PAPER

Mindfulness, Kindergarten, and Virtual Reality

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ABSTRACT

Mindfulness plays a crucial role in reducing stress levels and enhancing executive functioning and self-regulation. Several studies have shown that technology can have positive effects because it can aid mindfulness training. This review is the second part of a project that investigates the advantages of technology and mindfulness in kindergarten. In the previous section, we examined the role of social robots. However, this review focuses on the use of virtual reality (VR) in mindfulness practices. The objective of our study is to provide a comprehensive overview of the current research on the subject of VR and mindfulness. We aim to examine the possible pros and cons of this technology and, most importantly, inspire more investigation into the application of virtual technology in kindergarten settings. We conducted a systematic review of the literature. The results indicate that VR improves the mindfulness condition. VR settings provide a secure and reliable environment that offers enjoyable experiences for young students. Additionally, they enhance the focus, awareness, and regulation of breathing for the participants. The VR experience should have a simple layout that is easily distinguishable from the actual world. Additionally, the technology used should be appropriate for the target age group. Our primary objective is to inspire further research into the application of VR and mindfulness in kindergarten.

KEYWORDS

virtual reality (VR), mindfulness, kindergarten

1 INTRODUCTION

Mindfulness practices are being employed more often in schools to promote social-emotional learning. However, there is a limited understanding of their effectiveness in early childhood settings [1]. Studies have linked mindfulness to various favorable effects, such as improved interpersonal interactions, reduced stress, and enhanced well-being [2].

Lertladaluck et al. [3] report that school-aged children have used various mindfulness programs, such as the Inner Kids Program, Learning to Breathe, and MindUP, to improve their cognition, academic performance, behavior, and social-emotional well-being. These programs typically aim to promote relaxation and reduce stress [3].

Mindfulness can be defined as an individual's deliberate and unbiased focus on both internal and external stimuli in the current moment. Moreover, those who have elevated levels of mindfulness have enhanced proficiency in managing their adverse emotions, employing constructive coping mechanisms when confronted with challenges and setbacks, and sustaining interpersonal connections. Evidence suggests that the emergence of problem behaviors in early childhood can lead to lower academic performance and increased social maladjustment later in life, even though many behavior issues may resolve as individuals grow mentally [4].

Researchers have suggested mindfulness and meditation activities as potential remedies for reducing anxiety and sadness in individuals by promoting their awareness of current sensations with inquiry and empathy. Studies have demonstrated that these practices enhance the skills of stress resistance, promote emotion control methods, and reduce depressive mood [5]. This is because encouraging techniques to regulate emotions reduces feelings of depression [6].

Multiple studies have consistently demonstrated that virtual reality (VR) may effectively generate anxiety levels, both in terms of subjective experience and physiological responses, that are similar to those reported in real-life situations. Furthermore, the inclusion of gamification components in virtual environments has the potential to enhance motivation by introducing rewards, a storyline, and game advancement. Especially in children and teenagers, incorporating gamification features is believed to have a good effect on engagement and motivation. Moreover, researchers expect the use of immersive gear, such as VR glasses, to reduce the impact of external distractions and improve concentration on the job [7].

Digital well-being technologies have the potential to transform mental health interventions by addressing trainees' needs and offering more positive and transformative mental support [8]. Utilizing VR and incorporating its components into games, applications, and programs with specific objectives might significantly enhance emotional intelligence advancement in individuals of all age groups [9]. Research has shown [10, 11] that patients are capable of applying the knowledge gained from virtual environments to real-life situations.

This paper focuses on two research questions: 1) Can VR enhance mindfulness training in kindergarten, and 2) What are the main characteristics of VR that can be beneficial in mindfulness training? Taking this into consideration, the research initially examines the possible advantages of incorporating mindfulness practices in kindergarten within a broader context. Subsequently, it assesses the potential of VR as an educational aid for preschool children, followed by an evaluation of mindfulness-based VR programs. Ultimately, it highlights the benefits that VR offers, specifically in relation to its potential for enhancing mindfulness training in educational environments. The study aims to raise questions for future research.

2   METHOD

This study is a comprehensive review of articles. Our objective was to investigate the existing knowledge on the topic and highlight possible gaps in the literature. The databases we used were Google Scholar, Research Gate, and Mendelay. We included only English-language studies. We conducted the review using the following key words: VR, mindfulness, and kindergarten.

3 MINDFULNESS AND KINDERGARTEN

Social-emotional abilities are seen as essential components for future readiness for school and academic success. Research indicates that the development of social-emotional skills and executive functioning plays a crucial role in enabling children to effectively handle stressful situations, establish positive relationships with instructors and classmates, and regulate their emotions [12]. Improving emotional self-control and stress management skills in preschoolers boosts executive function and metacognitive abilities, and it is a crucial means of helping children deal with difficulties in both their personal lives and academic settings [13]. Practicing mindfulness [14] is one potential method for promoting social-emotional development. Yoga and mindfulness programs that are suitable for a child's age can assist in the development of their critical thinking abilities.

The prevalence of mindfulness-based preschool programs is limited. Nevertheless, there has been significant development in this field in recent years. Evidence indicates that mindfulness programs implemented in schools can enhance the executive functioning and self-regulation abilities of preschool-aged children. These programs are particularly significant in fostering the growth of working memory, attention, inhibition, and pro-social behavior in early children [2]. Furthermore, it is crucial to acknowledge that early childhood is a critical phase for the formation of self-regulation skills. Self-regulation refers to the capacity to manage and govern one's emotions, physical state, and focus in order to effectively accomplish objectives and enhance general well-being [15]. For instance, Flook et al. [16] found that children who engaged in a 12-week mindfulness-based kindness curriculum demonstrated enhanced social competence and achieved higher scores in learning and social-emotional development.

Lertladaluck et al. [3] investigated the efficacy of mindfulness training in enhancing executive function skills in preschool children who are at risk of experiencing delayed executive function development. The findings indicate that implementing mindfulness training in schools has a beneficial impact on executive functions, which are essential prerequisites for self-regulation in preschool children with initially limited executive function abilities [3].

Providing programs to encourage self-regulation in an early childhood environment is crucial [15]. Scientific evidence supports the effectiveness of a 15-minute mindfulness activity, such as focused breathing, yoga, or sensory awareness, in helping children inhibit automatic impulsive reactions and instead select a more intentional response. The findings of the studies [15] indicated that mindfulness programs can facilitate the growth of self-regulation in young children, namely in cognitive, emotional, and behavioral aspects. These programs have the potential to offer academic rewards.

Bert and Cigala [17] examined the impact of a mindfulness-based intervention on the development of social-emotional learning skills in preschool-aged children. They conducted a pilot study to assess the pro-social behavior, self-regulation, and perspective-taking abilities of 21 toddlers. Their findings demonstrated that the intervention had a notable impact on the pro-social behavior, inhibitory self-regulation, and perspective-taking abilities of the children, particularly in terms of their emotional and cognitive aspects [17].

Shlomov et al. [18] conducted a study to investigate the impact of a mindfulness-based curriculum, designed specifically for preschool children, on various elements of executive functioning. The study randomly divided 51 preschool-aged

children into two groups: one group received a mindfulness- or kindness-focused curriculum, while the other group engaged in an active control program known as dialogic reading. The findings suggest that preschool classrooms can introduce mindfulness-based curricula, which could potentially enhance executive functions in young children during the preschool period [18].

Moreno Gomez et al. [19] aimed to assess the efficacy of the mindfulness-based program Mindkinder research in enhancing school adjustment, addressing school behavior problems, and improving school results among preschool kids. A total of 118 students, aged between five and six years, participated in this study. Based on the findings, the experimental group exhibited a noteworthy enhancement in school adaptation, school conduct issues, and academic performance. Hence, this study indicates that mindfulness programs have the potential to enhance school adaptation and academic achievements during childhood [19]. A separate study investigated the impact of mindfulness training on young children. The study registered 31 Chinese preschoolers for a five-week mindfulness training program, conducted twice a week. A set of tests measuring executive functions assessed their cognitive flexibility, ability to suppress irrelevant information, and capacity to hold and manipulate information in their minds. The findings demonstrated a considerable improvement in cognitive shifting and working memory ability [20]. These studies indicate that mindfulness-based education shows promise for increasing children's skills and shaping their experiences [18].

3.1 Virtual reality and kindergarten

Virtual realities' ability to generate life-like virtual environments that completely engage learners, along with its ability to be repeated and controlled, has been effectively utilized in different domains, including education and healthcare, yielding positive outcomes [21]. However, research on virtual environment settings in kindergarten is limited. Unfortunately, there is also a huge literature gap when it comes to virtual environments promoting mindfulness skills in children aged four to six years. We present a number of studies using VR in kindergarten, as well as their outcomes.

Kusuma et al. [22] created a VR learning application that focuses on introducing different varieties of fish. The purpose of developing this application was to enhance the learning experience in kindergarten by focusing on the introduction of aquatic species, with a specific emphasis on fish. Their findings were that introducing VR technology, particularly for showcasing different species of fish, can effectively captivate kids' interest in learning, as young individuals tend to have a strong sense of curiosity. VR also enables the pupils to discern the diverse forms of fish and have a better understanding of the underwater environment [22].

The study by Lorusso et al. [23] investigated the effects of a partially immersive VR system on a group of 25 children in a kindergarten setting in Italy. The current study suggests a method that aims to improve motor skills, perceptual functions, executive functions, and social skills. They used a semi-immersive VR system called Nirvana 1. The children showed enthusiasm and curiosity and actively participated in the activities. The findings indicate that VR and digital applications have the capacity to become significant tools in enhancing children's cognitive and social growth, as well as enhancing regular educational activities in kindergarten environments.

Bakr et al. [24] presented a study where they used a novel VR tool, known as the CAVE (cave automated virtual environment), with kindergarten children so that the

kids would help them create an improved kindergarten building. They presented two kindergarten designs to the participants and questioned them about the architectural layout and colors. The results validated CAVE as an effective visualization tool that aligns with children's abilities and visual perception. Shapira, Amores, and Benavides [25] conducted a study using the Tactile VR environment, a VR system that allows users to freely navigate and engage with actual objects and toys. This study included children between the ages of five and 11. The study exposed the children to TactileVR and engaged them with virtual representations of real objects. Children quickly adapted to the TactileVR environment, instinctively explored various interactions, and finished activities more efficiently compared to non-tactile virtual items. Furthermore, the existence of tangible toys provided the chance for cooperative play, even in situations where only a portion of the children were utilizing a VR headset.

In a computerized dynamic assessment procedure, specifically in a three-dimensional interactive VR, Caligiuri [26] investigated the effects of a teaching method on children's cognitive adaptability in the area of analogical reasoning. They inquired whether a computerized setting for a dynamic assessment (DA) approach would more accurately demonstrate the child's cognitive modifiability compared to a standardized situation using tangible blocks. Children's cognitive modifiability appears to be influenced by both the kind of representation used in teaching and the level of immersion and partnership with the computer, as well as the mediation tactics employed.

3.2 Virtual reality and mindfulness

Modern technologies such as smartphone apps and VR headsets have gained popularity and made the practice of meditation, which aims to make mindfulness more accessible. According to Schaffer [5], VR experiences can enhance mindfulness practices because they are distraction-free environments. Similarly, research notes that VR systems significantly enhance profound relaxation [2]. The primary psychological result of mindfulness-based therapy facilitated by VR appears to be a reduction in anxiety [27]. VR is widely recognized as an educational tool that enhances students' experiential learning because it employs visions, particularly positive visualizations, to mentally imagine peaceful places for the purpose of relaxation and self-control [28].

As previously said, while mindfulness has undeniable advantages for preschool children, there is a lack of research that explores the combination of VR with mindfulness in this age group. However, we have conducted extensive research on this topic in older individuals and adults, allowing us to draw specific conclusions about the effectiveness of VR and its potential benefits in mindfulness training for younger age groups.

To begin with, M. Modrego-Alarcón et al. [29] researched the efficacy of a mindfulness-based program with and without VR to support stress reduction in university students. Individuals with anxiety often exhibit a tendency to excessively concentrate on metacognitive experiences, disregarding their current circumstances [30]. So, mindfulness could help them regulate their emotions. The sample consisted of 280 students from Spain who were randomly assigned to one of three groups: a mindfulness condition, a mindfulness condition enhanced by VR, or a relaxation condition. The findings indicate that VR surroundings enhance the mindfulness condition. Another study, which was conducted by Feinberg et al. [31],

presented learner-centered insights from 36 participants in a VR environment specifically created to teach meditation techniques to beginners. To facilitate learners' advancement, they developed ZenVR, an interactive system that delivers an eight-lesson meditation curriculum. They carried out a six-week longitudinal examination in a laboratory setting with 15 individuals who were new to meditation. They observed statistically significant enhancements in mindfulness and self-reported proficiency in meditation [31].

"Virtual Meditative Walk" (VMW) is a VR system that helps patients focus their attention inward during mindfulness meditation. Participants can fully engage in a VR experience by navigating around a forest, surrounded by gentle ambient breezes [32]. The design's purpose was to assist patients in learning MBSR (mindfulness-based stress reduction) meditation by providing immediate feedback and additional training reinforcement. Over time, patients developed the ability to utilize this consciousness beyond the VR setting [32].

Another study [33] examined the connection between meditation and VR. This study used a virtual environment in which participants went through three different stages. Each phase included a distinct setting where a "vocal coach" directed them through various exercises, utilizing skin conductance as a form of biofeedback to modify the environment's condition. The results indicated that post-session relaxation levels were significantly higher than pre-session relaxation levels, suggesting that short-term interventions can have immediate impacts [33].

A study was conducted on a group of healthy individuals in order to examine the effects of VR on dissociation, mindfulness, and self-efficacy. A VR system fully engaged the participants for 20 minutes. They were instructed to explore their surroundings and locate a certain set of objects that they had previously seen in images. Questionnaires were given before and after the immersion experience to evaluate the levels of psychological variables. Furthermore, cybersickness was evaluated. The findings revealed a positive correlation between immersion in the VR environment and an increase in dissociation and mindfulness [34].

Shakirova et al. [35] investigated the potential of VR in effectively enhancing the meditation experience. They integrated VR with mindfulness meditation and examined the impact of both mindfulness and relaxation, with or without VR. So, they created the "meditation island," a calm environment that resembled a mountain lake view. Participants could also listen to forest and bird noises. Even those who did not engage in VR meditation were provided with headphones playing background music [35]. The researchers either exposed the groups to VR or not and provided them with either mindfulness meditation instructions or basic relaxation instructions. However, the study was unable to substantiate the primary premise that even brief mindfulness meditation might augment subjective well-being as well as foster detachment and inquisitiveness towards one's internal experiences. The authors attempted to justify this outcome as a result of the VR design. More specifically, the virtual environment should clearly distinguish itself from the real world, enabling participants to focus on their work without distraction from the virtual world's flaws [35].

Research investigating short mindfulness-based interventions (MBIs) in VR among adult participants who are both new and experienced in meditation has shown encouraging results, including improvements in mindfulness and psychological well-being. A recent study found that administering a short MBI through VR reduced anxiety levels in homeless children [36].

Yildirim and O'Grady [33] aimed to examine whether a short VR mindfulness intervention could elicit a higher level of mindfulness compared to an audio-based

intervention and a control group. This practice aimed to direct their attention to their breathing and encourage them to fully experience the present moment. This guided mindfulness practice lasted 10 minutes, and the audio recording incorporated ambient beach sound effects, such as the sounds of ocean waves and bird tweeting, to enhance the immersion of the practice. The participants reported a higher level of awareness compared to those in the group that received guided audio [33].

Drigas, Mitsea, and Skianis [37] examined the efficacy of brain-rewiring approaches implemented in VR settings as an innovative solution for individuals with learning difficulties and other disorders, as well as the potential of these VR-assisted strategies to enhance metacognitive abilities. They examined several studies that analyzed the use of VR in mindfulness therapy. More specifically, they mentioned the research of Serra-Pla et al., which assessed the initial VR mindfulness therapy for individuals diagnosed with ADHD. The results demonstrated enhanced self-management of sadness and anxiety in the experimental group. They also analyzed Modrego et al.'s study, which was a randomized controlled experiment to assess the advantages of a VR mindfulness program in stress management. The findings indicated that VR mindfulness had a beneficial effect on the control of stress. Asati et al. (as mentioned in Drigas et al.) [37] evaluated the advantages of using VR meditation to improve sustained attention. The participants' brain waves indicated a higher state of relaxation, according to the results.

Miner [38] created a VR experience called "Stairway to Heaven." He designed this experience to provide mindfulness and breathe awareness training, utilizing a respiration sensor to regulate the teleportation mechanics within the virtual environment. In this virtual adventure, the participants need to control their breathing in order to move around the virtual "island" [38]. VR experiences, such as Stairway to Heaven, can effectively support breathe awareness training in VR by utilizing gamification strategies. The findings of Miner's research suggest that the integration of mindfulness training, respiration sensors, and VR can greatly facilitate the practice of mindful breath awareness.

Kosunen et al. [39] introduced RelaWorld, a neuro-adaptive VR meditation system that integrates VR and neurofeedback. They used a coastal landscape to enhance relaxation, and they intentionally chose a gender-neutral representation. The device utilized electroencephalography (EEG) to monitor users' brain activity in real-time. The findings of the research indicate that RelaWorld induces a more profound state of relaxation, a heightened sense of presence, and a deeper degree of meditation in comparison to a comparable configuration lacking a head-mounted display or neurofeedback [39].

Chandrasiri et al. (as mentioned in Kelly et al.) [40] conducted a study in a general population sample to compare the effects of using VR mindfulness software. They found that using the app, which included an audio guide and a 360-degree video clip of a beach, led to an increased state of awareness. They conducted a comparison between their VR application and a guided audio track. In both experimental situations [40], the level of mindfulness increased significantly [40].

In the study of Navarro-Haro et al. [10], 44 individuals participated in a mindfulness conference where they wore an Oculus Rift DK2 VR helmet. They experienced a serene 3D computer-generated environment. Participants not only embraced the intervention but also exhibited a notable increase in their state of mindfulness and had improved emotional well-being following their VR session.

The study of Crescentini et al. [41] utilized immersive VR to replicate low- and high-stress scenarios that can happen in real life. This study examined the impact of an eight-week mindfulness meditation program on the psychological and

physiological reactions triggered by immersive virtual environments. The designers designed these environments to replicate emergency situations with varying levels of stress, mirroring real-life experiences. The study showed that engaging in regular meditation for a duration of two months resulted in enhanced mindfulness abilities and decreased levels of both temporary and enduring anxiety.

4 VIRTUAL REALITY ADVANTAGES AND CHARACTERISTICS

Virtual reality enables users to observe and engage with a computer-generated environment. More than 50 years ago, the technology first surfaced, but its expensive cost and the need for specialized hardware capabilities hindered its widespread availability to the public. Recently, there has been a shift in this perspective. With the decreasing cost of headsets and technological advancements, VR is now accessible outside of expensive laboratories [33].

Virtual reality systems include a complex interaction between technology and human perception. Three key characteristics distinguish VR systems from other representational technologies: immersion, interactivity, and a sense of presence [28]. Currently, the majority of meditation applications do not utilize the interactive capabilities of VR because of the fear that there will be possible distractions in the virtual world. However, a drawback of this approach is that it lacks full interactivity and fails to fully utilize the technology to its maximum potential [42].

Virtual reality can be experienced through several types of displays, including conventional desktop PCs, head-mounted displays (HMDs), and cave-automated virtual environments [21]. Prior research has identified factors such as headset dimensions, weight, and comfort as potential obstacles. Furthermore, VR has the potential to induce sensations of disorientation and simulator sickness in certain individuals, thereby compromising its safety and acceptability as a mindfulness tool for certain users. These issues must be considered while selecting VR technology, developing the virtual environment, and planning the mindfulness exercise. One further difficulty is that meditation technology might be excessively calming and potentially induce drowsiness among meditators, which contradicts the state of being fully aware in the present moment [40].

Currently, the literature does not have comprehensive knowledge of the appropriate design principles for incorporating mindfulness into VR experiences. Kelly et al. [40] designed and evaluated Place, an application that facilitates mindfulness practice by immersing the user in a virtual forest setting. They examined the critical design decisions that designers must consider when developing VR experiences for mindfulness. The design approach could provide valuable insights for future studies of VR. Initially, it showcased the significance of employing an iterative and user-centric design method in developing VR interventions. Furthermore, the design process focused on important factors related to promoting mindfulness practice, such as the selection of a virtual environment, the credibility of the environment, and numerous concerns regarding consistency [40].

We should utilize digital mindfulness support to create an aesthetically pleasing environment for mindful interaction, which encourages individuals to deeply contemplate the present moment, presence-in, and presence-with. When it comes to digital mindfulness assistance, it should encourage the user to feel a sense of being present with objects or inside a natural or digital environment that inherently offers opportunities for mindfulness [43]. Another study proposed creating virtual environments that symbolically mirror the natural environment instead of attempting

to replicate it. This approach could enhance immersion by acquainting participants with an imperfect world and allowing them to concentrate on the study's objective rather than motivating them to actively search for the concealed flaws inside a virtual environment [35].

Lorusso et al. [11] suggest that VR is well-suited for preschool children due to its simplicity in comprehension and ease of interaction. Young children lack the ability to think abstractly; hence, they require the use of tangible objects or media in order to facilitate meaningful learning [22]. The effectiveness of mindfulness interventions in schools is contingent upon the expertise and training of teachers. Therefore, it is imperative that teachers, parents, and caregivers receive training in order to effectively implement these strategies in the classroom [28].

After evaluating the literature and the positive effects of VR mindfulness, we couldn't help but notice the advantages that the VR technology offers to the users, which aid the feeling of relaxation. Firstly, VR settings offer a predictable, safe, and supportive setting that minimizes external factors that could cause stress. Furthermore, incorporating VR into mindfulness training improves both self-awareness and recognition [28]. Additionally, the visual interaction pathways can reduce cognitive load and enhance user attention [37]. According to Drigas and Karyotaki [44], the cognitive load on working memory due to the emphasis on external attention cues has an effect both on knowledge encoding, the structure of mental representations, and working memory retrieval. VR enables the creation of dynamic 3D environments that engage several senses, allowing the brain to respond as it would in a real-life scenario. Additionally, VR environments offer authentic challenges and create an immersive and collaborative learning setting by encouraging learners to cultivate critical thinking skills and enabling them to analyze different facets of a problem. On top of that, the learning is game-based, boosting internal motivation and facilitating the acquisition of skills. Furthermore, developers intentionally design games to be motivating, captivating, and enjoyable, while some perceive meditation alone as a challenging task [45]. Lastly, the immersive environment enhances the feeling of being present, leading to more profound levels of information processing. Researchers have found that these positive characteristics of VR optimize educational results [37]. In general, VR satisfies the requirements of ART (accessibility, relevance, and timeliness) and offers the benefit of providing experiences to users regardless of their location. VR allows for the conceptual sensation of 'being elsewhere' without the need for physical travel. VR's 360-degree immersive experiences have the ability to captivate, inspire, and involve users in achieving their goals [38].

5   RESULTS AND DISCUSSION

The aim of this paper was to answer the following two questions:

1. Can VR enhance mindfulness training in kindergarten?
2. What are the main characteristics of VR that can be beneficial in mindfulness training?

Regarding the first, we couldn't find research that focused on VR mindfulness training in kindergarten. However, we analyzed how kindergarten kids reacted in VR environments and investigated multiple studies about VR mindfulness and its outcomes in older children and adults. Therefore, the literature review suggests that VR environments can enhance mindfulness training. This suggestion should be the

starting point for further research in the field, specifically for kindergarten kids. VR can be an effective intervention tool as it has beneficial effects on stress control, improves sustained attention and awareness, and enhances emotional regulation.

Researchers also discovered that VR experiences bolster breath awareness, a crucial aspect of mindfulness. Additionally, VR can elicit emotions of presence and immersion, improve our psychological well-being, and enhance the self-management of sadness and anxiety.

As a result, childhood is a critical stage for the formation of executive function abilities and self-development; educational programs that incorporate techniques such as mindfulness have the potential to impact brain development as early as preschool. Therefore, we should prioritize finding the optimal ways to teach mindfulness to young children. VR, with its gamification design, deeper states of relaxation, and a heightened sense of presence, has the ability to be an effective tool in kindergarten.

Concerning our second research question, VR proves to be an exceptionally captivating and enjoyable tool for young learners. VR offers three key attributes, namely immersion, interactivity, and the sensation of presence, which render it a very valuable tool in the hands of educators. It provides genuine challenges and fosters an engaging and cooperative learning environment by motivating learners to develop their critical thinking abilities. Furthermore, gamification structures the learning process, enhancing internal drive and facilitating skill acquisition. VR settings provide a controlled and secure environment that eliminates external elements that may induce stress. Additionally, the visual engagement routes in VR can decrease cognitive strain. Moreover, designers intentionally design games to be stimulating, fascinating, and pleasurable, whereas individuals sometimes perceive meditation as a challenging endeavor.

Furthermore, our findings suggest that the VR environment should clearly distinguish itself from the real world, enabling participants to focus on their tasks instead of becoming distracted and scrutinizing the virtual world's shortcomings. We found that this design yielded better results in terms of the participants' concentration and attention. Additionally, when designing a VR experience for young learners, it's important to consider the headset dimensions and the weight of the equipment. The simple design and the direct interaction make VR a well-suited tool for kindergarteners.

Undoubtedly, despite a few exceptions when VR causes feelings of nausea and sickness, it is a very promising tool that offers multiple advantages. However, we should conduct further studies that compare a VR mindfulness session to a typical one. Additionally, if our objective is to integrate VR into education, we must devise strategies to make it more cost-effective for schools. This is because, although the cost has decreased, the necessary equipment remains a significant expense and could potentially hinder its use. Lastly, it is necessary to start designing VR mindfulness experiences targeting kindergarten kids.

6 CONCLUSIONS

The studies have demonstrated that VR can facilitate short-term changes in the mindfulness state. VR technologies are effective in several therapies, and VR mindfulness training in particular offers immersive sensory experiences and relaxed environments. Furthermore, VR mindfulness enhances a range of physiological and neuropsychological factors closely linked to metacognitive capabilities, and VR breathing strategies facilitate participants' effortless ability to concentrate

their attention. VR has the ability to create a serene and captivating environment and, indeed, has the potential to revolutionize education by enhancing both societal experiences and cognitive abilities. Societies can incorporate VR metacognitive concepts into educational and professional environments to optimize performance and promote inclusivity.

Nevertheless, this study emphasizes the necessity for additional research into the long-term impacts of the interventions as well as an analysis of the best practices for applying them in kindergarten. The results of this study can also guide the decision-making and implementation of educational policies and strategies in early childhood environments. Additionally, they can enhance the methodological robustness and preparation of future studies investigating the effects of VR mindfulness on young children. We hope that this review will enhance curiosity in future researchers to cover the literature gap for VR mindfulness practices in kindergarten.

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