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Scientific and methodological foundations of using VR-practices in rehabilitation psychology

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Abstract. The increasing number of individuals affected by military actions in Ukraine has intensified the need for scientifically grounded digital tools in psychological rehabilitation. The rapid development of immersive technologies necessitates the methodological systematisation of their application in rehabilitation psychology. The aim of the study was to substantiate and develop a comprehensive methodology for the application of virtual reality (VR) technologies in rehabilitation psychology, including the systematisation of therapeutic scenarios, the design of an intervention model, and the creation of an algorithm for scenario selection. The research methodology was based on an interdisciplinary theoretical analysis integrating cognitive-behavioural therapy, trauma-focused psychotherapy, neuropsychology, and immersive digital technologies. Methods of analysis, synthesis, structural-functional modelling, and systematisation were applied to construct a three-stage intervention model and to design standardised practical protocols. It was established that immersive environments allow controlled exposure to traumatic stimuli while maintaining psychological safety and therapeutic flexibility. A functional classification of twenty therapeutic scenarios was developed according to their roles in exposure, stabilisation, integration, mindfulness training, and cognitive restoration. A three-stage model of interventions (exposure-stabilisation-integration) was substantiated, ensuring sequential therapeutic influence and minimising the risk of retraumatisation. A step-by-step algorithm for selecting optimal scenarios was designed based on the client's psycho-emotional state, therapeutic goals, and identified triggers. Standardised session protocols were structured, including preparatory, main, and integrative phases with

defined duration parameters and safety criteria. The practical value of the results lies in their applicability for rehabilitation psychologists, clinical practitioners, and higher education institutions training specialists in psychological rehabilitation, particularly in work with veterans, internally displaced persons, and other trauma-affected populations

Keywords: virtual reality; trauma; mindfulness; exposure therapy; methodological protocols

INTRODUCTION

The large-scale psychological consequences of military actions in Ukraine have significantly intensified the demand for structured and evidence-based approaches to psychological rehabilitation. Veterans, internally displaced persons, and civilians exposed to traumatic events require specialised interventions that combine clinical effectiveness with safety, controllability, and adaptability to individual psycho-emotional states. The complexity and scale of trauma-related conditions necessitate scalable and standardised therapeutic tools capable of ensuring both reproducibility and individualised regulation of emotional intensity. Traditional trauma-focused interventions, although empirically validated, present several limitations. They often rely on imaginal exposure or in vivo conditions that may lack sufficient controllability, reproducibility, and graded stimulus modulation. In contexts of severe trauma, these limitations may reduce therapeutic precision and increase the risk of destabilisation. In this regard, virtual reality (VR) technologies offer new possibilities for immersive, controlled, and adjustable therapeutic environments.

Systematic reviews and meta-analyses confirm the clinical effectiveness of VR-based exposure therapy. D. Schröder *et al.* (2023), synthesising randomised controlled trials, demonstrated statistically significant reductions in anxiety symptoms following VR interventions compared to control conditions. Y. Tan *et al.* (2025) further confirmed the effectiveness of VR exposure therapy for social anxiety disorder through meta-analysis and meta-regression, identifying variability in outcomes depending on protocol structure and therapist involvement. These findings not only support the therapeutic potential of VR exposure but also highlight the importance of structured implementation. In the context of post-traumatic stress disorder, L. Eshuis *et al.* (2021) reported that immersive VR exposure therapy is more effective than waitlist conditions and demonstrates outcomes comparable to traditional psychotherapeutic approaches. However, the authors emphasised heterogeneity in intervention protocols and methodological limitations within existing studies. Similarly, L. Dellazizzo *et al.* (2020), in a meta-review of meta-analyses, concluded that VR-based therapies show promising results across psychiatric conditions while underlining the need for greater methodological consistency and standardisation.

Beyond exposure-based interventions, VR applications have been explored for emotional regulation and stress reduction. W. Veling *et al.* (2021), in a randomised crossover trial, demonstrated significant short-term reductions in stress and anxiety levels using immersive relaxation environments. N. Baghaei *et al.* (2021), in a scoping review, identified diverse formats of VR interventions for depression and anxiety and emphasised the absence of unified methodological frameworks. J. Planert *et al.* (2025), through qualitative thematic analysis, highlighted the importance of embedding VR interventions within structured therapeutic pathways and ensuring supervised professional implementation. In previous publications, the authors of the present study examined the integration of VR technologies into the national system of psychological rehabilitation and professional training of specialists in Ukraine. Those studies focused on educational and institutional aspects, emphasising the innovative and scalable potential of immersive technologies in wartime and post-war contexts. These findings are consistent with the results of recent Ukrainian research. In particular, O. Chaban *et al.* (2024) developed a virtual reality exposure therapy protocol for the treatment of post-traumatic stress disorder in military veterans, demonstrating the effectiveness of immersive environments for controlled exposure and cross-cultural adaptation of therapeutic approaches in Ukraine. In addition, M. Kolotilov *et al.* (2025), in a narrative review of post-traumatic stress disorder, highlighted the growing role of cognitive-behavioural and technology-assisted approaches in trauma treatment, emphasising the need for structured and clinically grounded intervention models.

However, despite these contributions, existing studies did not develop a comprehensive methodological framework for the clinical application of VR technologies, nor did they formalise functional classification principles, decision-making algorithms, or safety-oriented implementation protocols. Despite the growing body of evidence supporting VR effectiveness, several critical gaps remain. First, there is insufficient systematisation of VR scenarios according to functional therapeutic groups aligned with specific psycho-emotional states and intervention goals. Second, most studies concentrate on outcome effectiveness rather than providing structured clinical decision-making algorithms for practical application. Third, limited attention has been paid to integrating exposure, stabilisation, and integration phases within a unified methodological framework. Fourth, the issue of structured professional training and competency requirements for specialists implementing VR-based rehabilitation remains underexplored. Addressing these gaps is particularly important in the Ukrainian context, where the scale of trauma demands safe, scalable, and standardised rehabilitation solutions. The absence of clearly defined methodological protocols may hinder effective implementation, limit reproducibility, and increase variability in therapeutic outcomes. Therefore, the aim of

this study was to substantiate and develop a comprehensive methodology for the application of VR practices in rehabilitation psychology. The study seeks to classify VR scenarios into functional therapeutic groups, develop a structured algorithm for scenario selection based on psycho-emotional assessment, and formulate methodological protocols ensuring safety, consistency, and professional applicability.

MATERIALS AND METHODS

The study was conducted within an interdisciplinary framework integrating cognitive-behavioral therapy, trauma-focused psychotherapy, neuropsychology, and immersive digital technologies. The research design was theoretical and methodological in nature and did not involve empirical data collection or participation of human subjects. The study aimed at developing a structured model for applying virtual reality technologies in rehabilitation psychology. A systematic analytical review of contemporary scientific literature was performed to ensure conceptual validity. The search was conducted in the databases Scopus, Web of Science, PubMed, and Google Scholar, with emphasis on publications from 2020-2025 due to the rapid evolution of immersive technologies. Peer-reviewed studies addressing virtual reality applications in trauma therapy, anxiety disorders, neuropsychological rehabilitation, and digital psychotherapeutic interventions were analysed. Priority was given to works presenting clearly described methodologies, empirical evidence, or theoretically grounded models relevant to the development of structured therapeutic protocols. Publications lacking methodological transparency or not directly related to therapeutic applications were excluded. This approach ensured scientific rigor, relevance, and a clear distinction between the theoretical stage of the research and potential future empirical validation.

The method of theoretical synthesis was applied to integrate exposure-based principles of cognitive-behavioural therapy, third-wave approaches (including mindfulness-oriented interventions), and neuropsychological concepts of emotional regulation and neuroplasticity. This synthesis enabled identification of mechanisms underlying immersive interventions, including habituation, extinction learning, attentional regulation, and adaptive memory reconsolidation. Structural-functional modelling was used to construct the three-stage intervention model: exposure, stabilisation, and integration. The exposure stage involves controlled activation of trauma-related emotional responses under monitored conditions. The stabilisation stage facilitates autonomic regulation and grounding through parasympathetic activation. The integration stage supports cognitive restructuring and consolidation of adaptive coping strategies. The sequential structure reflects psychophysiological adaptation processes and ensures therapeutic safety. Functional systematisation was applied to classify twenty therapeutic scenarios integrated into the Meta Quest 2 Pro virtual reality headset. The classification was based on primary therapeutic objective, level of sensory intensity, modality of stimulus presentation, cognitive demand and potential psychological risks. This classification ensured correspondence between technological characteristics and therapeutic goals.

To operationalise practical application, descriptive and algorithmic modelling methods were used to design a structured decision-making algorithm for scenario selection. The algorithm was based on a sequential assessment of the client's psycho-emotional state, determination of the therapeutic objective, evaluation of contraindications and risk factors, and selection of an appropriate scenario in accordance with the functional classification. Duration parameters were determined in accordance with trauma-therapy principles and psychophysiological activation-recovery cycles. The preparatory phase (5-7 minutes) provides grounding and readiness assessment, exposure (3-12 minutes) ensures sufficient activation without overload, stabilisation (5-10 minutes) supports autonomic regulation, and integration (10-18 minutes) consolidates adaptive learning. These intervals correspond to mechanisms of emotional activation and recovery.

The proposed model is primarily theoretical and methodological in nature and requires empirical validation through controlled experimental designs. As part of this initiative, the Kyiv Institute of Business and Technology the NGO Stryzhen are currently conducting pilot testing of VR practices within the educational program Rehabilitation Psychology. At this stage, the use of VR technologies is exploratory and aimed at assessing their applicability, safety, and effectiveness in both educational and rehabilitation contexts. The pilot phase involves the integration of VR scenarios into the training of master's students, with a focus on developing practical skills in the use of immersive technologies for supporting individuals experiencing post-traumatic stress, anxiety disorders, and psycho-emotional exhaustion. The testing process includes systematic monitoring and evaluation of the effectiveness of VR practices, including the analysis of changes in psycho-emotional state, levels of engagement, and the development of professional competencies. In cases where participants are involved in the pilot implementation, ethical principles (The Belmont report…, 1979) are strictly observed, including informed consent, voluntary participation, data confidentiality, and the right to withdraw at any stage, in accordance with generally accepted standards for psychological research.

RESULTS

Theoretical foundations and key VR practices in psychological rehabilitation

The conceptual foundation for the use of virtual reality technologies in psychological rehabilitation lies in the fundamental principles of cognitive-behavioural therapy. Exposure therapy, developed by J. Wolpe (1958), is based on the principle of systematic desensitisation, according to which gradual and controlled confrontation with a feared object in safe conditions leads to a reduction in the anxiety response. The VR environment is ideally suited for

implementing this principle, as it allows for the creation of realistic but fully controlled conditions of exposure, stabilisation, and integration. An additional theoretical basis comes from the third wave of cognitive-behavioural therapy, in particular mindfulness practices and Acceptance and Commitment Therapy. The concept of mindfulness, systematised by J. Kabat-Zinn (1994), emphasised the importance of cultivating skills of non-judgmental observation of one's own thoughts and emotions. Virtual reality creates unique opportunities for training these skills by providing a high level of immersion and sustained attentional focus. The neurophysiological justification for the effectiveness of VR neuro-trainers is based on an understanding of the mechanisms involved in the formation and processing of traumatic memories. Virtual environments activate the same brain structures as real stimuli but in controlled conditions, which allows safe engagement with traumatic material and the development of new, adaptive associations. Modern approaches to psychological rehabilitation increasingly integrate VR technologies, which make it possible to model controlled yet safe environments for therapeutic work. In this context, five key groups of VR practices can be distinguished, each serving specific functions and addressing different stages of mental health recovery (Table 1).

Table 1. Main VR-practices in rehabilitation psychology

Practice	Main Goal	Application Area	Key Advantages
Exposure	Reduction of fear and anxiety through controlled exposure	PTSD[1], phobias, social anxiety, OCD[2]	Realism, controllability, safety, motivation
Stabilisation	Formation of a sense of safety and self-regulation	Before exposure; in states of anxiety or dissociation	Grounding, reduction of hyperarousal, prevention of retraumatisation
Integrative	Incorporating traumatic experience into personal life history	Trauma therapy, work with veterans, psychotherapy of addictions	Post-traumatic growth, new identity, resilience
Mindfulness	Development of mindful presence "here and now"	Trauma, depression, anxiety disorders, chronic pain	Stress reduction, emotion regulation, tolerance to distress
Neuro-trainers	Restoration of cognitive functions through training	Neurorehabilitation; psychological rehabilitation of veterans, ADHD[3], elderly people	Neuroplasticity, individualisation, objectivity, integration with biofeedback systems

Note: [1]PTSD – post-traumatic stress disorder, [2]OCD – obsessive-compulsive disorder, [3]ADHD – attention deficit hyperactivity disorder
Source: developed by the authors based on Y. Kotukh *et al.* (2025a; 2025b) and B. Wiederhold & M. Wiederhold (2025)

Exposure practices are applied to recreate traumatic or anxiety-inducing situations in a virtual space. Through the gradual intensification of exposure, clients learn to regulate their emotional responses and reduce fear levels, particularly when working with PTSD, phobias, or social anxiety. VR technology enables complete environmental control and minimises the risk of retraumatisation. Stabilisation practices in VR provide a sense of safety and the development of self-regulation skills prior to deeper exposure work. Virtual environments are used for interactive breathing and body-based exercises, grounding techniques, and resource-building imagery, which are especially important for preventing dissociation or hyperarousal. Integrative practices in VR aim to incorporate traumatic experiences into an individual's life narrative and restore the integrity of personal identity. The use of group VR environments and interactive storylines facilitates the search for new meanings, existential orientation, and post-traumatic growth. Mindfulness practices in virtual spaces focus on training present-moment awareness. They help restore the ability to observe one's own thoughts and emotions without judgment, reduce stress and anxiety levels, and increase tolerance to distress.

The use of VR interfaces enhances the effect due to multisensory stimulation. Neuro-trainers, integrated into VR headsets, support cognitive function training based on the principle of neuroplasticity. Such practices are applied in rehabilitation after strokes and traumatic brain injuries, in work with veterans and children with attention deficit hyperactivity disorder, as well as in preventing cognitive decline in older adults. VR neuro-trainers combine a high level of individualisation, objective outcome measurement, and the possibility of integration with biofeedback systems. The key advantages of the VR approach are the ability to precisely dose the intensity of therapeutic influence, ensure complete client safety, create standardised conditions of intervention while maintaining the possibility of individualisation, as well as a high level of client engagement and motivation in the therapeutic process.

Three-stage model of VR interventions

Based on the analysis of modern approaches to trauma therapy and the specifics of VR technologies, a three-stage model of therapeutic interventions has been developed, ensuring the sequence and safety of the therapeutic process. The first stage – exposure – involves controlled immersion of the client into a virtual environment containing elements capable of evoking a moderate level of anxiety or discomfort. The goal of this stage is the gradual reduction of sensitivity to trigger stimuli through the mechanism of habituation. An important principle is the dosing of influence – the intensity of stimulation should be sufficient to

activate an emotional response, but not excessive so as not to lead to retraumatisation. The second stage – stabilisation – is aimed at restoring emotional balance and reducing physiological arousal after exposure. At this stage, calming VR scenarios are used, promoting activation of the parasympathetic nervous system and the formation of a sense of safety and control. The stabilisation stage is critically important for preventing the negative consequences of exposure and consolidating positive therapeutic experience. The third stage – integration – ensures the consolidation of the experience gained during the session and the development of skills for independent application of acquired self-regulation techniques. At this stage, the client not only restores emotional balance but also becomes aware of their own resources and abilities to cope with difficult situations in the future. The sequence of stages reflects the natural processes of adaptation of the nervous system to stressful influences and ensures optimal conditions for the formation of new, more adaptive reactions to traumatic stimuli.

Successful practical application of such a model requires organisational support and an institutional environment capable of ensuring its implementation in a broader social context. Therefore, the next step is the implementation of the developed model into practical activities, made possible through cooperation with the NGO Stryzhen. The participation of this organization in a grant program created opportunities for the testing of VR technologies in work with veterans, internally displaced persons, and other categories of affected individuals. Within the framework of a memorandum of cooperation with the Kyiv Institute of Business and Technology, it is planned to implement the task of scientific substantiation and practical integration of VR solutions into the field of rehabilitation psychology, covering both the educational process and clinical practice. In the Meta Quest 2 Pro VR headset, specialised therapeutic scenarios are integrated, developed with the needs of rehabilitation psychology in mind. These scenarios are systematised according to the principle of correspondence with the stages of the three-stage model of interventions and specific therapeutic tasks. The protocol of a VR session includes three main stages, each with specific tasks and methodological features. The preparatory stage, lasting five to seven minutes, involves a comprehensive assessment of the client's readiness for VR intervention. The client's psycho-emotional state is assessed using an anxiety scale from zero to ten points, as well as by observing non-verbal signs of tension. Critical is the identification of individual triggers that may be activated during the VR session. These triggers may be visual (open spaces, bright colours), auditory (loud sounds, specific melodies), or thematic (military symbols, crowds of people). A mandatory element of preparation is the establishment of a stop-signal and a detailed explanation of the possibility of stopping the session at any time.

The main stage, lasting fifteen to twenty-five minutes, implements the three-stage model of intervention. The session begins with an exposure scenario, which allows assessment of the client's reactions and, if necessary, adjustment of the intensity of influence. The transition to the stabilisation stage is based on the observation of the client's physiological and behavioural reactions. Completion with an integration scenario ensures the consolidation of positive experience and the formation of a resourceful state. The psychologist's support during the main stage includes providing short instructions that help the client focus on therapeutic tasks, continuous monitoring of non-verbal reactions, and readiness for immediate intervention in case of signs of distress. It is important to maintain a balance between supporting the client and preserving their autonomy in the virtual environment. The final stage, lasting five to ten minutes, ensures a smooth return of the client to reality and the integration of the experience gained. The gradual removal of the VR headset is accompanied by orienting the client in space and time. Reflection of the experience includes discussing emotional reactions, useful insights, and strategies that helped overcome difficulties. A repeated assessment of anxiety makes it possible to objectively evaluate the effectiveness of the session.

Algorithm for selecting a VR scenario

The selection of a virtual reality scenario within the developed methodology is based on a structured assessment of the client's psycho-emotional state and the therapeutic objective of the session. The algorithm was designed as a methodological tool to ensure clinical safety, consistency, and alignment between intervention intensity and client readiness. The first stage of the algorithm involves a comprehensive assessment of the client's baseline condition. Anxiety level is evaluated using a subjective scale (0-10), complemented by qualitative analysis of behavioural manifestations and individual response patterns. Specific triggers are identified through structured clinical interviewing and observation. The client's physical state, including fatigue level and general well-being, is also considered, as these factors influence the selection and intensity of immersive stimulation. The second stage includes defining the primary therapeutic objective of the session. An exposure-oriented objective is determined when controlled activation of trigger stimuli is clinically appropriate and the client demonstrates relative emotional stability. A stabilisation objective is prioritised when elevated emotional arousal or physiological tension is observed. An integration objective is defined for clients who have developed basic self-regulation skills and are prepared to consolidate adaptive coping strategies. The third stage consists of selecting the scenario according to the established objective and the functional classification criteria. At this stage, sensory intensity, cognitive load, and potential risk factors are evaluated. The implementation phase includes continuous monitoring of behavioural and physiological indicators, allowing dynamic adjustment of stimulation parameters. The final stage ensures structured completion of the session through resource-oriented scenarios and reflective discussion of the experience. This algorithm constitutes a component of the methodological framework and is summarised in Table 2.

Table 2. Correspondence of VR-scenarios to stages of work

Stage of work	Goal	Recommended practices	Duration	Cautions
Exposure	Controlled immersion	Metaphorical images for working with emotional overload; grounding techniques via natural landscapes	3-5 min	Open spaces, fog
Exposure peak	Deepening contact with the stimulus	Slow movements with focused attention; complex sensory techniques	7-12 min	Sounds, complexity of instructions
Transition to stabilisation	Reduction of intensity	Underwater environments with smooth movements; interactive elements	5-8 min	Bright colours
Stabilisation	Restoration of control	Natural landscapes with selective attention; combined breathing techniques	5-10 min	Winter scenery
Integration	Consolidation of experience	Cyclical metaphors; interactive trainers for action algorithms	10-18 min	Demand on cognitive resources

Source: developed by the authors based on W. Veling *et al.* (2021), L. Eshuis *et al.* (2021), D. Schröder *et al.* (2023) and Y. Tan *et al.* (2025)

The structure presented in Table 2 reflects a sequenced therapeutic logic that integrates exposure, stabilisation, and integration as interconnected stages of intervention. The progression from controlled immersion to peak exposure, followed by reduction of intensity and restoration of self-regulation, corresponds to psychophysiological mechanisms of emotional activation and recovery. The differentiation of goals, recommended practices, duration parameters, and precautionary factors is intended to ensure alignment between the client's current psycho-emotional state and the intensity of immersive stimulation. The specified duration intervals are based on safety-oriented exposure principles and the need to prevent overstimulation, while allowing sufficient time for emotional processing and consolidation. Overall, the table operationalises the methodological framework by translating theoretical principles into structured practical guidance for rehabilitation psychology.

Effective implementation of virtual reality technologies in rehabilitation psychology requires structured professional preparation and clearly defined organisational conditions. Professional training should integrate theoretical knowledge, supervised practical experience, and personal immersion in VR environments as interconnected components of competency development. Theoretical preparation encompasses understanding the principles of exposure-based interventions, mechanisms of stress reactivity and emotional regulation, as well as neurophysiological responses to immersive stimuli and potential adverse effects such as dissociation, cybersickness, or excessive arousal. Practical training is based on supervised sessions with a gradual increase in scenario complexity, enabling specialists to develop the ability to assess the client's psycho-emotional state before and during immersion, identify early signs of distress or overstimulation, adjust sensory intensity in real time, and apply grounding or stabilisation techniques when necessary, including safe termination of exposure if required. Personal immersion in VR environments plays a critical role in developing professional competence, as it allows specialists to experience sensory load, recognise potential emotional triggers and perceptual distortions, and better anticipate client responses, thereby improving the timing and accuracy of therapeutic interventions.

Organisational conditions also significantly influence the effectiveness of VR-based rehabilitation. The technical environment should ensure stable hardware performance, properly calibrated equipment, hygienic safety, and uninterrupted access to communication tools. The physical space must be designed to provide sufficient freedom of movement, eliminate potential hazards, and maintain appropriate lighting, sound insulation, and ventilation conditions. Prior to each session, structured screening procedures are required to identify contraindications and potential risks. Absolute contraindications include epilepsy with seizure risk, acute psychotic states, and severe cognitive disorganisation, while relative contraindications may involve reduced concentration, pronounced psychomotor retardation, or technology-related phobias. Screening should also account for vestibular sensitivity and susceptibility to cybersickness. Ethical compliance is ensured through a clearly defined informed consent process, which includes explanation of the immersive nature of VR exposure, possible psychological and physiological reactions, the participant's right to discontinue the session at any time, procedures for managing adverse reactions, and conditions for data processing and confidentiality. Confidentiality requirements extend to behavioural responses recorded within the VR environment, session logs, and any physiological monitoring data. Data storage must comply with general clinical confidentiality standards and digital data protection regulations. Thus, effective VR implementation in rehabilitation psychology depends not only on technological availability but on structured training, therapist competence, controlled environmental conditions, and clearly defined ethical safeguards.

DISCUSSION

The findings of the present study extend the existing body of empirical and theoretical research on virtual reality in psychotherapy by proposing a structured, safety-oriented, and operationalised methodological framework that integrates exposure, stabilisation, and integration within a unified model. Unlike many previous studies that primarily focus on treatment outcomes, the present research emphasises procedural standardisation, clinical decision-making,

and scenario classification, thereby addressing key methodological gaps identified in contemporary literature. The proposed approach is consistent with empirical evidence demonstrating the effectiveness of VR-based exposure therapy for anxiety and trauma-related disorders. A meta-analysis of randomised controlled trials conducted by E. Carl *et al.* (2019) confirmed that VR exposure therapy produces significant reductions in anxiety symptoms and shows comparable effectiveness to traditional in vivo exposure. Similarly, D. Schröder *et al.* (2023) and Y. Tan *et al.* (2025) provide high-level evidence supporting VR interventions, particularly emphasising their capacity to deliver controlled and reproducible exposure. These findings align with the exposure component of the three-stage model developed in the present study. However, while prior research validates effectiveness, it often lacks structured protocols for tailoring intervention intensity and sequencing therapeutic stages, which are explicitly addressed in the proposed algorithm.

In the context of post-traumatic stress disorder, L. Eshuis *et al.* (2021) demonstrated that immersive VR exposure therapy is more effective than waitlist conditions and comparable to conventional psychotherapy. At the same time, J. Maples-Keller *et al.* (2017) emphasised the importance of controlled environments and therapist-guided exposure in ensuring both safety and therapeutic effectiveness. These findings are directly reflected in the current model, which integrates continuous monitoring and adaptive intensity regulation as core elements of intervention design. The theoretical foundations of the proposed methodology are also supported by broader conceptual frameworks in psychotherapy. In particular, the integration of mindfulness-based and acceptance-oriented approaches corresponds to the principles of Acceptance and Commitment Therapy, which emphasises psychological flexibility, emotional regulation, and experiential processing (Hayes *et al.*, 2006). The inclusion of stabilisation and integration phases in the present model expands traditional exposure paradigms by incorporating mechanisms of emotional recovery and cognitive restructuring, thereby addressing limitations of purely exposure-based approaches. Furthermore, the conceptualisation of VR as a transformative therapeutic medium is consistent with the work of G. Riva *et al.* (2016), who highlighted the potential of immersive technologies to reshape experiential processing and facilitate psychological change. The ability of VR to simulate controlled yet realistic environments enables not only exposure but also the reconstruction of meaning and identity, which is particularly relevant in trauma rehabilitation.

Empirical support for the integration of multiple therapeutic functions within VR systems is provided by I.-C. Stanica *et al.* (2024), who demonstrated that multi-therapy VR interventions produce significant improvements in both psychological and physiological outcomes. This supports the multidimensional structure of the present model, which combines exposure, stabilisation, and integration rather than treating them as isolated components. In contrast to such integrated approaches, many earlier studies focus on single-function interventions, thereby limiting their applicability in complex clinical contexts. At the same time, several studies emphasised the lack of methodological consistency in VR-based interventions. L. Dellazizzo *et al.* (2020) and N. Baghaei *et al.* (2021) highlighted heterogeneity in protocols, outcome measures, and implementation strategies, which complicates comparison across studies and reduces reproducibility. The present research directly addresses this limitation by proposing a structured classification of therapeutic scenarios and a decision-making algorithm that standardises intervention selection based on psycho-emotional state and therapeutic goals.

The importance of structured implementation is further supported by qualitative findings reported by J. Planert *et al.* (2025), which underline the need for coherent therapeutic pathways and professional supervision in VR-based treatment. B. Wiederhold & M. Wiederhold (2025), in an expert review article, discussed the combination of virtual reality therapy with physiological monitoring to provide objective treatment metrics in post-traumatic stress disorder. Although the publication format is conceptual rather than experimental, it highlights the potential value of incorporating physiological indicators into VR-based treatment frameworks. This perspective supports the inclusion of monitoring elements within the safety-oriented algorithm developed in the present methodology. Y. Li *et al.* (2026) presented a protocol for a systematic review examining the effectiveness of self-guided virtual reality exposure therapy for social anxiety disorder. As a protocol, it does not report outcome data but indicates emerging scientific interest in autonomous VR applications. Similarly, W. Graham *et al.* (2025), in a systematic review published as a preprint, analysed self-guided VR therapy for anxiety and noted both accessibility advantages and concerns regarding insufficient clinical supervision. Compared to these autonomous models, the present approach retains therapist guidance while integrating algorithmic decision-making, thereby balancing personalisation with clinical oversight.

In addition to international research, the findings of this study are consistent with emerging Ukrainian scholarship on the role of VR in psychological rehabilitation. Y. Glybchenko (2023) conceptualises VR technologies as a PeaceTech instrument capable of supporting psychological recovery and resilience in wartime conditions, emphasising their scalability and societal relevance. Moreover, previous studies by Y. Kotukh *et al.* (2025a; 2025b) demonstrate the feasibility of integrating VR into both educational and rehabilitation systems in Ukraine, highlighting its potential for training specialists and supporting trauma-affected populations. However, these studies primarily focus on institutional and applied aspects, whereas the present research advances the field by providing a structured methodological framework for clinical implementation. The stabilisation phase proposed in the current study finds empirical support in the randomised crossover trial conducted

by W. Veling *et al.* (2021), which demonstrated that immersive virtual relaxation significantly reduces stress and anxiety levels in psychiatric populations. As this conclusion is derived from a randomised controlled design, it provides empirical justification for incorporating relaxation-based VR scenarios as a distinct therapeutic component rather than an auxiliary feature of exposure.

Overall, the proposed model differs from existing approaches in several key aspects. First, it introduces a functional classification of VR scenarios aligned with psycho-emotional states and therapeutic objectives, which is largely absent in prior studies. Second, it operationalises clinical decision-making through a step-by-step algorithm, addressing the lack of standardised implementation procedures. Third, it integrates exposure, stabilisation, and integration into a single coherent framework, thereby reflecting psychophysiological processes of activation and recovery. Finally, it incorporates safety-oriented mechanisms, including continuous monitoring and adaptive intensity regulation, which respond to concerns regarding retraumatisation risk.

CONCLUSIONS

The developed scientific and methodological foundations for the step-by-step application of twenty VR scenarios in rehabilitation psychology create a theoretical and practical basis for the introduction of innovative technologies into the national system of psychological assistance. The three-stage model of interventions ensures systematic and safe therapeutic processes, and detailed protocols and algorithms provide specialists with concrete tools for practical work. Systematisation of VR scenarios by functional purpose makes it possible to select therapeutic interventions in a targeted way, depending on the client's current needs and stage of rehabilitation. The developed methodological recommendations take into account both technical and ethical aspects of VR application, ensuring high standards of professional activity. The implementation of Meta Quest 2 Pro with integrated therapeutic scenarios into rehabilitation psychology practice has significant potential to improve the effectiveness of assistance to individuals with traumatic experiences. Controllability, safety, and a high level of client engagement make VR technologies a valuable addition to traditional methods of psychological rehabilitation. The presented methodological developments are the initial stage toward large-scale implementation of VR technologies in national psychological practice.

The proposed methodological framework has implications not only for clinical practice but also for the modernisation of professional training in rehabilitation psychology. Its implementation requires systematic integration of structured VR-based modules into university curricula, the development of competency-based standards for immersive interventions, supervised practice models, and regulatory guidelines to ensure safe, ethical, and effective professional application. Further development of this field requires empirical testing of the effectiveness of the proposed approaches, expansion of the VR toolkit, and systematic training of qualified specialists. Successful implementation of these tasks will contribute to a significant improvement in the quality of psychological rehabilitation and the creation of a modern, technologically equipped system of psychological assistance in Ukraine.

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Науково-методологічні засади використання VR-практик у реабілітаційній психології

Анотація. Зростання кількості осіб, які постраждали внаслідок військових дій в Україні, актуалізувало потребу у науково обґрунтованих цифрових інструментах психологічної реабілітації. Стрімкий розвиток імерсивних технологій зумовлює необхідність методологічної систематизації їх застосування у реабілітаційній психології. Метою дослідження було обґрунтування та розроблення комплексної методології використання технологій віртуальної реальності (VR) у реабілітаційній психології, зокрема систематизації терапевтичних сценаріїв, проєктування моделі втручання та створення алгоритму вибору сценаріїв. Методологія дослідження ґрунтувалася на міждисциплінарному теоретичному аналізі, що поєднує когнітивно-поведінкову терапію, травмофокусовану психотерапію, нейропсихологію та імерсивні цифрові технології. Для побудови трьохетапної моделі втручання та розроблення стандартизованих практичних протоколів застосовано методи аналізу, синтезу, структурно-функціонального моделювання та систематизації. Встановлено, що імерсивні середовища забезпечують контрольовану експозицію до травматичних стимулів із збереженням психологічної безпеки та терапевтичної гнучкості. Розроблено функціональну класифікацію двадцяти терапевтичних сценаріїв відповідно до їх ролі в експозиції, стабілізації, інтеграції, тренуванні усвідомленості та когнітивному відновленні. Обґрунтовано трьохетапну модель втручання (експозиція – стабілізація – інтеграція), що забезпечує послідовний терапевтичний вплив і мінімізує ризик ретравматизації. Запропоновано покроковий алгоритм вибору оптимальних сценаріїв з урахуванням психоемоційного стану клієнта, терапевтичних цілей і визначених тригерів. Структуровано стандартизовані протоколи сесій, що включають підготовчий, основний та інтеграційний етапи з визначеними параметрами тривалості та критеріями безпеки. Практична цінність результатів полягає у можливості їх застосування реабілітаційними психологами, клінічними практиками та закладами вищої освіти, які готують фахівців у сфері психологічної реабілітації, зокрема у роботі з ветеранами, внутрішньо переміщеними особами та іншими категоріями осіб, що зазнали травматичного впливу

Ключові слова: віртуальна реальність; травма; усвідомленість; експозиційна терапія; методологічні протоколи