

The psychological effects of a virtual reality-based treatment

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Abstract. Virtual Reality (VR) has become an increasingly relevant medium for psychological interventions because it can combine immersion, controlled stimuli, and therapist-guided reflection. However, VR systems explicitly grounded in Positive Psychology remain comparatively underexplored, particularly in supervised psychotherapy settings. This paper presents Positive Psychology VR, a Unity-based VR intervention composed of eight virtual environments designed around Positive Psychology constructs, including gratitude, mindfulness, savoring, personal strengths, positive reappraisal, emotional expression, and acts of kindness. We report an exploratory pilot study with 30 adults who participated in three weekly therapist-guided sessions using a Meta Quest 3 head-mounted display, followed by a three-month follow-up. Data were collected through participant characterization, open-ended session reports, psychologist observations, acceptability records, and follow-up feedback. Results indicate high acceptability, with all participants reporting that they would recommend the experience. No serious cybersickness events were reported. Qualitative findings suggest that the intervention supported self-awareness, reflection, emotional regulation, relaxation, and changes in perspective. Nature-inspired, meditation-oriented, and strengths-based environments were among the most frequently used and were often described as memorable anchors for later recall. At follow-up, most respondents reported perceived benefits that extended beyond the sessions, although individual variability was observed. These findings suggest that Positive Psychology-oriented VR can be feasibly integrated into professionally supervised psychotherapy as an adjunctive tool for reflection and emotional well-being. The study contributes design and evaluation insights for immersive therapeutic systems and highlights the need for larger, controlled, and longitudinal studies.

Keywords: Psychological therapy, Positive experiences, Satisfaction, Virtual reality

1 Introduction

The digitalization of mental-health care has accelerated over the last decade, and the COVID-19 pandemic further expanded routine use of telepsychology and technology-mediated care [Sampaio *et al.*, 2021]. Within this landscape, Virtual Reality (VR) is increasingly explored as a medium for psychological interventions because it can place people in computer-generated situations that are immersive yet controllable, allowing therapists to structure experiences that may be difficult to recreate reliably in everyday life [Pira *et al.*, 2023; McGhee *et al.*, 2024]. A key premise is that people can respond to VR scenarios in ways that resemble real-world behavior and physiology: Slater *et al.* [2009] describes how immersive VR can elicit real responses, e.g., heart-rate changes related to excitement or anxiety, supporting the notion of presence and helping explain why VR can be more engaging than conventional screen-based digital experiences [Magar *et al.*, 2025]. When delivered through head-mounted displays (HMDs), the sense of immersion is closely tied to presence and to the perception that interaction feels natural, enabled by multisensory cues and experimental control [Khundrakpam

et al., 2025].

In parallel, Positive Psychology (PP) focuses on cultivating strengths, positive emotions, and adaptive meaning-making strategies to increase well-being and reduce negative affect. While VR is widely used in psychology, less is known about how immersive systems can explicitly operationalize multiple PP constructs within therapist-guided interventions. Existing work motivates the use of immersive media for psychological care and well-being, but the design and evaluation of PP-grounded VR systems remain less developed from an XR perspective. In particular, there is still limited evidence on how multiple PP constructs can be translated into distinct virtual environments, selected by a therapist during supervised sessions, and evaluated not only for perceived psychological support but also for feasibility, comfort, acceptability, and recall over time.

Recent work further motivates a PP-grounded approach in immersive media. Taylor *et al.* [2024] emphasize the potential of Extended Reality (XR) technologies to promote mental well-being through emotionally engaging experiences when interventions are grounded in psychological theory. In addition, Sampaio *et al.* [2021] argue that VR may represent

a next step for remote mental-health care, while also highlighting the need for research and training to integrate VR into therapeutic practice.

Motivated by these converging trends, we investigate a therapist-guided VR intervention explicitly designed around PP principles and evaluated across three weekly sessions, with a three-month follow-up. We introduce Positive Psychology VR, a Unity-based VR software composed of eight PP-grounded virtual environments (VEs) intended to elicit positive emotions and support well-being through themes such as savoring positive events, gratitude, mindfulness, cognitive reappraisal, personal strengths, and acts of kindness. The VEs were designed in collaboration with a psychologist and reviewed by professional psychotherapists before being applied to volunteers (reported in Kunst *et al.* [2024]), and safe and comfortable use was also previously examined (reported in Kunst *et al.* [2025b]). In the present study, we examine feasibility, acceptability, comfort, and self-reported participant experiences during three weekly sessions and at a three-month follow-up in a supervised psychotherapy setting.

Accordingly, this study is guided by the following research questions: **RQ1)** How feasible and acceptable is the use of a therapist-guided Positive Psychology VR system across supervised sessions and a follow-up? **RQ2)** How do participants and the therapist perceive the role of the virtual environments in supporting reflection, self-awareness, emotional regulation, and later recall? **RQ3)** What design and deployment lessons emerge for VR-supported Positive Psychology interventions in supervised therapeutic contexts?

This work connects immersive media design (scene construction, multisensory engagement, and interaction constraints) with outcomes that matter in real-world use: acceptability, comfort, perceived usefulness, and participant-reported psychological support under professional guidance. Concretely, this paper contributes:

- A description of Positive Psychology VR, a PP-grounded VR intervention composed of eight purpose-built virtual environments implemented in Unity for use under therapist supervision.
- A pilot therapist-guided evaluation with 30 adults across three weekly sessions using an HMD, including immediate session feedback and a three-month follow-up focused on perceived relevance, recall, and possible impact in daily life.
- Qualitative insights into how participants describe the role of immersive settings as memorable anchors that support reflection, self-awareness, and perceived emotional regulation over time.

Together, these contributions provide an initial empirical step toward better understanding how PP-oriented VR experiences can be integrated into psychotherapy practice, and what aspects of immersive design may matter most for perceived benefit and sustained recall.

2 Background

Immersive systems have increasingly been adopted in clinical and well-being contexts because they offer an interac-

tive and programmable medium that can complement non-pharmacological interventions [Bohil *et al.*, 2011; Riva, 2022; Rooney *et al.*, 2025; Magar *et al.*, 2025]. A recurring advantage across the literature is the combination of engagement and experimental control: therapists can present situations that are difficult to arrange in everyday life, adjust intensity over time, and repeat exposures consistently while maintaining oversight of pacing and safety [Bohil *et al.*, 2011; Riva, 2022]. These properties have supported a wide range of therapeutic applications and motivate continued exploration of immersive interventions that are both theoretically grounded and practically deployable.

The most established clinical use case remains exposure therapy for specific phobias. Here, immersive experiences allow clinicians to reproduce feared scenarios, such as heights, and calibrate the challenge level while keeping the session structured and safe [Bohil *et al.*, 2011; Kvapil Varšová and Juřík, 2024]. Beyond phobias, broader clinical reviews report applications spanning anxiety disorders, eating and weight disorders, pain management, psychosis, addictions, and autism, frequently as an adjunct to evidence-based practice [Riva, 2022]. At the same time, even well-studied domains highlight design and reporting needs: for acrophobia, researchers call for clearer guidelines for tailoring environments to therapeutic tasks and collaborative settings [Kvapil Varšová and Juřík, 2024]. Similarly, in behavioral addictions, a systematic review and Bayesian network meta-analysis reported that immersive interventions reduced problematic internet use relative to other non-pharmacological approaches, but also emphasized that the number of trials remains limited compared to more established interventions—underscoring the need for larger studies and longer follow-ups [Tian *et al.*, 2025].

In parallel, immersive systems have been explored extensively in neurorehabilitation, where structured tasks can integrate evidence-based motor, cognitive, and sensory training, supported by instrumentation (e.g., motion capture, EEG) and multimodal feedback, e.g., haptics, functional electrical stimulation [Perez-Marcos *et al.*, 2018]. For older adults, systematic reviews of head-mounted display programs report improvements in physical outcomes such as balance and gait, alongside psychological outcomes such as anxiety, depression, and stress, as well as cognitive benefits (memory, attention) and quality-of-life gains [Kim and Ahn, 2024; Doré *et al.*, 2023]. Across these programs, usability and satisfaction are typically favorable, and adverse events such as nausea or disorientation tend to be mild or transient, reinforcing the importance of careful onboarding and dosing in structured interventions [Kim and Ahn, 2024; Doré *et al.*, 2023].

These findings connect naturally to Positive Psychology interventions, which aim to cultivate strengths and positive emotions while reducing negative affect. As a branch of Psychology, processes related to PP took time to be considered because pathology and harm were the main focus of many psychological investigations, causing more positive attributes, such as optimism, creativity, flow, altruism, humor, hope, and positive strengths, which help human beings adapt to new situations and achieve success, to only be applied in the clinical area years later [Seligman *et al.*, 2005; Cerezo *et al.*, 2014]. Peterson *et al.* [2006] found that courage, kindness,

and humor are associated with a return of life satisfaction in cases of physical illness, as well as an appreciation of beauty and a love of learning in cases of psychological disorders.

Seligman [2008] proposes a new field of study: positive health. He describes this new field as a state that goes beyond the mere absence of disease and is measurable, combining biological, subjective, and functional measures. Cohen *et al.* [2006] discovered a positive relationship between influenza and positive emotions. They found that a tendency to express positive emotions was associated with greater resistance to developing colds. They conclude that positive emotions play a larger and more important role in disease risk and health complaints than previously believed. Aspinwall and Tedeschi [2010] argue that focusing on concepts such as sense of coherence or resilience, meaning, optimism, positive affect, pursuit of benefits, cognitive adaptation, and growth makes it possible to build new ways of dealing with such constructs when treating illnesses and the healing process.

Sin and Lyubomirsky [2009] point out that a positive behavior intervention can utilize a wide variety of techniques, such as writing gratitude letters, practicing optimistic thinking, reliving positive experiences, and socializing. The authors also highlight some relevant points. The treatment format influenced the effectiveness of the interventions: individual therapy was the most effective, followed by group interventions, and lastly, self-administered interventions. The duration of the interventions moderated their benefits, with longer interventions being relatively more likely to produce greater gains in well-being, allowing the patient to learn to convert positive activities into habits. Finally, the authors state that the benefits of this type of intervention increase with age, perhaps related to emotional self-regulation or a more serious and mature approach to the intervention, leading to greater dedication to following its recommendations. Younger individuals should be encouraged to dedicate more effort and commitment.

However, the definition of what constitutes a positive psychology intervention (PPI) is presented by Parks and Biswas-Diener [2013]. For them, PPI involves 1) interventions that focus on positive topics, 2) interventions that operate through a positive mechanism or that target a positive outcome variable, and 3) interventions that are designed to promote well-being rather than correct weaknesses. The authors further describe three criteria that help in this definition: 1) the main objective of the PPI is to build one or more “positive” variables (e.g., subjective well-being, positive emotion, meaning); 2) there is empirical evidence that the intervention successfully manipulates the aforementioned target variable(s); and 3) there is empirical evidence that the improvement of the target variable leads to positive outcomes for the population.

Therefore, immersive experiences can reliably evoke complex emotional states by placing participants in controlled, high-impact scenarios, making them a promising vehicle for Positive Psychology-oriented work [Yaden *et al.*, 2018]. Reviews of Positive Psychology-inspired, technology-mediated programs, including immersive and other digital formats, report increases in positive affect and reductions in negative affect that can persist for months, and reduced loneliness during periods of social isolation such as the COVID-19 pandemic [DuPont *et al.*, 2023]. Experimental work further suggests

that immersive paradigms can be tailored to specific constructs: for example, VR “courage” experiences designed for high-risk occupations can induce fear while supporting courageous responding, with evidence of construct validity and potential organizational benefits [Wang *et al.*, 2022]. Early well-being training trials report feasibility and subjective benefits as well, while noting that some participants experience manageable cybersickness, which highlights the need for careful design, monitoring, and reporting [Kim *et al.*, 2020].

Across clinical and aging populations, acceptability and motivation with head-mounted interventions are often high, particularly when compared with repetitive conventional protocols. When symptoms occur, cybersickness tends to be limited and transient in structured programs [Doré *et al.*, 2023; Kim and Ahn, 2024]. Best practices that recur across studies emphasize graded progression, adaptive stimulus control, and personalization to daily activities, supported by therapist oversight and, when appropriate, objective measurement through instrumentation [Bohil *et al.*, 2011; Perez-Marcos *et al.*, 2018]. However, researchers also continue to point to gaps in standardization: clearer design guidelines by condition and task, longer follow-ups, and more consistent reporting of adverse events remain important for translating immersive approaches into routine practice [Kvapil Varšová and Juřík, 2024; Rooney *et al.*, 2025].

Taken together, prior work positions immersive systems as a versatile adjunctive platform that can extend therapeutic and rehabilitative methods through controllable exposure, engaging practice, and rich measurement [Riva, 2022; Rooney *et al.*, 2025; Magar *et al.*, 2025]. Evidence supports feasibility and acceptability across multiple populations, with promising mental- and physical-health outcomes [Doré *et al.*, 2023; Kim and Ahn, 2024]. At the same time, Positive Psychology-oriented immersive interventions remain comparatively underreported [Yaden *et al.*, 2018; DuPont *et al.*, 2023], and the field continues to call for work that connects experience design choices to therapeutic aims while strengthening long-term evaluation and safety reporting [Kvapil Varšová and Juřík, 2024; Rooney *et al.*, 2025]. This paper builds on those motivations by examining a therapist-guided, Positive Psychology-grounded intervention and reporting qualitative and follow-up insights that can inform both psychotherapy practice and immersive experience design.

3 Method

This study evaluates a therapist-guided intervention using Positive Psychology VR, a Unity-based software composed of eight Positive Psychology-grounded VEs. Volunteers participated in three weekly sessions conducted in a controlled setting (Figure 1) under the supervision of a licensed psychologist, followed by a three-month follow-up. Below we describe the intervention content, participants, procedure, and ethics.

The chosen evaluation method for this study was process assessment, as it considers the promotion of changes throughout psychotherapy, involving, for example, feelings, thoughts, behaviors, and the volunteer’s perception of such changes. To this end, the treatment plan sought to adapt to the indi-

visual aspects of the patient, the characteristics of the issue presented by the volunteer, and the use of techniques, in this case the use of the HMD and PP techniques, such as gratitude, identification of personal strengths, and acts of kindness [Peuker *et al.*, 2009; Zuanazzi *et al.*, 2021].



Figure 1. Session room and equipment.

3.1 Stimulus: Positive Psychology VR software

Positive Psychology VR was adapted from Cohn *et al.* [2014] and Hernandez *et al.* [2023] and implemented in Unity (<https://unity.com>). Cohn *et al.* [2014] developed 8 skills to increase positive emotion in daily life, which were grouped and employed over five consecutive weeks, involving practices outside the session. Hernandez *et al.* [2023] used these same skills applied over five weeks, but using HMDs as visual stimuli. For the study, some activities outside the session (such as meditating for 10 minutes, writing down events that happened during the day) [Cohn *et al.*, 2014] were incorporated into the scenes, and scenes 3, 4, 6, 7, and 8 [Hernandez *et al.*, 2023] were presented with different visual characteristics and attitudes. Although the intervention was intended for adults and older adults (people aged 18 and over), there were no volunteers aged 60 or older in the study. The system ran on a Meta Quest 3 HMD with a 4K+ display and a Guardian boundary system to support user safety [Kunst *et al.*, 2024, 2025b]. There were no dynamic adjustments to the virtual environments for each volunteer. To ensure consistent exposure, all volunteers experienced the same original content.

The software comprises eight VEs designed to elicit positive emotions and support well-being. The choice of eight virtual environments is related to the eight skills highlighted by Cohn *et al.* [2014]. Each VE targets a specific theme and includes structured stimuli intended to support therapist-led reflection. The environments were built focusing on what works, which allows for visualizing possible solutions to what doesn't work, as advocated by PP. However, it should be noted that the way each environment is perceived by the volunteer can turn it into a positive or negative stimulus, despite emphasizing positive experiences. The VEs are summarized below (following figures illustrate the visual design of each environment):

- VE #1 — Perceiving positive events: a Japanese-garden setting supports open exploration in a calm, nature-inspired scene with ambient bird sounds (obtained directly from Unity's free asset) and a stream (Figure 2a–b).

Construct: perception of positive events; savoring¹; attention to positive emotions. The scene is designed to facilitate mindful sensory appreciation and reduce negative rumination.

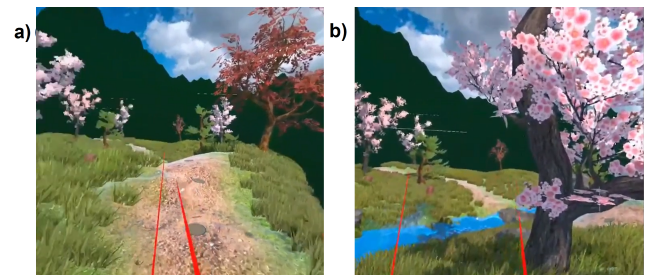


Figure 2. VE #1 - Garden environment in which it is possible to perceive positive events.

- VE #2 — Amplifying positive events: the Gratitude Gallery invites exploration of thirteen paintings and includes a short gratitude-related video (Figure 3a–b). Construct: amplification of positive events; savoring. The visual stimuli are intended to trigger memories and discussion, making positive experiences more vivid and lasting.

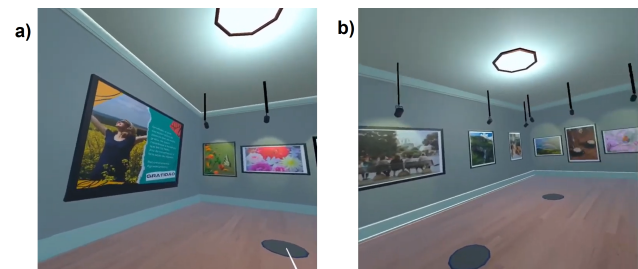


Figure 3. VE #2 - Place with stimuli to amplify positive aspects.

- VE #3 — Gratitude: a small screening room presents three short videos related to gratitude and everyday challenges (Figure 4a–b). Users can stop at any time. The videos were specifically created for the research based on short videos related to the gratitude and were taken from websites with free content. Construct: gratitude. The content is intended to prompt recognition of benefits received and support reflection that can be anchored by brief writing practices (virtual or physical).

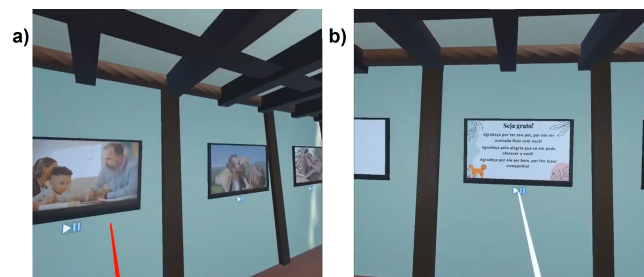


Figure 4. VE #3 - Videos that can increase or encourage the practice of gratitude.

¹ Savoring is the ability to notice, focus on, and prolong positive emotions when they occur. Instead of letting a pleasant experience pass unnoticed, the person takes mental and behavioral actions that increase and extend pleasure, admiration, and joy.

- VE #4 — Activation of positive emotions: an office-like environment contains a large whiteboard for writing and drawing (Figure 5a–b). Despite the whiteboard, the volunteer can write or draw wherever they want (“in the air”). This VE was the best evaluated by psychologist judges [Kunst *et al.*, 2024]. Construct: activation of positive emotions through expressive writing including positive or negative content, supporting reflection and emotional externalization [Diener and Seligman, 2002].

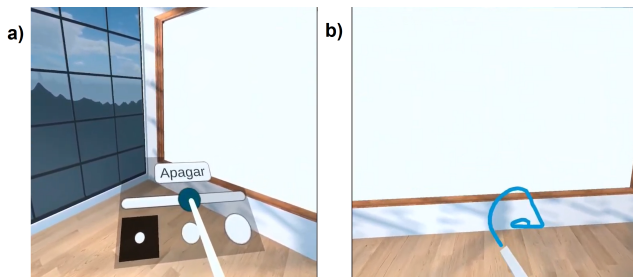


Figure 5. VE #4 - Place where a person can express their emotions.

- VE #5 — Mindfulness: a compact meditation room provides a controlled atmosphere with soft meditation music (obtained directly from Unity’s free asset) and a large mandala (Figure 6a–b). Construct: mindfulness/meditation for emotional regulation, attention, and stress reduction. The scene supports calm, present-focused awareness.

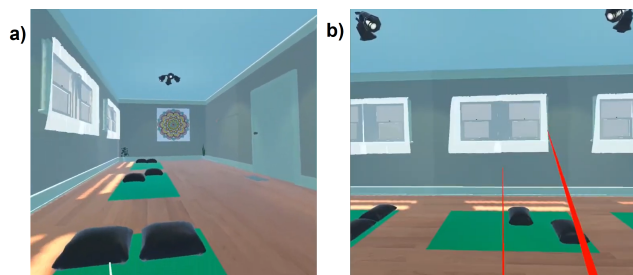


Figure 6. VE #5 - Space intended for the practice of meditation.

- VE #6 — Positive reappraisal: a city scene with everyday activities encourages observation and reinterpretation of experiences while navigating freely, listening to the sound of birds, obtained directly from Unity’s free asset. (Figure 7a–b). Construct: cognitive reappraisal. The design encourages selective attention to positive aspects in daily life and may be strengthened by verbalization during exploration.

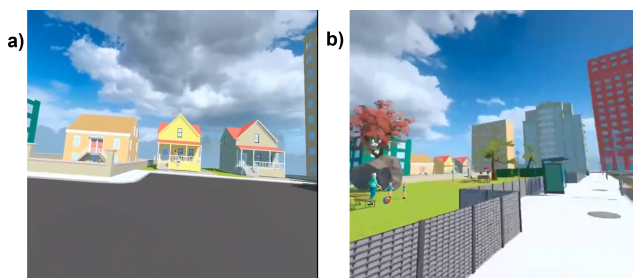


Figure 7. VE #6 - A place where a positive reassessment is possible.

- VE #7 — Personal strengths: a room presents seven short videos based on themes drawn from the VIA Character

website² (Figure 8a–b). From the website, the authorities and icons of the following personal strengths were used: spirituality, self-regulation, leadership, stability, perseverance, and creativity. The videos were specifically created for the research based on short videos related to the personal strengths and were taken from websites with free content. Construct: identification and use of personal strengths (e.g., justice, humanity, courage). The VE encourages reflection on existing strengths and areas for growth.

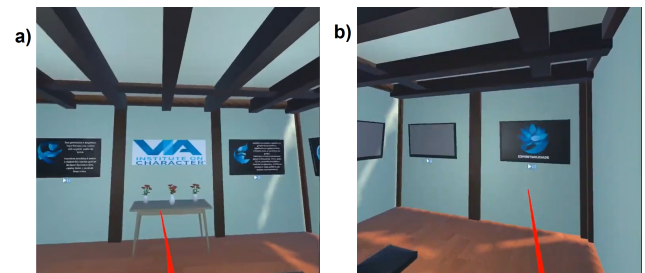


Figure 8. VE #7 - Videos designed to showcase or enhance personal strengths.

- VE #8 — Acts of kindness: a second city environment supports brief conversations with avatars and provides immediate graphical feedback positive or negative based on the user’s responses. Acts of kindness are triggered by the response given and by how the person would feel when dealing with specific situations in real life. The avatars used were obtained from the Unity Asset Store, pre-animated and without sound; interaction occurred via a screen with text (Figure 9a–b). Construct: pro-social behaviors and reciprocity. The experience includes reinforcement via badges³, earned after providing responses, to encourage continued engagement.

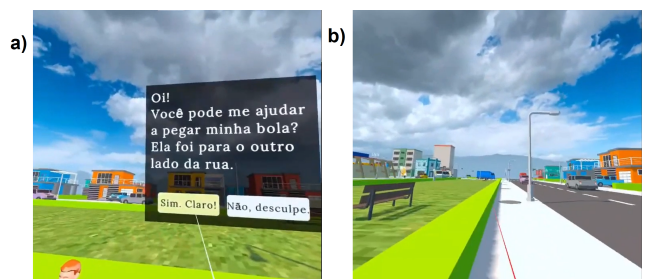


Figure 9. VE #8 - An environment where it is possible to practice acts of kindness towards other people.

Before being applied to volunteers, the VEs were designed in collaboration with a psychologist and reviewed by professional psychotherapists. The intervention is intended for patients under professional supervision in clinical practice.

To increase user engagement, this software incorporates interactive elements:

1. the environments and objects animations are made to enhance the sense of immersion;

²<https://www.viacharacter.org/character-strengths>

³Badges are icons that the platform gives to the user when they perform a desired behavior, in this case, an act of kindness. They function as immediate feedback and a visible record of social progress, showing that the action was noticed and valued.

2. the software offers activities in some environments to create moment of reflection. For instance, in the virtual environment #1, users navigate in different ways along the route; in the virtual environment #8, users answer the question regarding people in the simulation;
3. the software offers some videos with the option to play/pause them, aiming to reflection in environments #3 and #7.

In summary, Positive Psychology VR mechanics are designed to align with psychotherapeutic goals by incorporating virtual environments and feedback with the psychologist.

3.2 Volunteers and Procedure

Thirty adults (23 women, 7 men; median age 34 years) volunteered for the study. They were recruited after responding to advertisements in the university's online newsletter. Half were students ($n=15$); other occupations included a radio broadcaster, a nurse, a notary clerk, and a craftswoman. Participants included individuals affiliated with the university and members of the broader community. Inclusion and exclusion criteria required normal or corrected-to-normal vision and excluded volunteers with self-reported history of epilepsy, seizures, or chronic vertigo-recommended contraindications for research with head-mounted displays [Kemeny *et al.*, 2020].

Volunteers attended three weekly sessions (one per week for three weeks) in a controlled setting: an administrative room with a desk; three padded chairs, one of which is for the volunteer to place their belongings on; a laptop just for loading the scene to the HMD using the SideQuest app; a cell phone for the psychologist to assist the volunteer in navigating the virtual environment; and the HMD. Each session followed the same overall structure. First, the session began with a brief introduction and a discussion with the psychologist to define the topic for that day. For example, upon arrival, the participant would speak with the psychologist and identify the anxiety-related theme to be addressed during the session. While they conversed (during the initial rapport-building phase), the psychologist would consider the eight virtual environments to determine which was best suited for that specific session and the theme raised by the volunteer, adhering only to the rule of not repeating environments for the same volunteer. During the exploration, the psychologist, when appropriate, interacted with the volunteer, for example, to instruct them on how to navigate the virtual environment (VE #1, which required navigating specific points); how they were seated: whether looking out the window or at the mandala (VE #5); how they felt or remembered a moment from their life (used in all VE environments). The psychologist's interventions were minimal to reduce biases or inductions. Volunteers used the HMD for approximately 24 minutes per session. The remaining time was divided into pre-session discussion, onboarding, and post-session integration. Each session lasted approximately one hour in total. Figure 10 summarizes the experimental flow.

The questionnaire was specifically designed for this study and organized into three blocks, as follows:

1. Volunteer characterization: This block was completed

only during the first session and collected demographic and contextual information, including age, profession, gender, spirituality, marital status, current or previous psychotherapy experience, general psychological condition, the issue to be addressed during the intervention, and whether/how this issue affected the volunteer's daily routine.

2. Session experience: This block was completed at each session and collected information about the volunteer's state before and after HMD use, their perception of the day's experience, whether they felt immersed in the virtual environment, whether the system was easy to use, and whether they experienced any discomfort during HMD use. When discomfort was reported, the psychologist recorded its nature and whether any intervention was required, including stopping the session or providing additional support. This block also recorded whether the HMD session was successfully completed, which was used as an indicator of adherence.
3. Intervention progress and acceptability: This block was completed only in later sessions. In the second and third sessions, volunteers were asked about their experience with the HMD in the previous session and their perceived progress during the intervention. In the third session, before concluding the protocol, they were asked whether all sessions had been successfully completed, which was used as an indicator of retention, and whether they would recommend this type of treatment, which was used as an indicator of acceptability.

The decision not to use methods already established in the literature was due to the fact that most of them are constructed in an international context, requiring adaptation to the Brazilian reality. This indicates, according to Zuanazzi *et al.* [2021], a need for greater attention to the particularities of evaluating the psychotherapeutic process in Brazil. Thus, a more qualitative analysis was sought, aiming to "hear" the volunteers' opinions about the experience [Braun and Clarke, 2006].

During sessions, the psychologist took paper notes on psychotherapy-relevant aspects (confidential information) and on the volunteer's experience with the HMD and how the VE could be used in daily life, but without audio/video recordings. All responses were self-reported, meaning no fixed questionnaire protocol was used. The procedure relied on the clinical context of psychotherapy, in which the volunteer reports experiences to support their own mental health, and the psychologist's clinical experience to monitor behavioral changes across sessions. The psychologist also continuously monitored for physical or psychological complications during HMD use as part of professional safety oversight. Data collection for the three-month follow-up was conducted via WhatsApp text messages (each volunteer agreed to be contacted in this way). The sessions were not recorded; the psychologist only made paper notes that did not violate ethical or professional standards.

Volunteers were asked about their feelings and how the HMD experience affected their daily lives immediately before and after each session, again one week later, and at three months after the study ended (follow-up). At the end of HMD

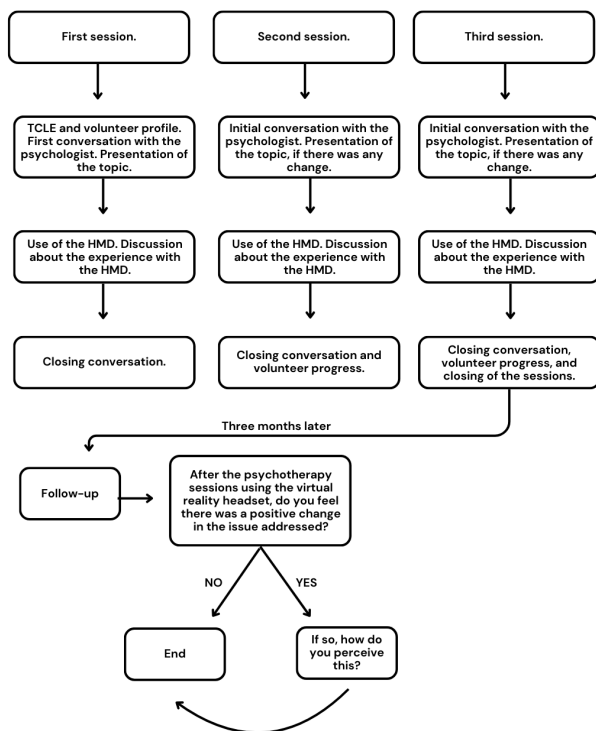


Figure 10. Flow of sessions and follow-up.

use, volunteers were also asked whether they felt discomfort or cybersickness; no serious cases were reported (see Kunst *et al.* [2025b]).

Our attention to cybersickness and discomfort is consistent with recommendations from Birkhead *et al.* [2019], and we followed their guidance to handle participant feedback carefully and systematically. No fixed questionnaire protocol was used for HMD experience and cybersickness. All reports presented in this paper were translated from Portuguese to English.

3.3 Ethical Considerations

This research was approved by the Ethics Committee of the Centro Universitário Frassinetti do Recife - UNIFAFIRE, process number 79310624.4.0000.5586, ensuring compliance with ethical standards and guidelines. Volunteers provided informed consent prior to participation, and collected data were handled anonymously.

4 Results and Discussion

To our knowledge, Positive Psychology-oriented interventions delivered through immersive systems remain comparatively underreported, which limits our understanding of how these experiences are perceived and integrated into psychotherapy practice. Motivated by this gap, we developed Positive Psychology VR and previously validated its design with professional psychologists [Kunst *et al.*, 2024]. In the present study, we focus on participants' and therapist-guided impressions of the intervention: we analyze open-ended, self-reported responses to identify recurring positive and negative

terms, perceived limitations, and salient aspects of the overall experience with the software.

4.1 Analysis of the individual factors of the participants

During the first session, the psychologist invited each volunteer to choose a personal theme to be addressed across the three weekly sessions. As summarized in Table 1, anxiety was the most frequent selected theme: 13 volunteers selected anxiety as the primary theme, and two additional volunteers selected depression/anxiety. This theme was more common among women ($n=11$) and among volunteers aged 20-30, highlighting the relevance of anxiety-related concerns in this sample and providing context for interpreting how different virtual environments were selected and experienced over the intervention period.

Two volunteers chose themes that were explicitly positive in tone. One reported a desire to “delve deeper into the emotional realm,” while the other aimed to “see life in a more positive light.” Both participants were women, aged 52 and 47, respectively. Although these cases were a minority, they illustrate that the intervention was not limited to symptom-focused goals and could also be used to support strengths-oriented reflection and personal growth.

Notably, despite the predominance of anxiety-related themes in the sample, volunteers' descriptions of their overall experience with the HMD tended to shift in a positive direction after the sessions. This positive modulation may reflect short-term changes in emotional state or mindset associated with the combined therapist-guided experience and immersive exposure. Such observations are consistent with prior work showing that Positive Psychology interventions can be delivered through digital formats to enhance well-being and happiness and complement traditional practice [Mitchell *et al.*, 2010; Mongrain and Anselmo-Matthews, 2012; Seligman *et al.*, 2005]. In addition, a growing body of research supports the use of immersive interventions within psychotherapy more broadly [Yaden *et al.*, 2018; Kim *et al.*, 2020; Kvapil Varšová and Juřík, 2024].

4.2 Impact of the environments

We tracked participants' self-reported experience with HMD use across all 3 sessions, summarized in Table 1. Across the study, every volunteer reported enjoying the experience. Their comments captured both perceived therapeutic usefulness, e.g., “it helped me express myself better” and “be productive”, and medium-related impressions, e.g., “I felt protected”, “innovative”, “interactive”, “incredible”, and “different”. These reports do not establish therapeutic effectiveness, but they provide a participant-centered view of how the VR system was experienced in supervised practice.

For VE #1, prior results [Kunst *et al.*, 2025a] indicated favorable participant perceptions regardless of the session in which the environment was used. In the present study, this suggests that the garden environment functioned as a flexible reflective prompt that could be integrated at different moments of the three-session trajectory, depending on the therapist's judgment and the participant's theme.

Table 1. Characteristics of the volunteers grouped by theme. F: female; M: male; ADHD: attention-deficit/hyperactivity disorder.

Volunteer	Age (years)	Gender	Topic covered	General experience with VR	VEs
2	24	F	anxiety	different, curious	4, 2, 8
3	36	F	anxiety	good	1, 8, 3
4	34	F	anxiety	innovative	3, 1, 7
6	28	M	anxiety	interactive	7, 8, 1
9	47	F	anxiety	great	3, 1, 5
11	22	F	anxiety	productive	1, 7, 6
12	26	F	anxiety	curious, reflective	7, 8, 5
16	31	M	anxiety	liked	7, 5, 4
18	34	F	anxiety	loved it, felt protected	5, 3, 1
19	19	F	anxiety	good	4, 1, 3
24	51	F	anxiety	enriching	2, 7, 5
28	24	F	anxiety	good	3, 1, 7
30	28	F	anxiety	different	3, 1, 5
10	54	M	depression, anxiety	different	8, 7, 6
22	21	M	depression, anxiety	good	1, 8, 2
29	35	F	depression	interesting	7, 5, 1
1	29	F	closing cycles	liked	6, 4, 7
7	27	M	closing cycles	liked	7, 1, 5
25	32	M	closing cycles	interesting	3, 7, 1
13	35	M	agitated	innovative	8, 7, 5
14	48	F	agitated	incredible	3, 5, 7
5	52	F	deepening in the emotional field	liked	2, 6, 5
8	35	F	sensitive, fragile	liked	8, 1, 5
15	47	F	see life in a more positive way	wonderful	1, 7, 5
17	21	F	emotionally weakened	helped to express herself better	3, 7, 5
20	24	F	realistic, nervous	good	1, 7, 4
21	22	F	self-sabotage, anger	productive	8, 4, 5
23	36	F	ADHD	liked	7, 4, 5
26	23	F	eating disorder	relaxing	5, 4, 1
27	41	F	discouraged	innovative, impactful	1, 3, 5

Overall, the consistently positive feedback strengthens the case for acceptability in supervised practice. Within the limits of a brief exploratory study, participants described the VR-supported sessions as useful for reflection, emotional expression, relaxation, and recalling session content. These findings are best interpreted as perceived usefulness and acceptability rather than evidence of clinical effectiveness.

Usage frequency provides insight into how the therapist incorporated the environments into the intervention. Remembering that the choice for each virtual environment by the psychologist occurred through the initial conversation with the volunteer about the topic of the day and the professional's free choice for the virtual environment, simply following the rule of not repeating the virtual environment for the same volunteer. As shown in Table 1, the most frequently selected environments were VE #1, VE #5, and VE #7 (18 uses each). This frequency should not be interpreted as evidence that these environments were more effective than the others. Rather, it suggests that nature-inspired, meditation-oriented, and strengths-based environments were often considered suitable for the themes participants brought, especially when the session goal involved calm reflection, emotional regulation, or self-understanding.

Usage frequency further highlights which environments may have contributed most to the reported changes. As shown

in Table 1, the most frequently selected environments by the therapist were VE #1, #5, and #7 (18 uses each). One plausible explanation is that these environments map well to common therapeutic needs in the sample—particularly the preference for calmer, reflective experiences and practices that can be transferred to daily life.

VE #1, for example, is a Japanese garden with birds, a stream, and other nature-like cues. Prior work on nature exposure and virtual forest bathing suggests that naturalistic environments can support relaxation, mood improvement, and engagement [Chen *et al.*, 2025; Kang, 2025]. For the XR contribution of this study, the relevant point is that VE #1 offered a low-interaction, sensory-rich scene that participants could later recall as a memorable anchor for reflection.

VE #5 is a meditation studio designed to support calm, attention, and present-focused practice through a controlled indoor setting and ambient sound. In this environment, the volunteer could work on breathing and everyday challenges while the immersive context reduced external distractions. Related work suggests that relaxation-oriented practices can benefit from immersive delivery [Sari *et al.*, 2025]. In this study, the design implication is that simple, stable, and low-stimulation VR spaces may be useful when the therapeutic goal is guided breathing, attentional focus, or emotional regulation.

VE #7 centers on personal strengths through a room containing seven short videos about strengths-related themes. Volunteers frequently commented on this environment, often because they were not previously aware of a particular personal strength or did not know there was a dedicated resource, such as the VIA Character website, focused on these strengths. This suggests that video-based VR content can serve as a concrete and discussable stimulus for therapist-guided reflection. Rather than requiring complex interaction, VE #7 functioned as a structured prompt for self-understanding, goal-setting, and discussion of coping strategies, consistent with Positive Psychology perspectives on strengths-based framing [Kour et al., 2019; Elstad et al., 2025].

VE #2, used 4 times, is a gallery with background sound that invites exploration of thirteen paintings and includes a short video about gratitude. The images were intended to evoke memories and discussion, supporting the amplification of positive events and possible reinterpretations of personal problems. Of the 4 uses, 3 involved participants who reported anxiety as the topic to be addressed. From a design perspective, VE #2 illustrates how curated visual stimuli can be used as prompts for savoring and gratitude-oriented reflection, constructs that Positive Psychology literature associates with positive affect and well-being [Bryant, 2003; Bryant et al., 2005; Emmons and McCullough, 2003].

VE #3, set in a small projection room, presents three short videos on gratitude and everyday challenges. It was used 11 times, including 7 in the first session, and was often combined across the intervention trajectory with VE #1, VE #5, and VE #7. The environment provided a focused audiovisual prompt for discussing gratitude, recognition of support, and interpersonal meaning. For XR design, this environment shows how short, therapist-mediated video content can be embedded in VR as a reflective stimulus without requiring complex interaction. However, as discussed later, the representativeness of video content is an important design limitation.

VE #4, used 8 times, mostly in the second session and often with topics unrelated to anxiety, is an office-like room with a large whiteboard for writing or drawing. The environment was designed to support emotional expression and externalization through marks, words, or drawings that could be discussed with the therapist. For the XR audience, the important design lesson is that even simple interaction mechanisms, such as free writing or drawing in space, can provide a concrete object of reflection during therapist-guided sessions. This environment, therefore, complements the more observational VEs by providing participants with an active way to express and organize their thoughts.

VE #6, which addresses positive reappraisal, is set in a small urban area where participants observe everyday activities and reinterpret those experiences. It was used three times, including twice in the last session, suggesting that the therapist sometimes used it to reinforce a practice discussed earlier in the intervention. Positive reappraisal involves changing the interpretation of a situation to support positive emotions or psychological well-being [Folkman and Moskowitz, 2000]. In design terms, VE #6 translates this construct into an everyday urban setting, making the reflective task closer to ordinary life rather than placing it in an explicitly therapeutic or symbolic environment.

VE #8, focused on acts of kindness, takes place in an urban environment where participants interact with avatars through brief text-based exchanges and receive graphical feedback based on their responses. It was used 9 times, 6 of which involved participants who brought anxiety as their main topic. The environment was intended to prompt reflection on prosocial behavior, empathy, and reciprocity, which are relevant themes in Positive Psychology [Diener and Seligman, 2002; Hodges et al., 2010]. From an XR perspective, VE #8 is also informative because it exposes a design limitation: acts of kindness were represented mainly through question-answer interaction rather than embodied action, spoken dialogue, or richer avatar behavior. Future versions should explore more interactive forms of helping, more visible feedback, and stronger social presence.

A few negative issues were raised. Volunteer 1, when using VE #6, said she enjoyed the experience, but was left looking for a representation of her body in the VE. Volunteer 10 said he found VE #7 uncomfortable because it was a closed environment. However, he found the VE curious. This Volunteer said he had symptoms of claustrophobia. The same VE #7 still caused Volunteer 13 an uncomfortable sensation that made him sweat, “close his body” and sometimes wanted to leave the room (leave). This fact, according to the psychologist, occurred due to the work theme in the session, which made him react that way while navigating the VE. Finally, Volunteer 17 said, at the end of the last session, that the videos shown in VE #3 and #7 did not represent her, as they included white people and made reference to the Christian religion (understood broadly).

4.3 Final-session perceived progress and acceptability

Across the three sessions, volunteers described how they were feeling throughout the process and, in the final session, reflected on their overall progress. Table 2 compiles these self-reported outcomes. We coded final-session responses into self-awareness, emotional regulation, gratitude, behavioral change, and coping practice. Self-awareness appeared in 10/30 responses, behavioral change in 7/30, and gratitude in 5/30. Several accounts were concrete and action-oriented. For example, Volunteer 7 reported feeling “motivated to be a better person”, Volunteer 13 described beginning to “better notice repetitive patterns”, and Volunteers 14 and 23 emphasized “changes in behavior and awareness”. Notably, these reports emerged across diverse themes, such as closing a cycle, agitation, restlessness, and ADHD, suggesting that the intervention was perceived as meaningful beyond a single presenting concern.

Linking the volunteers’ chosen themes to these reflections also helps clarify the nature of the reported change. For instance, Volunteer 2, who selected anxiety as their focus, concluded that they “think differently” after the sessions. Volunteer 10, who worked on depression and anxiety, reported a “change in well-being.” Taken together, these narratives indicate that even within a brief three-session format, participants perceived shifts in perspective and day-to-day coping strategies, consistent with the goal of using therapist-guided immersive experiences to scaffold reflection and practice.

These subjective accounts are also compatible with emerging evidence that immersive experiences can modulate emotional states and support regulatory processes. Cheng *et al.* [2024] showed, using electroencephalogram-based neural response capture, that immersive interventions can increase positive emotions by enabling autonomy and creative behavior. Li *et al.* [2024] further reported that when a virtual environment succeeds in calming the user, it is associated with decreased oscillatory energy in the α band and increased oscillatory energy in the β band. In practical terms, this pattern is consistent with the idea that calmer states may support greater cognitive control over actions and activities, offering one possible lens for interpreting why volunteers frequently described improved reflection, self-awareness, and emotional regulation after the sessions.

In the final session, we asked volunteers “How likely are you to recommend this VR-based psychotherapy to others?” as an overall indicator of satisfaction. All participants reported that they would recommend the experience (100% recommendation rate). Several volunteers expanded on their ratings by stating that “everyone needs this type of VR-based psychotherapy,” suggesting that the intervention resonated with their expectations and that they perceived it as relevant to people beyond their own situations.

Alongside these self-reports, the psychologist documented observations at each session. Drawing on her experience with traditional psychotherapy without immersive support, she noted behavioral changes that she attributed to the combined use of immersive exposure and Positive Psychology-oriented reflection. Volunteers’ narratives in the final session aligned with these observations. In particular, participants frequently described how the immersive experience helped them visualize scenes, an ability that the psychologist also identified as a common difficulty in traditional practice. Volunteers also framed Positive Psychology as a novel and practical source of personal tools for daily challenges, emphasizing that the themes supported goal focus and concrete coping strategies.

4.4 After-three-months feedback

At the three-month follow-up, two volunteers did not respond and three reported no perceived changes. The remaining volunteers ($n = 25$) described meaningful impacts months after the sessions. The psychologist’s account also provides context for the three volunteers who reported no changes: although they showed positive progress during the sessions, they were described as being in a fragile psychological state, including one participant using medication, and as having low expectations for the research, which may have shaped their follow-up perceptions. Notably, despite reporting no lasting change, these volunteers still indicated that they would recommend this type of psychotherapy using immersive support, pointing to a distinction between perceived long-term personal change and overall acceptability of the experience.

Volunteers’ follow-up narratives provide concrete examples of how the intervention was experienced as meaningful over time. Volunteer 25, a male participant who focused on “closing a cycle,” reflected: “I felt like I was the one who won. Was it only three months? So much has changed, I’m very grateful.” This statement aligns with the progress

observed across his sessions and illustrates a sustained perception of change beyond the intervention period. Volunteer 19, a female participant who worked on anxiety, emphasized continued interest in the format: “I miss the virtual environment in psychology; it was an experience that I’m interested in using in future therapy sessions!” Together, these accounts suggest that the combination of therapist guidance and immersive experiences can be perceived as impactful not only in-session but also as something participants would like to continue integrating into psychotherapy.

Other reports highlight mechanisms that participants themselves considered central. Volunteer 7 stated, “I felt part of the environment. It was very productive,” underscoring the role of immersion in supporting engagement and reflection during the session. Volunteer 10 described a shift in perspective: “It helped me see my problems differently, giving me the chance to observe them from the outside. It allowed me to better understand the patterns and feelings that were affecting me, and gave me new tools to deal with them.” For this volunteer, who brought depression and anxiety as themes, the experience was framed as both reflective and practical. Similarly, Volunteer 18 reported: “I was able to find peace. Today I work in my field and am building a relationship with someone, so I can say that the sessions were truly fundamental in freeing me from the path of anguish that prevented me from accepting, even unconsciously, that good things could happen to me.” This narrative points to perceived gains in self-esteem and social functioning, consistent with the intervention’s intent to support strengths-oriented coping and emotional regulation.

These longer-term accounts are compatible with prior evidence that benefits from relatively brief Positive Psychology interventions can persist beyond the intervention window. Fordyce [1977] reported that after a two-week intervention period, participants continued the program and showed good results. Sin and Lyubomirsky [2009] found in a meta-analysis that shorter interventions (less than four weeks) can maintain positive affect after the sessions, based on 25 articles. Meevissen *et al.* [2011], working with 54 volunteers, observed that optimism could be maintained two weeks after an intervention, with cognitive, behavioral, and physical impacts.

At the same time, it is important to recognize variability in perceived long-term change. Volunteers 17, 29, and 30, approximately 10% of the sample, reported no lasting changes at follow-up. However, during the sessions they described positive progress and incorporation of practices (Table 2, “Feeling at the end of the sessions”), and they still stated that they would recommend this type of intervention to others. As summarized in Table 1, these participants brought different themes (emotionally weakened, depression, and anxiety), while their experience using the HMD was described in positive or neutral terms, e.g., “helped to express myself better,” “interesting,” “different”. Taken together, these results suggest that while short, supervised interventions can produce perceived benefits for many participants, some individuals may require additional sessions with qualified professionals to support the consolidation of in-session gains into sustained changes over time.

As reported previously [Kunst *et al.*, 2025b], only one volunteer showed discomfort, but only in the first session, due to the weight of the HMD. Four additional volunteers

Table 2. General perceptions and follow-up.

Volunteers	Feeling at the end of the sessions	Feeling after follow-up
1	Understand that you do not need to be so strict with yourself	More reflective, has been thinking more calmly and more broadly
2	Think differently	You feel better. You have more confidence to talk about what is bothering you
3	Improvement in the difficulty point	Did not respond
4	Improved self-knowledge, realized things he did not know	I am more disciplined, and i feel more in control of my anxiety
5	Self-knowledge was exercised	I handle his feelings better and with more ease
6	Increased self-knowledge	Did not respond
7	Motivated to be a better person	I felt part of the environment. it was very productive
8	Take the focus off what bothers you and does not let it bother you	It helped to recreate a cool place, making us feel comfortable and connected to that environment, making that situation similar to our day
9	Improved self-knowledge, practiced relaxation in stressful situations	I realized that there were some triggers that were making it difficult for me to move forward in my life, now i am managing to organize myself in relation to these triggers
10	There was a change in well-being	It helped me see my problems differently, giving me the chance to observe them from the outside. It allowed me to better understand the patterns and feelings that were affecting me, and gave me new tools to deal with them
11	More aware of yourself, in how to deal with emotions	It made me see certain things in different ways. it increased my self-awareness, and it gave me other ways to calm down, understand, and soothe my feelings
12	More productive reflection	Focusing on the work experience gave me time for guided reflection to reinforce some changes that were already happening
13	Better perceives repeated patterns	I always think back to the topics I have worked on, and I am trying to work on the areas of difficulty
14	Different behavior than usual	I can better recognize my triggers, verbalize what bothers me, and look at the situation without blaming myself for things that are not my fault. I feel much more confident and self-assured; I have come to understand my limitations and accept my achievements without imposter syndrome. in such a short time, the game has changed
15	Know you have the ability to win. Deepen self-knowledge.	Made me reflect on personal issues
16	Make better decisions through self-knowledge	It made me less anxious and worried. I was able to cope better. I simulated the scenarios
17	Improved self-perception and deeper self-knowledge	There was no positive change
18	Began the practice of gratitude and breathing	I was able to find peace. Today I work in my field and am building a relationship with someone, so I can say that the sessions were truly fundamental in freeing me from the path of anguish that prevented me from accepting, even unconsciously, that good things could happen to me
19	Be more aware of what affects you and deepen your self-knowledge	I miss the virtual environment in psychology, it was an experience that I am interested in using in future therapy sessions!
20	Inserted self-knowledge practice	After the sessions, I applied some things that the psychologist said could improve my issues and I started going to the psychologist too
21	Discovery of distraction points and how to work on them	At first, I did not quite understand the objective, but then the vr headset helped me. I thought everything worked well. It was easier to use (the VR headset) to visualize everything being discussed in the session, even when the scenario was more static and there was not much action
22	More objectivity in the professional path	I have had a significant improvement, because lately I have been relating more with people and the way I speak
23	Change of consciousness, behavior	I have a better awareness of the facts
24	Internalized what was experienced	I must be more kind to myself, on my path, to be careful, to have self-esteem, to not be too hard on myself
25	Achieving goals with love and practices of knowledge and self-knowledge, dealing with life is obstacles calmly	I felt like I was the one who won. Was it only 3 months (in the sense of: 3 months have already passed)? so much has changed, I am very grateful!
26	Not afraid to express yourself and seek help	Sensations of comfort and tranquility more refined
27	Inserted the practice of gratitude into everyday life	I think that experiencing things through images makes it easier to remember later
28	Feeling of worthiness, observing gratitude in a true way, increasing self-care	There was one of the scenes, the garden with a lake, which still makes sense today and I remember it, because I was with a psychologist, but I felt as if I was the only one there and I was the only one following my path
29	See things differently and think positively	In three sessions, it is practically impossible to generate a noticeable change, you know. But I feel like I access some memories through the virtual environment, which has become the anchor of the session, while the other elements (the psychologist's narrative, my perception of the virtual environment, the correlation with the topic, my sensations) seem to exist around this image/memory of the virtual scenarios
30	There was no change in the routine	There was no positive change

related, in the second session, being afraid. However, this feeling was related to the topic worked on and not to the use of the HMD. The other volunteers did not report any cybersickness. As pointed by Hsieh *et al.* [2025], this result

indicates a good clinical feasibility.

Furthermore, it was possible to “track” the affect related to the use of the HMD during psychotherapy throughout the three sessions based on the volunteers’ narratives. For exam-

ple, some of them verbalized the benefit of having a visual stimulus. Volunteer 1 said that it is often difficult to imagine what the psychologist asks and that sometimes what she imagines is not what was requested. “I have difficulty mentally visualizing an environment. With the glasses, this problem was solved,” said Volunteer 1. According to the psychologist, it is normal in a psychotherapy session to ask the patient to imagine a certain place or person; however, sometimes the patient demonstrates difficulty in visualization.

Other narratives confirm the benefit of HMD. “The scenes are very provocative. It opened my mind. Now I evaluate things, think more.” “I don’t see this here in Brazil, neither in clinical practice nor in research.” “For me, the image (virtual environment) was worth (had an impact) more than the conversation (with the psychologist).” “(HMD) made me feel like I was in another place even though I was in a closed room.” “This (use of VR in psychotherapy) should have existed a long time ago. Everyone should experience this tool in Psychology.” Volunteers 11, 4, 28, 6 and 25, respectively.

Volunteers 21 and 30 said that the use of the HMD allowed her to visualize the birds outside of the sessions and even after the three-month follow-up, showing the importance of a standardized stimulus. Finally, Volunteer 27 said, “Since I already do yoga, in the virtual environment I feel like I’m really there” referring to VE 5, and even asked to stay beyond the session time (she was the last person of the day), contemplating the environment and listening to the meditation music.

Thus, the results point to possible practical guidelines, such as:

1. when to use which environment: there is no clear rule, but it is understood that, after anamnesis with the psychologist, she will talk to the patient and perceive which environment to use;
2. for whom: for adults without severe psychopathic conditions;
3. at what stage of treatment: it can already be used in the first session and there is no limitation of use;
4. with what risks: the study showed minimal risk, and it can be used cautiously as it is related to the management of emotions.

Therefore, based on the principles of Psychotherapy and Cohn’s eight skills, the article differs from existing studies on well-being and psychotherapy with VR by bringing a wider range of themes that can be worked on in a single software: appreciating beauty, gratitude, acts of kindness, personal strengths, meditation, self-expression.

4.5 Thematic analysis of qualitative feedback

Based on the questionnaire and themes reported by the volunteers, the qualitative feedback highlights a coherent set of recurring experiences described by participants. Across sessions and follow-up, volunteers frequently pointed to increased self-awareness, shifts in perspective, improved emotional control, and feelings of relaxation, often linking these outcomes to the immersive qualities of the virtual environ-

ments, especially nature-inspired scenes that were remembered as emotionally salient anchors.

The most common terms across the open-ended reports include “self-awareness,” “change,” “anxiety,” “reflection,” “feelings,” “environment,” “nature,” “consciousness,” and “confidence.” Together, these terms suggest that the intervention was primarily interpreted as supporting reflective processes, e.g., noticing patterns, re-framing experiences, and emotion-related outcomes, e.g., calm, regulation, security, with the environment itself often described as an active component of the experience rather than a neutral backdrop.

To make these qualitative trends explicit, we grouped responses into thematic categories that capture how participants articulated their perceived benefits and impressions:

- **Self-awareness:** Participants frequently described deeper understanding of themselves, including recognizing emotions, behaviors, triggers, or recurring patterns.
- **Change of perspective:** Many accounts emphasized seeing problems, themselves, or daily life “in a different way,” suggesting reframing and new interpretations of previously stressful situations.
- **Relaxation and reduction of anxiety:** Volunteers often reported feeling calmer, less anxious, or more at peace after sessions.
- **Reflection:** Reports commonly included deliberate reflection or reconsideration of personal topics, sometimes described as “deep reflection” or sustained thinking after the sessions.
- **Confidence and security:** Several participants mentioned feeling safer, more confident, or more assured, both during the experience and afterward.
- **Emotional control:** Many narratives described new ways of managing emotions, including feeling more able to regulate responses and maintain calm when facing challenges.
- **Nature and environmental connection:** Participants frequently referenced the environments themselves—describing immersion, connection to the scene, and recalling specific places as anchors for emotional experience and later recall.

Table 3 summarizes how often these thematic groups appeared in the dataset. We use high to indicate themes that were repeatedly referenced by many participants, making them dominant across the corpus, and moderate to indicate themes that appeared consistently but less frequently than the dominant group. This frequency-based summary helps situate the qualitative findings by showing which perceived effects were most widespread among participants.

Table 3. Thematic group frequency.

Theme	Term Count
Self-awareness	high
Change of perspective	high
Relaxation/reduction of anxiety	high
Reflection	high
Confidence and security	moderate
Emotional control	moderate
Nature/environmental connection	moderate

4.6 Insights from the thematic analysis

The thematic feedback suggests that the intervention was most consistently experienced as a catalyst for self-awareness, emotional clarity, and a more deliberate interpretation of personal challenges. Participants repeatedly described changes in mindset, often framed as seeing themselves or their problems “in a different way”, alongside shifts in emotional state, particularly relaxation and perceived reductions in anxiety. Importantly, these accounts were rarely detached from the medium: volunteers frequently connected their reflections to the feeling of immersion and to the character of the environments, with nature-inspired scenes often described as especially calming and memorable.

A recurring pattern across reports is the role of the setting as an anchor for recall. Participants often referred back to specific scenes as central elements of what they learned or processed emotionally, suggesting that the environments functioned not only as contexts for discussion but also as cues that supported later recollection and continued reflection. This reinforces the idea that, in supervised practice, immersive setting design can meaningfully shape how therapeutic content is experienced and consolidated.

Taken together, the qualitative data indicates that the intervention supported personal growth, more positive self-perception, and emotional well-being, particularly through experiences that combined immersion with guided reflection.

5 Limitations

This study was designed as an exploratory evaluation of a therapist-guided VR-supported Positive Psychology intervention. Therefore, the findings should be interpreted primarily in terms of feasibility, acceptability, participant experience, therapist perception, and design insights for supervised use. Because the study did not include a control group or random assignment, it does not isolate the specific effect of VR from the broader therapeutic process. The positive reports observed across sessions and at follow-up should therefore be understood as participant-reported perceived benefits, not as evidence of clinical efficacy.

The measurement strategy also reflects the exploratory nature of the study. Data were collected through open-ended participant reports, therapist observations, acceptability records, and follow-up feedback rather than standardized psychometric instruments. This approach allowed participants to describe their experiences in their own terms and helped capture how the virtual environments were integrated into therapeutic reflection. However, it limits comparison with studies that use validated scales and does not allow estimation of clinical effect sizes. Future evaluations should combine qualitative process data with nationally validated measures of well-being, affect, anxiety, presence, usability, and cybersickness.

The qualitative findings should also be interpreted within the limits of the available data. The reported themes were derived from participant statements and therapist observations collected during and after the sessions, and are therefore interpretive and context-dependent. In addition, the reports were translated from Portuguese to English for publication, which

may have affected some nuances of expression. Future studies should adopt a more formal qualitative protocol, including explicit coding procedures, multiple coders when possible, and a clearer audit trail connecting themes to representative excerpts.

Another boundary concerns the therapist-driven selection of virtual environments. In this study, the psychologist selected the environment for each session based on the participant’s theme, emotional state, and therapeutic goals. This reflects how such a system may be used in supervised practice, where the therapist adapts the intervention to the individual. However, because environment selection was not randomized or based on a fixed allocation protocol, the frequency of use of each environment should not be interpreted as evidence that some environments are inherently more effective than others. Future work should document the therapist’s rationale for environment selection more systematically and compare therapist-selected sequences with predefined or randomized sequences and to have more virtual environments that incorporate nature and day-to-day scenarios.

The sample and follow-up also limit generalization. The study involved 30 adult volunteers, most of whom were women, with a median age of 34 years. Although the software was intended for adults and older adults, no participant aged 60 years or older applied to take part in the study. Participants were recruited through a university newsletter and may have been more open to technology-mediated interventions than the general population, even though some participants were from outside the university. Their session themes were also heterogeneous, which was useful for exploring possible uses of the system but prevents conclusions about specific clinical populations. The three-month follow-up adds value by showing that participants could still recall and reflect on the experience after the sessions, but it was self-reported, had two non-respondents, and did not control for other therapeutic activities or life events during the follow-up period.

Finally, some limitations concern the design and content of the virtual environments. The environments were structured as therapist-guided prompts for reflection rather than fully autonomous therapeutic simulations, and some interactions were intentionally simple. For example, VE #8 represented acts of kindness through text-based choices and graphical feedback, without spoken dialogue or more embodied helping actions, which may have limited social presence. Future versions could include richer avatar behavior, gesture-based interaction, adaptive feedback, and more visible reward mechanisms. Cultural and demographic representativeness should also be improved. Although most participants described the environments positively, one participant reported that videos in VE #3 and VE #7 did not represent her because they showed predominantly white people and included references interpreted as Christian. Future iterations should therefore include a more systematic review of racial, cultural, religious, and demographic representation with input from diverse users and therapists.

Overall, these limitations define the scope of the contribution. The present findings support the feasibility and acceptability of using Positive Psychology VR as an adjunctive tool under professional supervision and provide design lessons for VR-supported therapeutic and well-being interventions.

Claims about clinical efficacy, generalization to other populations, or independent use require further controlled and longitudinal research.

6 Conclusion

Our findings indicate meaningful therapeutic outcomes in a brief, supervised intervention. All participants reported that they would recommend the experience (100% recommendation rate), and the follow-up data suggest that perceived benefits can persist three months after the sessions, for facilitating the visualization of the scene being worked on and for incorporating integrated visual, auditory, and navigational aspects. Across the qualitative dataset, the most frequently reported changes concerned self-awareness, shifts in perspective, and reduced anxiety or increased relaxation, pointing to consistent patterns in how volunteers described impact. Participants also commonly linked satisfaction to the immersive character of the experience and to the distinctiveness of engaging with therapeutic themes through virtual environments. Importantly, no serious cybersickness incidents were reported across sessions, which supports the feasibility of delivering the intervention in a structured and professionally supervised setting and is consistent with the broader literature that describes adverse effects in organized therapeutic programs as typically mild and transient.

In practical terms, this work demonstrates how eight theoretically-grounded virtual environments can be integrated into psychotherapy through professional guidance, offering a model that can be replicated in settings where access to diverse therapeutic resources is limited. Usage patterns and participant accounts also help prioritize content: VE #1, VE #5, and VE #7 were the most frequently used environments, and our results suggest that nature-inspired experiences and strengths-oriented stimuli can be especially salient for reflection and recall. These insights can guide future iteration of therapeutic content as well as how clinicians select environments based on individual themes.

At the same time, the follow-up responses underscore variability in longer-term consolidation. Two volunteers did not respond at follow-up, and three reported no perceived lasting change (Volunteers 17, 29, and 30), even though they showed progress during the monitored sessions and still indicated they would recommend the intervention. This pattern highlights the need to better understand dosing and personalization: future studies should investigate optimal session frequency and duration, establish more standardized training and usage protocols for therapists, and examine comparative effectiveness against traditional psychotherapy modalities. From a system perspective, future work should also refine navigation, interaction, and animations in Positive Psychology VR to further strengthen comfort, usability, and engagement. It may also be valuable to compare outcomes between volunteers who focused on anxiety and those who did not, to deepen interpretation of theme-specific effects. Finally, while the present findings are promising, longitudinal studies with larger samples are necessary to confirm generalizability and strengthen the evidence base.

Overall, this work suggests that when immersive experi-

ence design is grounded in theory and delivered under professional guidance, it can open new pathways for psychological reflection and growth, supporting resilience and meaning-making through experiences that participants continue to recall beyond the session itself, indicating its potential application in clinical practice in the field of Psychology.

Declarations

Author contributions

MHK: Writing - original draft. **EHS:** Writing - review. **WLC:** Conceptualization, Formal analysis, Writing - review & editing. **FFFP, CRMM, FLSNM, WPMC, JMT:** Supervision, Writing - review & editing. All authors read and approved the final manuscript.

Conflicts of interest

The authors declare that they have no conflicts of interest.

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Availability of data and materials

Data and materials supporting this study are available upon request at <https://youtu.be/jxU58dT7V9k>.

Use of Artificial Intelligence

Generative Artificial Intelligence tools were used to support the initial reorganization of the manuscript and the revision of the writing, always under full human supervision. Decisions regarding scope, method, interpretation of results, final wording, and responsibility for the content remained exclusively with the authors.

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