simplicity, symmetry, and connection to nature—elicited stronger emotional and meditative responses. The study therefore contributes a context-sensitive understanding of healing space, revealing how cultural frameworks act as mediators between sensory design and psychological effect.

This extends existing environmental psychology theories by emphasising that environmental preferences and restorative responses are not culturally neutral, but grounded in shared symbolic systems. The concept of healing space is therefore broadened to include moral, aesthetic, and spiritual dimensions specific to cultural context.

(c) Conceptualising VR as a Psychological Medium

The study also contributes theoretically by reframing VR as a psychological and emotional medium rather than a purely technological one. While much of the literature on VR focuses on its novelty, hardware, or visual realism, this research demonstrates that the effectiveness of VR depends on perceptual coherence and emotional engagement, not merely on graphic fidelity. Participants' sense of presence, focus, and calmness arose when the virtual environments reflected authentic environmental design principles and cultural familiarity.

This finding introduces the concept of psychological authenticity in VR, the capacity of virtual environments to evoke genuine affective states through perceptual and symbolic cues. This perspective positions VR as an extension of human spatial perception, capable of translating design qualities into experiential and emotional impact.

5.3.2 METHODOLOGICAL CONTRIBUTION

(a) Establishing VR as a Valid Research Tool in Environmental Design

Methodologically, the study demonstrates that VR can function as a rigorous and replicable research instrument for investigating human responses to spatial design.

By simulating multiple environments, each differing only in environmental characteristics, the study achieved an experimental level of control rarely possible in field studies. The mixed-methods approach combined qualitative interviews, meditation diaries, and quantitative questionnaires, ensuring both empirical validity and experiential richness.

This integration offers a model for future research, showing that VR can bridge scientific precision and phenomenological depth in design evaluation. It validates VR as an effective medium for studying psychological outcomes of space, enabling researchers to manipulate environmental variables while maintaining ecological credibility.

(b) Mixed-Methods Application in VR Contexts

The study's methodological innovation also lies in its triangulated approach. Qualitative data illuminated subjective experiences of relaxation, focus, and adaptation, while quantitative results statistically confirmed differences in those experiences across environments.

The combination of both datasets provided a holistic understanding of environmental effects, establishing a robust framework for mixed-methods research in virtual contexts. This approach is particularly valuable for architectural and design research, where human experience is often difficult to quantify.

By adapting established environmental psychology metrics to the VR format, this study created a replicable process for measuring emotional and cognitive responses to spatial design providing a methodological precedent for future cross-disciplinary research.

(c) Addressing Adaptation and Temporal Dynamics

Another methodological contribution concerns the recognition of adaptation and time as key variables in VR research. Rather than treating each environment as an isolated experience, the study observed how participants' responses evolved over multiple sessions. This revealed that mindfulness and comfort in VR develop through repetition, familiarity, and self-regulation.

By including time as a dynamic factor, the research moves beyond static measurement to demonstrate how VR meditation fosters learning and transformation. This methodological insight opens pathways for longitudinal research exploring how sustained exposure to virtual environments influences well-being and emotional resilience.

5.3.3 PRACTICAL AND DESIGN CONTRIBUTION

(a) Design Guidelines for Healing Environments

Practically, the study generates evidence-based design principles for both physical and virtual meditation environments.

The results identified specific environmental characteristics that consistently supported relaxation and mindfulness:

- **Natural elements and biophilic cues** – greenery, light variation, and natural soundscapes that induce calmness.
- **Balanced spatial proportion** – symmetry, openness, and moderate enclosure fostering a sense of safety and focus.
- **Controlled sensory harmony** – soft light, warm tones, and gentle acoustic textures avoiding overstimulation.
- **Cultural resonance** – inclusion of symbolic or aesthetic elements that reflect users' moral and spiritual context.
- **Customisation potential** – allowing users to adjust sound, light, and visual themes to suit personal comfort.

These principles can guide architects, designers, and developers in creating restorative environments that engage the senses, mind, and culture simultaneously. They also inform the development of VR-based well-being applications, ensuring that digital spaces achieve emotional depth and cultural inclusivity.

(b) Implications for Universities and Educational Institutions

For university settings, this study provides a clear rationale for integrating VR meditation systems into student well-being programmes. Participants' feedback confirmed that even short sessions improved concentration, reduced anxiety, and provided accessible relief from academic pressure.

Compared with constructing new physical facilities, VR meditation is cost-effective, portable, and scalable. Institutions can therefore use VR as a supplementary well-being strategy, providing digital access to restorative experiences within existing spaces such as libraries or counselling centres.

Moreover, the study offers pedagogical value for design education. By demonstrating how VR can simulate architectural atmospheres, it provides a platform for students to experience design research through immersion, linking spatial theory to human emotion.

(c) Framework for Future Hybrid Design

Finally, the research proposes a hybrid model of healing space that integrates physical and virtual design principles. The evidence shows that the psychological mechanisms underlying well-being—balance, order, familiarity, and sensory coherence—function similarly across both domains. This hybrid model envisions environments where physical spaces are enhanced through digital layers, and virtual spaces are informed by architectural integrity and cultural meaning.

Such integration reflects a future direction in environmental design where technology becomes a partner in healing rather than a distraction from it. The model emphasises that architecture in the digital era must engage equally with material experience and virtual perception, designing for the mind as well as the body.

5.3.4 SUMMARY OF CONTRIBUTIONS

To summarise, the study makes the following key contributions:

1. **Theoretical Contributions**
    - Reinterprets healing space as a multi-dimensional phenomenon encompassing physical, perceptual, symbolic, and virtual dimensions.

- Integrates cultural and spiritual context into environmental psychology, demonstrating that well-being is culturally interpreted.
- Introduces the concept of psychological authenticity in VR, showing that immersive design can evoke genuine emotional states.

2. **Methodological Contributions**
    - Validates VR as a rigorous and replicable research tool for environmental design studies.
    - Demonstrates a successful mixed-methods framework for analysing emotional and perceptual responses in virtual settings.
    - Highlights adaptation and temporal progression as critical methodological variables in VR well-being research.
3. **Practical and Design Contributions**
    - Establishes evidence-based design guidelines for creating restorative meditation environments both physical and virtual.
    - Provides actionable recommendations for universities seeking accessible, low-cost strategies for student well-being.
    - Proposes a hybrid model that bridges architectural design and VR technology, expanding the definition and reach of healing spaces.

Collectively, these contributions advance understanding of how environmental design, cultural interpretation, and virtual immersion converge to influence human well-being.

They position VR not merely as a technological novelty but as a legitimate domain of design research and healing practice, capable of shaping future approaches to architecture, education, and mental health.

5.4 LIMITATIONS OF THE STUDY

As with any empirical investigation, this study has certain limitations that must be acknowledged to ensure a transparent and balanced interpretation of its findings. These limitations do not undermine the validity of the results but instead clarify the scope and boundaries within which the conclusions should be understood. They also highlight potential areas for refinement in future research and provide context for interpreting the strength and generalisability of the outcomes.

The limitations of this research can be discussed in five main areas:

1. methodological design and sequencing;
2. participant characteristics and cultural scope;
3. technological and sensory constraints of VR;
4. duration and setting of the study; and
5. interpretive and analytical boundaries.

5.4.1 METHODOLOGICAL DESIGN AND SEQUENCING

The most significant methodological limitation concerns the fixed order of exposure to the four VR environments. For logistical reasons, all participants experienced the classroom, public garden, designed meditation room, and white room in the same sequence. While this arrangement allowed for consistent timing, equipment setup, and a logical narrative transition from the ordinary to the contemplative, it also introduced the possibility of order effects. Participants' higher relaxation scores in the later environments may have reflected increased familiarity with the headset, improved meditative ability, or cumulative relaxation rather than purely environmental differences. Although the mixed-methods design mitigated this issue—participants frequently attributed their comfort to the specific environmental qualities rather than to repetition, the influence of sequencing cannot be fully discounted. A counterbalanced design, in which the order of exposure varies across groups, would better isolate environmental factors in future studies.

A further limitation relates to the controlled laboratory context. The need for experimental consistency required that sessions occur under stable lighting and sound conditions, yet this created an artificial atmosphere that differs from how meditation normally unfolds in natural or spontaneous settings. Awareness of being observed, or of performing within a research environment, may have subtly affected participants' focus and relaxation levels during early sessions. Although interview data suggest that most participants eventually adapted and achieved immersion, the formal context inevitably constrained the ecological validity of the meditation experience.

5.4.2 PARTICIPANT CHARACTERISTICS AND CULTURAL SCOPE

The participant group comprised Thai university students, representing a culturally and demographically homogeneous population. This focus was intentional, as the research aimed to explore meditation experiences within a Thai–Buddhist framework where concepts of balance, simplicity, and moral order are culturally embedded. However, this specificity limits generalisation to broader populations. Participants' shared familiarity with meditation, exposure to Buddhist values, and collective understanding of calmness shaped their interpretations of the VR environments; users from different cultural or religious backgrounds might experience the same settings quite differently. The study therefore offers context-rich insight into Thai spatial perception but calls for comparative cross-cultural research to test the universality of these findings.

The demographic profile of the participants also shaped the results. As undergraduate students, they faced study-related stress, time pressure, and social adaptation issues typical of university life—conditions that may heighten receptivity to meditation and restorative environments. Older adults or professional groups might display different levels of responsiveness, either deeper because of maturity and experience or more constrained by physical discomfort with the VR device. Thus, while the results accurately represent the target group, they may not reflect how other populations would respond to VR-based meditation.

5.4.3 TECHNOLOGICAL AND SENSORY CONSTRAINTS OF VR

Despite the advantages of VR as a controllable research tool, its technological nature imposed several sensory and ergonomic limitations. The most evident constraint lies in the limited multisensory realism of current systems. Although participants experienced convincing visual and auditory immersion, the absence of tactile, olfactory, and thermal cues meant that environments could not reproduce the full embodiment of physical space. Several participants mentioned missing the sensation of air movement, temperature variation, or natural scent, especially in the garden environment. These omissions reduced sensory depth but also demonstrated that visual and auditory harmony alone can elicit substantial psychological benefits—a useful insight for digital-well-being design.

A second issue concerns physical comfort and equipment ergonomics. Some participants reported headset weight, facial pressure, or mild fatigue during longer sessions, which occasionally interfered with concentration. Session durations were therefore kept between ten and fifteen minutes to minimise discomfort. In addition, minor technical irregularities such as brief frame delays or tracking errors occasionally disrupted immersion, reminding users of the artificiality of the simulation. Although these interruptions were infrequent and did not compromise the results, they reveal how minor hardware limitations can influence presence. Finally, variation in individual susceptibility to VR linked to previous experience, visual sensitivity, or motion tolerance produced subtle differences in adaptation time and emotional depth. Future research with larger samples could quantify these individual factors to refine understanding of VR's psychological impact.

5.4.4 DURATION AND SETTING OF THE STUDY

The relatively short overall duration of the experimental programme limits conclusions about long-term effects. Although the study extended across several months, each participant completed a fixed sequence of multiple meditation sessions within the four VR environments. The design therefore captured immediate psychological outcomes—such as relaxation, focus, and satisfaction—rather than long-term behavioural or physiological changes. While short-term improvements were evident, it remains uncertain whether continued VR meditation over longer periods would yield sustained benefits for stress management or academic performance. Longitudinal follow-up studies could explore these possibilities by tracking participants' experiences over weeks or semesters.

The indoor laboratory setting also shaped participants' experience. Although the environment was controlled for light and sound, it remained part of the real world: background noise, air-conditioning, or the awareness of nearby activity may have influenced immersion. While the VR headset provided a strong sense of privacy and detachment, it could not fully isolate users from external conditions. These limitations are inherent in controlled laboratory research and should be considered when interpreting the findings or applying them in more naturalistic university settings such as libraries, counselling rooms, or dedicated relaxation spaces.

5.4.5 ANALYTICAL AND INTERPRETIVE BOUNDARIES

The interpretive framework of this study relied primarily on subjective, self-reported data. Participants' perceptions of relaxation, focus, and emotional comfort were gathered through questionnaires and interviews, providing rich insight into lived experience but lacking complementary physiological measures such as heart rate, skin conductance, or EEG. Incorporating biometric indicators in future research could validate subjective reports and offer a more comprehensive picture of the psychophysiological processes underlying VR meditation. Similarly, the temporal structure of the data limited analysis of moment-to-moment fluctuations in attention or emotional response; real-time monitoring could capture these subtle dynamics.

Another interpretive limitation stems from linguistic nuance. All participants were Thai, and interviews were analysed in the original language; however, emotional descriptors such as "peaceful," "calm," or "focused" may carry slightly different connotations across individuals. Although coding procedures were cross-checked to ensure reliability, translation and semantic variation always introduce minor interpretive uncertainty. A related concern involves the researcher's positionality: familiarity with Thai–Buddhist spatial culture may have influenced the framing of themes. Reflexivity was maintained throughout analysis to mitigate bias, yet complete neutrality is unattainable in qualitative research. Recognising these interpretive boundaries underscores that findings represent negotiated meanings rather than objective absolutes, while transparency in reporting ensures their credibility.

5.4.6 SUMMARY OF LIMITATIONS

In summary, this study's limitations include the fixed sequence of environments, cultural homogeneity of participants, sensory and ergonomic constraints of VR, short study duration within a controlled setting, and reliance on self-reported psychological measures. These boundaries highlight where caution is needed in generalising results and indicate avenues for methodological refinement. Nevertheless, the overall consistency of qualitative and quantitative evidence confirms the robustness of the conclusions: even within these constraints, participants experienced authentic relaxation, focus, and emotional comfort through VR meditation. The findings therefore validate VR as a credible platform for exploring healing spaces while identifying clear directions for technological and methodological advancement.

5.5 FUTURE RESEARCH DIRECTIONS

While this study has contributed new understanding of how virtual environments can support mindfulness and well-being, it also opens several promising avenues for further investigation. These directions emerge naturally from the limitations and insights discussed previously and suggest ways in which future research can expand, refine, and validate the concept of healing space in both physical and virtual contexts. Broadly, these directions relate to methodological enhancement, technological innovation, cross-cultural and contextual exploration, and the integration of VR into wider educational and therapeutic systems.

5.5.1 METHODOLOGICAL AND ANALYTICAL EXPANSION

Future studies could extend the methodological design of this research by adopting counterbalanced or randomised exposure sequences to reduce potential order effects and strengthen causal inference. Allowing participants to experience the four environments in varying orders would help clarify whether differences in relaxation and focus are driven by the environmental qualities themselves or by adaptation and familiarity. Similarly, future work could employ longitudinal designs, tracking participants over extended periods to examine whether VR meditation produces lasting improvements in stress reduction, concentration, and emotional regulation. Such studies might involve repeated sessions over several weeks or months, combined with follow-up interviews to measure retention of mindfulness skills beyond the immediate experimental context.

To complement self-reported perceptions, future research should also incorporate physiological and behavioural data to triangulate psychological outcomes. Measures such as heart rate variability, electrodermal activity, or brainwave patterns could objectively confirm relaxation levels and deepen understanding of the psychophysiological mechanisms underlying VR meditation. This mixed-methods integration would enable researchers to examine how environmental factors, cultural meaning, and cognitive processes interact in real time to shape well-being. In addition, future studies could include moment-to-moment data capture using biosensors or gaze-tracking technology to reveal how attention fluctuates within each virtual scene, identifying which spatial or sensory elements are most restorative. These methodological enhancements would significantly enrich the evidence base for VR healing environments and align this field more closely with established environmental psychology and neuroscience frameworks.

5.5.2 TECHNOLOGICAL DEVELOPMENT AND SENSORY REALISM

Rapid advances in virtual reality technology present opportunities to overcome many of the sensory and ergonomic limitations identified in this study. Future research should explore the integration of multisensory simulation, combining visual and auditory cues with tactile, olfactory, or thermal feedback. For example, the inclusion of air movement, gentle temperature changes, or natural scents could increase realism and emotional depth, helping users experience the environment as fully embodied rather than merely perceived. Newer haptic devices and scent-emitting technologies could make such multisensory immersion feasible in controlled research settings, while lighter, wireless headsets can reduce physical discomfort and encourage longer sessions.

Moreover, VR platforms could incorporate adaptive or interactive features that respond to users' emotional or physiological states. Through biofeedback loops, the environment could adjust lighting, sound, or visual intensity according to the user's relaxation level, heart rate, or breathing rhythm. Such intelligent systems would transform VR meditation into a responsive, personalised healing experience—mirroring how real-world spaces naturally interact with users' sensory feedback. Beyond the laboratory, the development of portable or mobile VR meditation applications could make such experiences accessible to a broader population, allowing users to engage in brief restorative sessions during daily life, whether in dormitories, offices, or transit spaces. Research in this direction would merge design, psychology, and technology to explore how digital environments can dynamically support well-being in everyday contexts.

5.5.3 CROSS-CULTURAL AND CONTEXTUAL RESEARCH

The cultural specificity of this study highlights the importance of extending VR meditation research across diverse populations. Comparative studies could examine how users from different cultural and religious backgrounds interpret virtual healing spaces and whether universal design principles such as harmony, balance, and naturalness—maintain their restorative impact across contexts. For instance, researchers might explore how Western minimalism, Japanese Zen aesthetics, or Middle Eastern geometric ornamentation affect users' meditative engagement. Such cross-cultural comparison would deepen theoretical understanding of how spatial symbolism, colour, and form influence perception and emotion across societies.

In the Thai context, further research could investigate how local environmental settings such as temples, forests, or riversides can be modelled in VR to preserve cultural identity while serving new educational or therapeutic purposes. Engaging participants from different regions, age groups, or occupations would also reveal how social background and personal experience shape responsiveness to VR meditation. In addition, future projects could explore inclusive design approaches, considering gender, accessibility, and neurodiversity to ensure that VR healing environments remain welcoming to all users. Such studies would contribute to a more global and equitable understanding of how digital design can foster emotional and cultural connection.

5.5.4 INTEGRATION WITH EDUCATIONAL AND INSTITUTIONAL SYSTEMS

The practical implications of this research point toward further investigation into how VR meditation can be embedded within educational and health-care infrastructures. For universities, future studies could evaluate the long-term effectiveness of VR meditation programmes as part of student well-being services, comparing them with traditional mindfulness courses or physical relaxation spaces. Evaluating outcomes such as stress reduction, academic performance, and social adjustment would provide evidence for institutional adoption and policy development. Collaborative studies between architecture, psychology, and counselling departments could examine how spatial design, technology, and pedagogy intersect to create supportive learning environments.

Beyond higher education, future work could explore VR meditation as a tool for clinical or community-based well-being, particularly for populations with limited access to nature or dedicated meditation spaces. Studies could examine its potential for hospital recovery rooms, workplace stress management, or mental health interventions, adapting design elements to each context. Additionally, VR could be integrated into hybrid programmes combining digital and physical healing spaces, where students or patients can move between real environments and their virtual counterparts, reinforcing the mental associations of calmness and balance. Long-term, such interdisciplinary collaboration would establish VR not merely as an experimental medium but as a legitimate component of the built environment's therapeutic ecosystem.

5.5.5 THEORETICAL ADVANCEMENT AND INTERDISCIPLINARY DIALOGUE

Finally, future research should continue to advance theoretical understanding of healing environments in the digital age. The findings of this study invite further exploration of how perception, culture, and technology interact to shape human well-being. Scholars could develop integrative frameworks that combine environmental psychology, architectural theory, and digital media studies to articulate how virtual and physical design share common psychological principles. Future studies might also investigate how immersive technologies reshape the philosophical concept of place, blurring distinctions between real and simulated environments.

By situating VR meditation research within broader academic conversations about embodiment, phenomenology, and cultural cognition, future inquiry can contribute to a richer, multidisciplinary understanding of how humans construct meaning, comfort, and belonging in digital spaces. Such work would continue the trajectory initiated by this study—transforming VR from a representational tool into a profound medium for examining the relationship between mind, body, and environment.

5.5.6 SUMMARY OF FUTURE RESEARCH DIRECTIONS

In summary, future research should:

- Refine methodological design through counterbalancing, longitudinal tracking, and physiological validation.
- Advance technological realism by integrating multisensory and adaptive feedback systems.
- Expand cultural scope through comparative and inclusive design research.
- Explore institutional integration of VR meditation in education and healthcare.
- Deepen theoretical dialogue linking environmental design, psychology, and digital phenomenology.

Together, these directions will strengthen the scientific and design foundations of VR-based healing environments, ensuring that future work continues to merge empirical evidence with cultural understanding and technological innovation. By extending the dialogue between architecture and human well-being into the virtual realm, future researchers can further establish VR as both a mirror and an evolution of the healing spaces that have long shaped human experience.

5.6 REFLECTIONS AND IMPLICATIONS

This section provides a reflective overview of the research process and its wider implications for design, education, and human well-being. It situates the study not only as an academic investigation but also as a personal and professional journey that deepened understanding of the connection between space, perception, and mindfulness.

5.6.1 PERSONAL REFLECTIONS ON THE RESEARCH JOURNEY

Conducting this research has been both intellectually and personally transformative. The process evolved through the continuous interaction between design, technology, and human experience, requiring constant negotiation between creative intuition and methodological rigour. As the researcher, I was challenged to merge two domains often considered distinct: the physical logic of architectural design and the emotional and spiritual depth of mindfulness. Developing the VR meditation environments demanded sensitivity to spatial aesthetics, psychological engagement, and cultural symbolism. Through this journey, I learned that the design of healing spaceswhether real or virt ual is ultimately a moral and human-centred endeavour, concerned not merely with aesthetics but with fostering empathy, balance, and inner calm.

This process also became a form of self-reflection. Immersing repeatedly in the virtual meditation environments allowed me to experience first-hand the subtle shifts in awareness that participants described. I discovered that calmness arises less from technological precision than from the intentional creation of an atmosphere that encourages openness and non-judgment. The research, therefore, mirrored the principles of mindfulness itself—accepting imperfection, attending to the present moment, and observing how design influences inner experience. This reflective awareness strengthened my sense of responsibility as a designer and researcher, reminding me that healing design begins with compassion and sensitivity to human fragility.

5.6.2 REFLECTIONS ON DESIGN RESEARCH AND PRACTICE

From a professional perspective, the study reshaped my understanding of design research as an integrative and experiential discipline. Using VR as a research tool demonstrated that architectural design can move beyond representation toward lived and embodied experience. Observing how participants emotionally and cognitively interacted with light, sound, and spatial rhythm reaffirmed that the designer's role extends beyond form-making to facilitating psychological well-being. This insight reframed design as a process of cultivating experience rather than constructing artefacts. It also highlighted that technology, when ethically and thoughtfully applied, can enhance rather than diminish human connection enabling spaces that respond to emotion and consciousness rather than simply enclosing activity.

This research also revealed that the integration of mindfulness and design is not merely a thematic overlap but a methodological one. The discipline of mindfulness—observation without judgment mirrors the critical reflection required in design practice. Both processes involve seeing clearly, simplifying complexity, and creating conditions for harmony. Through this lens, the study became a practical exercise in mindful design: listening to participants, refining the VR environments iteratively, and recognising how design choices subtly shape human emotion. These experiences reinforced that future design research should remain grounded in ethical empathy understanding people's psychological needs before technological ambition.

5.6.3 BROADER IMPLICATIONS FOR EDUCATION AND WELL-BEING

The outcomes of this study also carry implications for design education, institutional policy, and social well-being. Within architectural education, the research suggests that empathy, psychology, and human experience should hold equal weight with technical and aesthetic training. Future designers must learn to consider how their work affects mental health and emotional balance. Integrating experiential tools such as VR into the curriculum could allow students to explore spatial atmosphere and sensory impact directly, transforming abstract theory into lived understanding. For universities, the findings indicate that VR meditation could serve as an accessible well-being intervention particularly beneficial for students experiencing academic stress. Implementing such programmes would not only promote mindfulness but also demonstrate how design and technology can serve inclusive, human-centred goals.

Beyond academia, the study offers implications for broader social and professional practice. In architecture and environmental design, it emphasises that technological innovation should remain anchored in human values serving restoration, not stimulation. Healing environments, whether physical or virtual, must prioritise cultural authenticity, inclusivity, and emotional resonance over spectacle or novelty. This principle extends to policy-making: investment in VR meditation and hybrid well-being environments could support community resilience, especially in urban contexts where access to nature is limited. The study thus contributes to a wider discourse on how design guided by empathy and mindfulness—can actively shape healthier societies.

5.6.4 SUMMARY OF REFLECTIONS AND IMPLICATIONS

Overall, this research reaffirmed that the essence of design lies in creating experiences that restore balance between people, place, and the inner self. Virtual Reality proved not to be a substitute for real environments but a valuable extension of human imagination and perception, enabling new ways to explore spatial and emotional connection. The integration of mindfulness and design demonstrated that healing begins with awareness—within the designer, within the user, and within the shared space of experience. The implications of this work encourage future designers, educators, and institutions to recognise that innovation achieves its greatest meaning when it serves the quiet, essential work of human well-being.

5.7 CONCLUSION

This study set out to explore the relationship between environmental design, mindfulness, and well-being through the lens of virtual-reality (VR) meditation environments for university students in Thailand. The research aimed to understand how healing spaces influence human experience, how different types of meditation environments affect users when simulated through VR, and how VR technology might inform the design and accessibility of future meditation and well-being spaces in higher education. Using a mixed-methods approach that combined qualitative interviews, meditation diaries, and quantitative surveys within a controlled experimental design, this study provides original insights into how virtual environments—when anchored in cultural, spatial, and sensory harmony—can evoke authentic emotional and psychological responses comparable to those found in physical healing spaces.

5.7.1 REVISITING THE RESEARCH AIMS AND QUESTIONS

The overarching aim of this research was to determine how environmental qualities—both physical and perceived—affect well-being and mindfulness when experienced through virtual simulation. The study was guided by three principal research questions:

1. **How do healing spaces influence student well-being, and what is the relationship between their physical, perceptual, and symbolic qualities?**

2. **What are the effects of different types of meditation environments on student well-being when experienced through VR simulations?**
3. **Which meditation environment is most suitable for supporting student well-being in a university context, and what role can VR play in enabling access to such spaces?**

Each question has been systematically addressed across the thesis. Chapter 2 reviewed theories of healing environments, restorative and contemplative design, and mindfulness-based well-being, establishing that human health and emotional balance are deeply influenced by environmental perception. Chapter 3 outlined the methodological framework, combining qualitative and quantitative inquiry to capture both the experiential and statistical dimensions of meditation in VR. Chapter 4 presented and analysed the results, revealing clear and significant differences among the four environments—the Classroom, Public Garden, Designed Meditation Room, and White Room. Chapter 5 then interpreted these findings within theoretical and cultural contexts, illustrating how environmental qualities and user adaptation collectively shape mindfulness and emotional recovery.

The conclusions drawn from this investigation reaffirm that design—whether physical or virtual—is not merely a visual or functional act but a psychological and ethical practice. Healing environments operate through perception, memory, and symbolic meaning as much as through material form. VR, as shown in this study, provides a powerful medium to study and replicate these complex interactions, enabling a deeper understanding of how design mediates human well-being and consciousness.

5.7.2 SUMMARY OF KEY FINDINGS

The findings of this research can be summarised across five interrelated themes corresponding to the major discussions in Chapter 5.

1. **Environmental design and well-being:**

   The study confirmed that environments exhibiting balance, proportion, and sensory harmony support relaxation and mindfulness, even when simulated digitally. Participants consistently associated open, nature-based, and aesthetically ordered spaces with feelings of calm and focus. These responses echo established theories of restorative design (Kaplan & Kaplan, 1989; Ulrich, 1984), validating their relevance within virtual contexts. Spatial coherence—achieved through visual balance, soft lighting, and ambient sound—emerged as a key determinant of psychological restoration.

2. **The role of VR as both medium and method:**

   VR proved capable of producing emotionally authentic experiences of mindfulness and presence. Participants reported genuine immersion and restorative effects, indicating that virtual environments can evoke physiological and emotional responses similar to those of physical settings. The medium's controllability also made it an effective research tool, allowing environmental variables to be manipulated precisely while preserving ecological realism. Although VR lacks tactile and olfactory realism, its strength lies in its ability to deliver consistent sensory experience and to bridge empirical research with experiential design. This duality positions VR as a laboratory of empathy—a space where the psychology of form and perception can be explored safely before real-world implementation.

3. **Cultural and symbolic meaning:**

Cultural resonance strongly influenced participants' perception of calm and authenticity. Thai–Buddhist spatial values—simplicity, symmetry, and connection to nature—guided how participants interpreted the Public Garden and Designed Meditation Room. The inclusion of familiar symbols, such as the Buddha image, enhanced the emotional and spiritual credibility of the virtual spaces. This finding underscores that healing is culturally situated: environments achieve meaning through shared systems of value and belief, not through form alone.

4. **Adaptation and mindfulness progression:**

Participants demonstrated a progressive improvement in focus, comfort, and emotional regulation as they advanced through the VR sessions. Early experiences were characterised by novelty and distraction, while later sessions reflected deeper meditative absorption and stability. This indicates that mindfulness within VR follows a developmental curve shaped by familiarity and repetition. VR can thus serve not only as an observational platform but as a pedagogical tool for cultivating mindfulness practice over time.

5. **Relationship between physical and virtual healing spaces:**

The research revealed that VR can replicate the perceptual and emotional essence of physical healing environments, though not their full multisensory embodiment. VR should therefore be seen as a complementary extension rather than a substitute for real spaces. It offers accessibility, flexibility, and cost-effectiveness—particularly valuable in universities where physical resources are limited—while physical spaces remain essential for social, tactile, and embodied engagement. Together, they define a hybrid model of well-being design for contemporary education.

5.7.3 INTEGRATION OF FINDINGS ACROSS CHAPTERS

This thesis demonstrates the value of integrating design research, environmental psychology, and cultural interpretation into a unified interdisciplinary framework. The conceptual synthesis developed across all chapters shows that healing environments—material or virtual—operate through four interconnected dimensions: environmental harmony, cultural resonance, technological mediation, and adaptive mindfulness. Each dimension contributes to the creation of spaces that restore psychological balance and moral awareness.

By uniting these perspectives, the research advances the understanding of healing space as both a psychological state and a design construct. It reinforces that well-being emerges from the alignment of spatial form, sensory perception, and emotional meaning. VR functions as a transformative research platform that allows these alignments to be observed, tested, and refined systematically. Importantly, the mixed-methods integration strengthened the validity of these conclusions: qualitative narratives gave life and depth to the numerical patterns, while quantitative data grounded participants' reflections in measurable evidence. This complementarity confirms that subjective experience and statistical verification can work together to produce a richer, more human-centred understanding of architectural well-being.

5.7.4 IMPLICATIONS FOR ARCHITECTURAL AND DESIGN RESEARCH

The findings of this thesis have direct implications for architectural scholarship and practice. They demonstrate that digital technologies can be used not only for visualisation but as empirical tools for studying human experience. The immersive capacity of VR enables researchers to simulate environmental atmospheres, test design hypotheses, and evaluate emotional responses with unprecedented precision. This methodological innovation enriches the evidence base for architectural decision-making and supports the creation of environments that are both aesthetically refined and psychologically supportive.

In professional design practice, the study highlights the ethical dimension of architecture—reminding designers that spatial form inevitably carries emotional consequence. Healing-oriented design principles should not be limited to specialised facilities but extended to everyday settings such as classrooms, offices, and residences. Architects are encouraged to consider how spatial proportion, sensory balance, and cultural symbolism affect users' cognitive and emotional states. Moreover, the study reaffirms that globalised practice must remain culturally sensitive: authentic well-being design depends on responsiveness to local moral and aesthetic frameworks.

5.7.5 BROADER SIGNIFICANCE: EDUCATION, WELL-BEING, AND TECHNOLOGY

The implications of this research extend beyond architecture into the domains of higher education, mental health, and digital culture. The successful implementation of VR meditation sessions among university students demonstrates how technology can be used compassionately to support emotional resilience. In academic environments often marked by competition and stress, virtual meditation spaces offer an inclusive, low-cost, and accessible form of care. Universities could incorporate such interventions into student-support programmes, counselling services, or even design curricula that teach mindfulness through immersive simulation. By embedding well-being technologies into learning frameworks, institutions could cultivate self-awareness and empathy alongside intellectual development.

At a societal level, the study contributes to rethinking technology's role in human life. Rather than viewing VR as escapist or isolating, this research positions it as a medium for awareness and restoration. VR can cultivate presence, empathy, and self-regulation when guided by intentional design. This redefinition has profound implications for how digital technologies are developed and used across education, healthcare, and creative industries. It affirms that innovation, when aligned with ethical and cultural understanding, can enhance rather than diminish human well-being.

5.7.6 REFLECTION ON THE RESEARCH CONTRIBUTION

This thesis contributes to knowledge on multiple levels. Theoretically, it reinterprets healing space as a multi-dimensional construct encompassing physical, perceptual, symbolic, and virtual domains. Methodologically, it validates VR as a credible platform for architectural and environmental-psychology research—combining empirical precision with qualitative depth. Practically, it provides design principles for creating both physical and digital spaces that foster mindfulness, balance, and restoration. Culturally, it amplifies Thai–Buddhist perspectives on simplicity, order, and connection to nature, thereby enriching global discourse on the emotional and ethical dimensions of design.

Ultimately, this research establishes a bridge between architecture and consciousness. It shows that spatial design can function as a medium of healing, shaping perception and awareness through proportion, light, sound, and cultural symbolism. The future of architecture, as this study suggests, lies in designing experiences of harmony rather than constructing objects of form alone.

5.7.7 FINAL REFLECTIONS

In conclusion, this thesis confirms that well-being arises when individuals encounter environments—real or simulated—that harmonise sensory order with emotional meaning. Virtual reality, when informed by thoughtful design, can evoke genuine states of mindfulness and calm, revealing technology's potential to nurture rather than fragment the human spirit. Healing, as demonstrated here, is both spatial and mental: it occurs through the balance of environment, body, and awareness. Spaces that embody coherence, lightness, and compassion invite individuals to rediscover stillness within themselves.

Whether created in stone, timber, or digital light, the essence of healing space lies in its capacity to reconnect people with presence and peace. As architecture continues to evolve in dialogue with technology, the lessons from this study encourage designers to create not merely structures but experiences—places where body, mind, and culture converge in equilibrium. VR, far from being the opposite of reality, emerges as its extension: a tool for exploring empathy, imagination, and perception in new forms. By integrating mindfulness, cultural sensitivity, and human-centred ethics into both digital and physical design, architecture can remain profoundly relevant in an era of technological acceleration. The pursuit of healing space thus continues as both a creative opportunity and a moral responsibility—to design environments that remind humanity of its enduring capacity for awareness, balance, compassion, and environmental sustainability. Future generations of designers, educators, and technologists will build upon this foundation to craft spaces—physical, virtual, and hybrid—that affirm the inseparable connection between human flourishing and the designed world.

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APPENDICES

APPENDIX A: INFORMATION LETTER

Participant Information Sheet for Undergraduate Students

[FOR USE WITH STANDARD PRIVACY NOTICE FOR RESEARCH PARTICIPANTS]

Name of department: Department of Architecture

Title of the study: Exploring Healing Spaces: Virtual Reality Simulation of Meditation Environments and Their Impact on University Students' Well-being in Thailand

Introduction

I am a PhD Candidate in the department of Architecture, University of Strathclyde, studying the impact of different physical settings and environments of Buddhist meditation. This study is being conducted by Monthian Nguitragool, under the supervision of Professor Ashraf M. Salama, in the Department of Architecture at University of Strathclyde.

What is the purpose of this research?

The purpose of this study is to examine undergraduate student experiences in the different physical settings of meditation practice. This understanding will help educators to develop a more appropriate and effective environment for meditation practice to be adapted in the university campus.

Do you have to take part?

Your participation in this study is completely voluntary. Refusal to participate will involve no penalty or loss of benefits to which you are otherwise entitled as a student of your institution. You have the right to refuse to answer any questions that you do not want to answer. If you feel uncomfortable answering any question, you may skip it and move on to the next item. Your responses will not affect your grade in this class in any way. You may elect to withdraw from this study, by ceasing to complete the survey, at any time and any information we have collected from you will be destroyed. Withdrawing from this study would have no foreseeable negative effects. Any significant new findings developed during the course of the research, which may relate to your willingness to continue participation, will be provided to you.

What will you do in the project?

If you volunteer to be interviewed you will do the following things:

- you will be asked to sign a consent form.
- you will be asked to complete a short demographic and meditation questionnaires.
- you will be asked to meditate through visual reality VR application, and you will be asked to write the diaries on your meditation experiences of each practice.
- you will be asked to take part in an online interview lasting approximately 45 minutes. The interview questions will pertain to how you practice meditation and the perceived effects of meditation spaces on your mental and physical health.

If you do not wish to be recorded in the online interview, handwritten notes of the interview will be taken instead. All interview video recorded will be destroyed after the completion of the study. Subjects will be allowed to review, edit or erase tapes at their request. This would be achieved by arranging a second meeting in a convenient, comfortable, public location of the subject's choice.

Why have you been invited to take part?

You were invited to be part of this investigation because you are:

- Undergraduate student at Burapha University, Thailand
- Interested in Buddhist meditation

What are the potential risks to you in taking part?

There are minimal risks to you in your participation in this study as the subject involves sharing information of a personal nature. If you feel that any particular question is too personal, or a question causes you to feel distressed, you are free to refrain from answering. Also, you may withdraw from participating in this study or stop the interview at any time without any consequences.

You can choose to pause or interrupt your participation if you find the VR demo or any portion of the study unpleasant, or if you feel motion sickness or dizziness. If you wear eyeglasses, this issue could become more problematic. No preparatory requirements are asked of the participants

What information is being collected in the project?

The questionnaire data will be anonymous, and the identities of the respondents will be unknown even to the researchers. Participants' meditation diaries and Interviews and audio recorded will be pseudo-anonymised. The researcher will later transcribe the audio recordings of the interviews with the participant's permission. Without the participant's written consent, no data will be disseminated.

Who will have access to the information?

Your individual privacy will be maintained in all published and written data resulting from the study. Your name will not appear on any of the surveys and your responses will be identified only as a study code number. Surveys will be de-identified within a few weeks and then destroyed. The de-identified data will be kept in a locked room where they will remain for approximately five years following completion of the project. This data will be organized by a number assigned to you so that your identity will be available only to the researcher, and will remain completely confidential. If you withdraw from this study, no further data will be collected but any information that you have provided may be retained by the researcher and analyzed.

Where will the information be stored and how long will it be kept for?

To ensure a robust and backed-up system, the data will be stored on a PC, an external hard drive, and the University's Strathcloud. The researcher will share the raw data only with the chief and consulting investigators, and it will be kept anonymous. In accordance with the Data Management Plan guidelines, the collected and processed data will be stored and archived on both hard and digital copies for a period of 3-5 years after the completion of the research project.

Benefits:

As a participant in this study, you will have the opportunity to meditate in the vary of spaces via Visual Reality . You may also experience some health benefits such as decreases in stress, anxiety and depression. You will have access to the results of this study upon its completion. Your participation in this study might contribute to the knowledge of the helping profession about the effects of Meditation spaces on a personal and a professional level.

Compensation:

You will be offered Virtual Reality headset before beginning the study.

What happens next?

Thank you for taking the time to read this information. If you agree to participate in the project, you will be asked to sign a consent form. After the project is completed, the information from this study will be published as a PhD thesis and may be disseminated through other means such as academic papers, conferences, or lectures.

Researcher contact details:

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APPENDIX B: INFORMED CONSENT

Consent Form for Undergraduate Students

Name of department: Architecture Department

Title of the study: Exploring Healing Spaces: Virtual Reality Simulation of Meditation Environments and Their Impact on University Students' Well-being in Thailand

- I confirm that I have read and understood the Participant Information Sheet for the above project and the researcher has answered any queries to my satisfaction.
- I confirm that I have read and understood the Privacy Notice for Participants in Research Projects and understand how my personal information will be used and what will happen to it (i.e. how it will be stored and for how long).
- I understand that my participation is voluntary and that I am free to withdraw from the project at any time, up to the point of completion, without having to give a reason and without any consequences.
- I understand that I can request the withdrawal from the study of some personal information and that whenever possible researchers will comply with my request. This includes the following personal data:
    - video recordings of physical tests that identify me;
    - audio recordings of interviews that identify me;
    - my personal information from transcripts.

- I understand that anonymised data (i.e. data that do not identify me personally) cannot be withdrawn once they have been included in the study.
- I understand that any information recorded in the research will remain confidential and no information that identifies me will be made publicly available.
- I consent to being a participant in the project.
- I consent to being audio and/or video recorded as part of the project.

In agreeing to participate in this research, I am aware that I may be entitled to compensation for accidental bodily injury, including death or disease, arising out of the research without the need to prove fault. However, such compensation is subject to acceptance of the Conditions of Compensation, a copy of which is available on request.

(PRINT NAME)	
Signature of Participant:	Date:

APPENDIX C: DEMOGRAPHICS QUESTIONNAIR

Demographics Questionnaire

Please provide your answer by placing an X in the spaces provided or by writing in your response.

Thank you for taking the time to complete this questionnaire.

1. What is your gender?
    a. Male
    b. Female
    c. Prefer not to answer

2. What is your religion?
    a. Buddhism
    b. Hindu
    c. Islam
    d. Christian
    e. Other ________________

3. What major are you currently in? ____________________

4. Which year of university are you currently in?
    a. 1st year
    b. 2nd year
    c. 3rd year
    d. 4th year
    e. 5th year or more

APPENDIX D: MEDITATION QUESTIONNAIR

Meditation Questionnaire

Please provide your answer by placing an X in the spaces provided or by writing in your response. Thank you for taking the time to complete this questionnaire.

1. Have you been practicing Meditation? ____________________

   *If answered "No" please discontinue survey.

2. Place a checkmark to indicate in which of these forms of meditation you engage in.

   a. Vipassana Meditation

   b. Loving-Kindness Meditation

   c. Mindfulness Meditation

   d. Transcendental Meditation

   e. Other Form of Meditation

1a. If you checked more than one answer to question 1, which form of meditation do you use the most? (Check one answer only).

   a. Vipassana Meditation

   b. Loving-Kindness Meditation

   c. Mindfulness Meditation

   d. Transcendental Meditation

   e. Other Form of Meditation

3. How long have you engaged with meditation?

   a. Less than 1 month

   b. 1 month, but less than 3 months

   c. 3 months, but less than 6 months

   d. 6 months, but less than 12 months

e. More than 12 months

4. How often do you meditate per week?

a. 1 day
b. 2 days
c. 3 days
d. 4 days
e. 5 days
f. 6 days
g. 7 days
h. Other_______________

5. How many hours do you meditate per day?

a. Less than 10 minutes
b. 10 - 30 minutes
c. 30 minutes -1 hour
d. 1-2 hours
e. More than 2 hours

6. Where do you prefer to practice meditation?

a. Temple
b. Home
c. Meditation Studio
d. Public garden
e. Other _______________

APPENDIX E: INTERVIEW QUESTION

Semi-Structured Interview Questions

1. Tell me how the meditation practice sessions went for you?
   a. What did you like about the session?
   b. What did you dislike about the session?
2. How did you perceive the Vipassana Meditation in the university campus?
   a. Tell about your perception of Vipassana Meditation in the university campus before you experienced it
   b. Tell me about your perception of Vipassana Meditation in the university campus
3. Describe your experience during the meditation sessions?
   a. What were you feeling before the meditation sessions?
   b. What were you feeling after the meditation sessions?
   c. What feelings arose during the meditation?
   d. Would you to continue the meditation sessions?
4. Tell me about your experiences in different environment of Vipassana Meditation.
   a. What were your expectations about the different environment of Vipassana Meditation in the university?
   b. What was your experience in each environment of practice Vipassana Meditation?
   c. Which environment of 3 provided space do you prefer to meditate on the campus?
5. Do you think that different spaces and environments of practicing meditation have a different impact on you?
   a. If yes then how would you feel of each space of meditation?

6. Do you have any stresses in university life?
    a. If yes then what causes those stresses?
    b. And how did you cope with those stress?
    c. Do you think that meditation would help you coping with stress?
7. Is there anything additional you'd like to say about practice meditation on campus?

APPENDIX F: MEDITATION DIARY QUESTION

Meditation Diary Questions

Please provide your answer by writing your experience of practicing meditation.

Type of environment ________________________Time of use this environment_________

1. How this meditation practice session went for you?
2. How did you perceive the Vipassana Meditation in this type of environment?
3. Describe your experience on this environment during this meditation sessions.
4. Additional opinion you'd like to say about this practice.

APPENDIX G: SURVEY QUESTIONNAIRE

Questionnaire for Classroom Environment

Section 1: General Experience with Meditation

Please rate the following statements based on your overall experience with meditation in the classroom environment.

Scale:

-2: Strongly Disagree

-1: Disagree

0: Neutral

+1: Agree

+2: Strongly Agree

1. The environment shown in the VR headset (classroom) was conducive to effective meditation.
2. The lighting in the classroom environment was suitable for meditation.
3. The sound levels in the classroom environment were suitable for meditation.
4. The guided meditation narrative within the classroom environment was clear and helpful.
5. The background sounds and relaxation music in the classroom environment enhanced my meditation experience.
6. The classroom environment in the VR headset helped me focus during meditation and was peaceful, helping me calm my mind.

Section 2: VR Experience for Meditation Practice in Classroom Environment

1. The VR headset was comfortable to wear.
2. The VR experience felt immersive and realistic.
3. The VR technology created a conducive meditation environment and enhanced my overall meditation practice.
4. I would recommend using VR for meditation practice as an alternative to actual classroom meditation.

Section 3: Open-Ended Questions for Classroom Environment

1. What aspects of the classroom environment did you find most beneficial for your meditation practice?
2. Were there any challenges or distractions you faced in the classroom environment? Please specify.
3. How did the classroom environment impact your overall well-being? Provide specific examples if possible.
4. How did the VR experience influence your meditation practice in the classroom environment?
5. Do you have any additional suggestions regarding the use of VR in classroom meditation?

Questionnaire for Garden Environment

Section 1: General Experience with Meditation

Please rate the following statements based on your overall experience with meditation in the garden environment.

Scale:

-2: Strongly Disagree

-1: Disagree

0: Neutral

+1: Agree

+2: Strongly Agree

1. The environment shown in the VR headset (garden) was conducive to effective meditation.
2. The natural light in the garden environment was suitable for meditation.
3. The sound levels in the garden environment, including natural sounds, were suitable for meditation.
4. The guided meditation narrative within the garden environment was clear and helpful.
5. Natural elements such as greenery views and sounds of nature in the garden environment helped me relax my mind during meditation and enhanced my ability to focus during meditation sessions.
6. Being in the garden environment within the VR headset contributed positively to my overall meditation experience.

7. The presence of natural elements like greenery and natural sounds was essential for creating a conducive meditation environment.

Section 2: VR Experience for Meditation Practice in Garden Environment

1. The VR headset was comfortable to wear.
2. The VR experience felt immersive and realistic.
3. The VR technology created a conducive meditation environment and enhanced my overall meditation practice.
4. I would recommend using VR for meditation practice as an alternative to actual classroom meditation.

Section 3: Open-Ended Questions for Garden Environment

1. What aspects of the garden environment did you find most beneficial for your meditation practice?
2. Were there any challenges or distractions you faced in the garden environment? Please specify.
3. How did the garden environment impact your overall well-being? Provide specific examples if possible.
4. How did the VR experience influence your meditation practice in the garden environment?
5. Do you have any additional suggestions regarding the use of VR in garden meditation?

Questionnaire for Designed Meditation Room Environment

Section 1: General Experience with Meditation

Please rate the following statements based on your overall experience with meditation in the designed meditation room environment.

Scale:

-2: Strongly Disagree

-1: Disagree

0: Neutral

+1: Agree

+2: Strongly Agree

1. The environment shown in the VR headset (designed meditation room) was conducive to effective meditation.
2. The natural light and built-in lighting in the designed meditation room were suitable for meditation.
3. The sound levels in the designed meditation room, including background sounds and relaxation music, were suitable for meditation.
4. The guided meditation narrative within the designed meditation room was clear and helpful.
5. The presence of a Buddha statue in the designed meditation room helped me increase focus and contributed to my meditation practice.

6. Natural elements such as greenery views and sounds of nature in the designed meditation room helped me relax my mind during meditation and enhanced my ability to focus during meditation sessions.
7. Being in the designed meditation room within the VR headset contributed positively to my overall meditation experience.
8. The presence of natural elements like greenery and natural sounds was essential for creating a conducive meditation environment.

Section 2: VR Experience for Meditation Practice in Designed Meditation Room Environment

1. The VR headset was comfortable to wear.
2. The VR experience felt immersive and realistic.
3. The VR technology created a conducive meditation environment and enhanced my overall meditation practice.
4. I would recommend using VR for meditation practice as an alternative to actual classroom meditation.

Section 3: Open-Ended Questions for Designed Meditation Room Environment

1. What aspects of the designed meditation room environment did you find most beneficial for your meditation practice?
2. Were there any challenges or distractions you faced in the designed meditation room environment? Please specify.
3. How did the designed meditation room environment impact your overall well-being? Provide specific examples if possible.

4. How did the VR experience influence your meditation practice in the designed meditation room environment?
5. Do you have any additional suggestions regarding the use of VR in designed meditation room?

<u>Questionnaire for Control Space (White Plain Room) Environment</u>

Section 1: General Experience with Meditation

Please rate the following statements based on your overall experience with meditation in the control space (white plain room) environment.

Scale:

-2: Strongly Disagree

-1: Disagree

0: Neutral

+1: Agree

+2: Strongly Agree

1. The environment shown in the VR headset (white room) was conducive to effective meditation.
2. The lighting in the white room environment was suitable for meditation.
3. The sound levels in the white room environment were suitable for meditation.
4. The guided meditation narrative within the white room was clear and helpful.
5. The minimal distractions in the white room helped me focus more on myself and contributed to my meditation practice.

Section 2: VR Experience for Meditation Practice in Control Space (White Plain Room) Environment

1. The VR headset was comfortable to wear.
2. The VR experience felt immersive and realistic.

3. The VR technology created a conducive meditation environment and enhanced my overall meditation practice.
4. I would recommend using VR for meditation practice as an alternative to actual classroom meditation.

Section 3: Open-Ended Questions for Control Space (White Plain Room) Environment

1. What aspects of the white room environment did you find most beneficial for your meditation practice?
2. Were there any challenges or distractions you faced in the white room environment? Please specify.
3. How did the white room environment impact your overall well-being? Provide specific examples if possible.
4. How did the VR experience influence your meditation practice in the white room environment?

APPENDIX H: MEDITATION PRACTICE SCRIPT

Vipassana Meditation Practice Script

Introduction

Hello everyone, welcome to short meditation practice. This session will be taken approximately 15 minutes. This form of meditation is based on Buddhist Vipassana Meditation, it is called Mindfulness meditation practice. Being mindful in the present is the core of this practice.

Preparation

A comfortable seat for meditating should be provided, which is not too soft and not too hard to avoid any unpleasant conditions during the meditation, and a well-ventilated area is recommended.

Phase 1

If you're ready, stand upright and relax, leaving both hands at your sides. Then feel your body standing stable and still, and relax. Then feel it from your head to your feet slowly, then feel it from your feet to your head slowly, doing this for three sets.

And then sit down slowly and mindfully, preparing to meditate by crossing your legs over the soles, stacking your hands in your lap with your palm facing up. Sit upright, keep your shoulder relaxed and comfortable. When you're in the ready position, then slowly close your eyes.

Phase 2

Then feel your breath coming and going. Bring the focus of the mind to the breath, to its coming and going, to its ease and flow. Breathing in and out slowly and consciously by taking long deep breaths, let your breath ease and flow. Doing this consciously for about 2 minutes.

Phase 3

And now start saying in your mind as "it's down" and "it's up". Breathing in says "it's up", breathing out says "it's down". Keep doing this for about 5 minutes.

Additional section during meditating

It is usual that some moments during meditation our mind is wandering elsewhere, but when the focus floats away, gradually, bring the mind back to focus on the breath. Focusing on breathing helps us to focus and concentrate on breathing, not to be distracted and to be mindful. For example, when you are feeling tired or fatigued, or even to be distracted during the practice, just being in the present, accept what is happening, and bring the focus back to the breath. Keep doing this method when you feel that your mind is disturbed.

Phase 4

And now open your eyes slowly.... relax your mind, and continue to focus on breathing for another minute.

At the same time, consciously look at the things in front of you, then gradually turns to the right and then gradually turns to the left. Now this session is finished, please stand up consciously.

APPENDIX I: QUANTITATIVE DATA

Appendix I1. Descriptive Statistics of Questionnaire Items Across Four VR Environments

Table I1.1 Descriptive Statistics of Questionnaire Items Across Four VR Environments

Metric	Classroom	Garden	Meditation Room	White Room
Environment Supports Effective Meditation	Neutral	Agree	Strongly Agree	Neutral
Lighting is Suitable for Meditation	Neutral	Agree	Strongly Agree	Neutral
Sound Levels are Suitable for Meditation	Agree	Strongly Agree	Strongly Agree	Agree
Guiding Voice is Clear and Effective	Strongly Agree	Strongly Agree	Strongly Agree	Agree
Ambient Sounds Enhance the Meditation Experience	Neutral	Agree	Strongly Agree	Neutral
VR Helps Maintain Focus and Calmness	Neutral	Agree	Agree	Neutral
VR Device is Comfortable	Neutral	Neutral	Neutral	Neutral
VR Experience Feels Realistic	Agree	Agree	Agree	Agree
VR Enhances Meditation Experience	Agree	Agree	Agree	Agree
Recommend Using VR for Meditation Instead of Real Environment	Neutral	Agree	Strongly Agree	Neutral

(Full SPSS table showing item-level means, standard deviations, minimum and maximum values for all 53 participants.)

Appendix I2. Mean Scores of Participants' Evaluations Across Four VR Environments

Table I2.1 Mean Scores of Participants' Evaluations Across Four VR Environments

Metric	Classroom (Mean)	Garden (Mean)	Meditation Room (Mean)	White Room (Mean)
Environment Supports Effective Meditation	1.0	1.8	2.0	1.0
Lighting is Suitable for Meditation	0.8	1.5	2.0	0.9
Sound Levels are Suitable for Meditation	1.2	1.9	2.0	1.5
Guiding Voice is Clear and Effective	1.9	1.9	2.0	1.8
Ambient Sounds Enhance the Meditation Experience	0.9	1.6	2.0	1.1
VR Helps Maintain Focus and Calmness	0.8	1.7	1.9	1.0
VR Device is Comfortable	0.6	1.0	1.5	0.7
VR Experience Feels Realistic	1.2	1.7	1.8	1.5
VR Enhances Meditation Experience	1.1	1.8	1.9	1.2
Recommend Using VR for Meditation Instead of Real Environment	0.9	1.7	1.9	1.0

(Full version of the mean-score table used for Section 4.4.2, including sub-item details before dimensional averaging.)