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Original Article

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Improving or worsening? the development and evaluation of a VR-based psychotherapy to bullying victims and perpetrators in school adolescents

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ABSTRACT

Introduction: Bullying remains a pervasive issue in schools, with significant long-term effects on mental health and social development. This study evaluated the effectiveness of a Virtual Reality (VR)-based emotional regulation intervention in addressing bullying among school adolescents, focusing on changes in self-perceived roles as victims or bullies and associated difficulties.

Methods: This study used a quasi-experimental design, with 98 junior high school students assigned to either a four-session VR intervention (n=33) or a no-treatment control group (n=65). The intervention consisted of four 15-minute psychotherapy sessions using the PeriXa Batin VR module. Data were collected using the Strengths and Difficulties Questionnaire and System Usability Scale (SUS). Statistical analyses included the Mann-Whitney U test, a General Linear Model (GLM), and thematic analysis.

Results: The intervention was associated with a significant reduction in self-perceived bullying behaviors ($p < 0.001$), particularly among males. However, it also led to an increase in self-reported difficulty scores ($p < 0.005$). The VR module was received positively, with high usability ratings, although some participants reported minor technical issues and temporary discomfort, such as dizziness. The VR intervention effectively fostered self-awareness, which may explain both the reduction in bullying and the concurrent increase in emotional distress as victims confronted their experiences. The limitations include short intervention duration, small sample size, and reliance on self-reported data.

Conclusions: While VR is a promising tool, schools should implement it alongside support systems, such as counseling, to help students manage the challenges of increased self-awareness. Future research should focus on the long-term effects and integration of such technologies into comprehensive school wellness programs.

Keywords: adolescents, bullying, virtual reality, emotional regulation, school-based intervention

Introduction

Bullying is a pervasive global issue defined as intentional, repeated, intentional aggressive behavior within a power imbalance, manifesting in both physical and verbal forms (Volk, Dane and Marini, 2014; Keliat and Pasaribu, 2023). In Indonesia, it has become a significant public health concern, with a high proportion of students reporting experiencing harm (Badan Pusat Statistik, 2023). The consequences for victims are severe and long-lasting, often including chronic psychological disorders,

such as depression and anxiety, which can escalate to suicidal ideation (Agustiningsih *et al.*, 2024; Hwang, 2025). This impact frequently extends into adulthood, contributing to poor long-term health, impaired self-esteem, and challenges in forming relationships (Ferreira and Coelho, 2024; Momose and Ishida, 2024), thereby underscoring the urgent need for effective intervention.

A key pathway to addressing this issue is to enhance adolescents' self-awareness, which is fundamental to developing self-control and emotional regulation. Research indicates that low emotional clarity and poor attention to emotions are directly linked to increased relational aggressiveness, a tendency that is often mediated by a lack of self-control (Moroń, Doktor and Glinka, 2018). Conversely, interventions that foster self-awareness through self-reflection can improve emotional regulation, helping adolescents recognize and manage impulsive reactions that often precipitate bullying behaviors (Zahra and Hayati, 2022; Hadi and Gharaibeh, 2023). By cultivating this internal skill, it is possible to encourage prosocial decision-making and break the bullying cycle (Lewis, Himmelberger and Elmore, 2021).

Virtual Reality (VR) offers a novel and immersive platform for delivering interventions aimed at enhancing self-awareness and emotion regulation. By creating a powerful sense of presence in realistic simulations, VR provides a safe and controlled environment where adolescents can practice and develop emotional skills without the risks associated with real-world exposure (Slater, 2018; Ionescu *et al.*, 2021) However, while the therapeutic potential of VR is well-documented in various settings interventions (Riva, Mantovani and Gaggioli, 2004; Slater, 2018; Ionescu *et al.*, 2021), a significant gap remains in the current research concerning its application in this specific context. Rigorous studies evaluating the use of VR-based therapy for bullying prevention and emotional regulation among school adolescents are emerging, highlighting the critical need for evidence to inform practice.

To address this gap, the present study developed and evaluated a novel, brief VR-based emotion regulation therapy module for school adolescents involved in bullying. The primary aim was to evaluate the effectiveness of the intervention in altering participants' self-perceived roles as bullies or victims, and to assess concurrent changes in their associated psychosocial difficulties. The secondary aim was to examine the influence of gender on these outcomes and assess the usability and user experience of VR applications.

Materials and Methods

Study Design

The study employed a quasi-experimental pre-test/post-test design with a non-equivalent control group. Participants were recruited from two junior high schools in Depok, West Java, with one school assigned to the intervention site and the other to the control site.

Sample and Sampling

Recruitment occurred in two distinct phases. First, an initial pool of 300 students were screened for eligibility. The inclusion criteria for this phase were students aged 11–16. Students were excluded if they had a pre-existing diagnosis of severe mental illness or were currently receiving other forms of psychological therapy. From the pool of eligible students, purposive sampling was used to select a smaller cohort for inclusion in the study. Specifically, we selected students who reported the highest total difficulty scores on the Strengths and Difficulties Questionnaire (SDQ) during screening. This selection resulted in a target sample of 105 students who were allocated to the intervention group (n=35) or the control group (n=70) based on their school attendance. After accounting for participant dropout (two in the intervention group and four in the control group) and removing one incomplete response, the final analyzed sample consisted of 33 students in the intervention group and 65 in the control group.

A 1:2 allocation ratio was implemented, owing to constraints on time and available VR equipment (Dumville *et al.*, 2006). This approach allowed for intensive monitoring of the smaller intervention group while maintaining a larger and more stable control group for comparison, thus balancing the practical limitations of a novel intervention with the need for scientific rigor. A priori sample size calculation was conducted using G*Power software (Faul *et al.*, 2007). To detect a moderate effect size with a power of 0.8 and a 95% confidence interval using a t-test approach, the target sample size was determined to be adequate.

Variables and Instruments

The primary outcome variables were Perceived Role as Bully/Victim and Perceived Difficulty, which were measured using the Strengths and Difficulties Questionnaire (SDQ). Perceived Role was assessed using two direct yes/no items from the SDQ's impact supplement. Perceived Difficulty was measured using the 25-item SDQ, which is divided into five subscales: Conduct Problems, Emotional Symptoms, Peer Problems, Hyperactivity, and Prosocial Behavior. Parent-child communication was examined using a 10-item questionnaire rated on a Likert scale adapted from a previous study Widyatuti, Hafilah Shabrina and Yuni Nursasi (2018). The instrument focused on key elements such as the adolescents' ability to discuss feelings, their comfort in expressing emotions, and the perceived responsiveness of their parents, yielding a total score of 40 points. The usability of the VR application was assessed using the System Usability Scale (SUS), a standard 10-item tool for evaluating user friendliness (von Wangenheim et al., 2016). The SUS provides a score

from 0 to 100, where a score above 68 is considered to be above average. In this study, SUS was used to measure participants' perceptions of the VR program's ease of use, feature integration, and overall user satisfaction.

Participants in the intervention group received a 15-minute VR psychotherapy session each day for four consecutive days, totaling four sessions. The primary outcome measure, the Strengths and Difficulties Questionnaire (SDQ), was administered after completion of the fourth and final sessions. The System Usability Scale (SUS) was administered after the first session to gauge the initial user experience. The control group served as the no-treatment control group for the primary outcome. The post-test SDQ was administered to this group on the same day that the intervention group completed their fourth session, establishing a comparable endpoint for analysis. Following the collection of all primary outcome data, participants in the control group were offered a single 15-minute VR session as an ethical consideration to ensure that they also received a potential benefit from participating in the study. SUS was administered to this group immediately after a single session to gather comparable usability data. Sessions were held in the morning at the school premises, strategically timed when there were no class schedules to ensure minimal disruption and enhance participant availability. The experiment was conducted by a dedicated team of two enumerators and two researchers. All team members underwent rigorous training prior to the study to ensure consistency and standardization in delivering the intervention.

Data were collected using Google Forms and stored in a university repository accessible solely to the research team to ensure participant confidentiality and security. A researcher analyzed all quantitative data from all questionnaires using SPSS v.26 employing various statistical methods, including normality, correlation tests, and a General Linear Model (GLM) to draw meaningful and accurate conclusions from the findings. Then, four researchers worked together to perform grouping and sentiment analysis in qualitative data following SUS with thematic and content analysis using a shared Google Sheet.

Development of Program

The intervention utilized a VR-based low-intensity psychological therapy module named *PeriXa Batin*, which was delivered using Meta-Quest 2 and 3 devices. The module was co-developed by a multidisciplinary team of mental health nursing experts and software developers, using the Unity platform. The design was guided by established emotion regulation theories and an iterative process involving subject matter experts to ensure clinical relevance. The core of the intervention was a 12-minute guided psychotherapy session designed to help participants regulate emotions, such as sadness, anger, and frustration. The session began with an introduction and relaxation phase, in which participants were guided into a calm mental state using deep breathing techniques within a tranquil virtual environment. Following this, the gathering and releasing emotion phase prompted participants to visualize negative emotions and then guided them through metaphorical forgiveness exercises. Finally, the session concluded with a focus on acceptance and closing, using affirmations to cultivate patience before bringing the participant back to full awareness, with the aim of leaving them feeling refreshed. A translated version of the full-session script is available as supplementary material.

Ethical Consideration

This study was approved by the Research Ethics Committee of the Faculty of Nursing, Universitas Indonesia (Reference: KET-214/UN2.F12.D1.2.1/PPM.00.02/2024). Permission to conduct research was secured by the administration of both participating schools. Prior to data collection, written informed consent was obtained from the parents or legal guardians of all participants, and written consent was obtained from each adolescent participant. All participants were informed that their involvement was voluntary, that they could withdraw from the study at any time without penalty, and that their data would be kept confidential and would be used solely for research purposes. such as data gathering, statistical examination, and interactions with participants, were thoroughly examined and found to meet the necessary ethical criteria to safeguard the rights, confidentiality, and well-being of all individuals participating. By following this ethical framework, the study maintains the credibility of its results and showcases its dedication to conducting research in a responsible and morally sound manner.

Results

A total of 98 junior high school students participated in the study, with 65 (66.3%) in the control group and 33 (33.7%) in the intervention group. Demographic and baseline characteristics of the patients are shown in Table 1. The majority of the participants were male (60.2%) and in the 7th grade (61.2%). The age of the students ranged from 11 to 16 years, with most being 13 years (49.0%). At baseline, a significant portion of the sample self-identified as having been a victim of bullying (65.3%), whereas 40.8% perceived themselves as having been involved in bullying others.

Correlation Between Perceived Role as Victims or Bullies and Self-Perceived Difficulties Across Groups Pre and *Post Intervention*

Our study revealed crucial insights into the correlation between perceived roles as victims or bullies and self-perceived difficulties across groups, before and after the intervention (Table 2). For participants

Table 1. Demographic of Participants

Variable	Category	n	Percent
Group	Control	65	66.3%
	Intervention	33	33.7%
	Total	**98**	**100.0%**
Grade	7	60	61.2%
	8	38	38.8%
Gender	Male	59	60.2%
	Female	39	39.8%
Age	11	2	2.0%
	12	20	20.4%
	13	48	49.0%
	14	26	26.5%
	15	1	1.0%
	16	1	1.0%
Bullying Involvement Perception	Yes	40	40.8%
	No	58	59.2%
Victim	Yes	64	65.3%
	No	34	34.7%

identifying as victims, pre-intervention findings indicated a significant positive correlation with communication difficulties ($\rho = 0.239$, $p < 0.01$), suggesting that victims often perceived challenges in effectively communicating. However, emotional difficulty showed a weaker, non-significant association ($\rho = 0.138$, $p = 0.114$). Post-intervention, the victims' perceived roles displayed stronger correlations with peer problems ($\rho = 0.279$, $p < 0.01$) and emotional difficulties ($\rho = 0.285$, $p < 0.01$), reflecting heightened challenges in these areas. Moreover, hyperactivity exhibited a significant post-intervention correlation with victimization ($\rho = 0.201$, $p < 0.05$), suggesting an increase in perceived difficulties intervention. For participants identified as bullies, pre-intervention correlations showed slight, non-significant associations with peer problems ($\rho = -0.146$, $p = 0.103$) and conduct issues ($\rho = -0.132$, $p = 0.145$). Interestingly, post-intervention, these correlations diminished or remained insignificant, with weak associations observed for peer problems ($\rho = 0.040$, $p = 0.651$) and conduct issues ($\rho = 0.133$, $p = 0.140$). This suggests that the intervention had little to no measurable impact on the relationship between perceived roles as bullies and self-perceived difficulties.

Overall Changes in Role as Bullies or Victims and Perceived Difficulty After Intervention

The VR-based intervention significantly influenced participants' self-perception of bullies ($Z = -3.692$, $p < 0.001$), as shown in Table 3. However, the intervention did not result in a notable change in participants' self-perception of victims, yielding a non-significant result ($Z = -0.437$, $p = 0.662$). This suggests that while the therapy effectively addressed bullying behaviors, it may not have adequately impacted how victims viewed themselves or processed their experiences. Significant results were observed in a few key areas.

There was a statistically significant negative change ($Z = -2.588$, $p = 0.010$) in Difficulty Improvement, indicating that participants perceived increased difficulties post-intervention. Similarly, Conduct Improvement exhibited a significant decline ($Z = -3.311$, $p = 0.001$), reflecting a worsened perception of conduct. Additionally, a highly significant effect was observed for perceived role of bullying, further reinforcing the intervention's impact on reducing bullying tendencies. However, several variables did not yield statistically significant results, including Peer Problems ($Z = -1.276$, $p = 0.202$), hyperactivity ($Z = -1.591$, $p = 0.112$), emotion ($Z = -1.307$, $p = 0.191$), Protective Factors ($Z = -1.104$, $p = 0.270$), and Parent-Child Communication ($Z = -0.817$, $p = 0.414$). While these variables showed trends, none

Table 2. Correlations Between Perceived Role as Victims/Bullies and Self-Perceived Difficulties

Time	Variables	Perceived Victims		Perceived Bullies	
		(ρ)	p-value	(ρ)	(p-value)
Pre-Intervention	Difficulty	0.130	0.130	-0.142	0.097
	Peer Problem	0.051	0.571	-0.146	0.103
	Conduct	0.107	0.238	-0.132	0.145
	Hyperactivity	0.045	0.614	-0.104	0.247
	Emotion	0.138	0.114	-0.019	0.830
	Protective	0.098	0.282	0.070	0.440
	Communication	0.239	0.005*	0.139	0.101
Post-Intervention	Difficulty	0.325	< 0.001*	0.071	0.405
	Peer Problem	0.279	0.002*	0.040	0.651
	Conduct	0.105	0.242	0.133	0.140
	Hyperactivity	0.201	0.024*	0.048	0.589
	Emotion	0.285	0.001*	0.063	0.467
	Protective	0.243	0.007*	0.101	0.260
	Communication	0.137	0.107	-0.019	0.823

*Mann Whitney; < 0.05 means significant

Table 3. Changes on Perceived Difficulty and Perceived Role Between Groups after VR Intervention using Mann Whitney

Variable Changes	N	Z	Sig. (2-tailed)
Difficulty	98	-2.588	0.010*
Peer Problems	98	-1.276	0.202
Conduct	98	-3.311	0.001*
Hyperactivity	98	-1.591	0.112
Emotion	98	-1.307	0.191
Protective Factors	98	-1.104	0.270
Parent-Child Communication	98	-0.817	0.414
Perceived Role as Bully	98	-3.692	< 0.001*
Perceived Role as Victims	98	-0.437	0.662

reached significance, suggesting limited measurable changes in these areas after the intervention (Table 3).

Effect of Genders and Intervention on Perceived Role as Victim or Bullies Across Groups

Table 4 reveals key insights into the intervention's effects on perceived roles as bullies and victims. Regarding perceived role as bullying, the intervention group demonstrated a significant reduction in their perceived role as bullies ($F = 17.061$, $p < 0.001$). Gender differences were evident, with males showing a greater reduction in bullying behaviors than females ($F = 5.756$, $p = 0.018$). A marginal interaction effect was noted ($F = 3.818$, $p = .054$), suggesting that males in the intervention group changed their role as bullies more prominently. In contrast, for victims, the intervention did not have a significant overall influence on the perceived role of victims ($F = 0.093$, $p = 0.761$), nor did gender independently affect victimization outcomes ($F = 0.642$, $p = 0.425$). However, a significant interaction effect was observed ($F = 4.318$, $p = 0.040$). Interestingly, there was no interaction between gender and VR intervention in shaping perceived difficulties, as shown in Table 4, signaling that gender does not hinder VR intervention from impacting the outcome of our participants.

Detailed Changes in Subcomponent Analysis After Intervention based on Questionnaires

The GLM revealed significant differences in perceived difficulties between the intervention and control groups based on questionnaire data. Several notable findings emerge when analyzing key questions and their corresponding p-values, F-values, and Partial Eta Squared values. The statistics for these results can be found in the supplemental tables (Table 5).

The VR group demonstrated a highly significant decrease in being perceived as bullies ($p = 0.000$, $F = 14.788$, partial $\eta^2 = 0.133$), underscoring the success of the intervention in tackling bullying behavior. The results showed no significant disparities in self-identification as victims between the groups ($p = 0.686$, $F = 0.164$, partial $\eta^2 = 0.002$), indicating that the intervention had a limited effect on reducing the perception of victimization. Significant disparities were found in parent-child communication. Individuals who participated in the intervention reported a significantly greater level of struggle when talking to their parents about their problems ($p = 0.012$, $F = 6.621$, partial $\eta^2 = 0.065$) and when expressing their genuine emotions ($p = 0.036$, $F = 4.520$, partial $\eta^2 = 0.045$). The challenges of discussing issues with parents were significant ($p = 0.004$, $F = 8.481$, partial $\eta^2 = 0.081$), suggesting potential unforeseen outcomes of the VR intervention in this context.

Emotion-related and hyperactivity difficulties also showed significant differences in the VR group. Participants reported increased struggles with attention and focus ($p = 0.044$, $F = 4.147$, partial $\eta^2 = 0.041$) and heightened anger regulation ($p = 0.007$, $F = 7.517$, partial $\eta^2 = 0.073$). Marginal significance was observed for feeling nervous in new situations and lacking confidence ($p = 0.056$, $F = 3.728$, partial $\eta^2 = 0.037$), reflecting the emotional challenges linked to the intervention. Peer relationships also exhibited significant changes. The intervention group reported a reduction in perceived positive peer connections, as reflected in the question "I have one or more good friends' ($p = 0.003$, $F = 9.090$, partial $\eta^2 = 0.086$). Additionally, participants indicated increased experience of being teased or bullied ($p =$

Table 4. Effect of Interaction between gender (male) and VR intervention on perceived role as bullies or victims across groups using General Linear Model analysis

Dependent Variable	Source	F-value	p-value	Partial η^2	n
Perceived Role as Bullies	VR Intervention	17.061	< 0.001*	0.154	98
	Gender	5.756	0.018*	0.058	98
	VR Intervention × Gender	3.818	0.054	0.039	98
erceived Role as Victims	VR Intervention	0.093	0.761	0.001	98
	Gender	0.642	0.425	0.007	98
	VR Intervention × Gender	4.318	0.040*	0.044	98
Total Difficulty	Group × Gender	1.643	0.203	0.017	98
Conduct	Group × Gender	0.040	0.842	0.000	98
Hyperactivity	Group × Gender	2.864	0.094	0.030	98
Emotional Problems	Group × Gender	2.955	0.089	0.030	98
Parent-Child Communication	Group × Gender	0.001	0.981	0.000	98
Protective	Group × Gender	0.250	0.618	0.003	

*< 0.005 indicates significancy

Table 5. Difference in perceived difficulties based on questionnaire between intervention and control groups using GLM (n=98)

No	Question	p-value	F-value	Partial η²	n
1	I have bullied someone.	<0.001*	14.788	0.133	98
2	I have been a victim of bullying.	0.686	0.164	0.002	98
3	I can discuss my feelings with my parents without feeling embarrassed.	0.470	0.527	0.005	98
4	My parents are good listeners.	0.360	0.846	0.009	98
5	My parents can understand my feelings without me having to say them.	0.583	0.304	0.003	98
6	I feel satisfied when talking with my parents.	0.221	1.520	0.016	98
7	If I have a problem, I can talk to my parents about it.	0.004*	8.481	0.081	98
8	I openly show attention to my parents.	0.127	2.373	0.024	98
9	When I ask questions, I get honest answers from my parents.	0.227	1.479	0.015	98
10	My parents try to understand my perspective.	0.364	0.831	0.009	98
11	I find it easy to discuss problems with my parents.	0.012*	6.621	0.065	98
12	I find it easy to express my true feelings to my parents.	0.036*	4.520	0.045	98
13	I try to be kind to others. I care about their feelings.	0.122	2.436	0.025	98
14	If I have toys, CDs, or food, I usually share them with others.	0.906	0.014	0.000	98
15	I am always ready to help someone who is hurt, upset, or in pain.	0.276	1.199	0.012	98
16	I am kind to younger children.	0.819	0.053	0.001	98
17	I often offer to help others (parents, teachers, children).	0.170	1.908	0.019	98
18	I often have headaches, stomachaches, or other kinds of pain.	0.621	0.246	0.003	98
19	I feel a lot of anxiety or worry about everything.	0.324	0.981	0.010	98
20	I often feel unhappy, sad, or cry.	0.684	0.167	0.002	98
21	I feel nervous in new situations, and I easily lose confidence.	0.056	3.728	0.037	98
22	There are many things I am afraid of, and I easily become scared.	0.990	0.000	0.000	98
23	I am restless. I cannot stay still for long.	0.144	2.171	0.022	98
24	When I am restless or anxious, my body often moves without me realizing it.	0.492	0.475	0.005	98
25	My attention is easily distracted, and I find it hard to focus on anything.	0.044*	4.147	0.041	98
26	I think about the consequences before acting or doing something.	0.172	1.893	0.019	98
27	I finish the tasks I am working on. I have good attention to detail.	0.324	0.981	0.010	98
28	I get very angry and often cannot control my anger.	0.007*	7.517	0.073	98
29	I usually do what others tell me to do.	0.671	0.182	0.002	98
30	I often argue with others. I can force others to do what I want.	0.094	2.853	0.029	98
31	I am often accused of lying or cheating.	0.002*	10.255	0.097	98
32	I take things that do not belong to me from home, school, or anywhere else.	0.162	1.990	0.020	98
33	I prefer to be alone rather than with people my age.	0.225	1.490	0.015	98
34	I have one or more good friends.	0.003*	9.090	0.086	98
35	People my age generally like me.	0.068	3.403	0.034	98
36	I am often teased or bullied by other children or teenagers.	0.049*	3.986	0.400	98
37	I find it easier to make friends with adults than with people my age.	0.998	0.000	0.000	98

*< 0.005 indicates significancy

0.049, F = 3.986, partial η² = 0.040), highlighting areas that require further attention in future interventions.

Evaluation of Usability in VR-Based Psychotherapy

Our study highlights key factors influencing participants' interest in being involved in the next intervention, details of which are provided in the supplemental table (Table 6). Significant positive correlations were found for Items 1 (desire to use the app, 0.247), 5 (integrated functionality, 0.322), 9 (confidence, 0.189), and 10 (willingness to prepare, 0.276), indicating that these aspects play a critical role in motivating participants. Conversely, Items 3 (ease of use) and 7 (perceptions of quick learning) show weak and insignificant correlations, suggesting that they have a minimal impact on attendance. App functionality and user motivation exhibited the strongest links to consistent participation. Drawing on the line between the after-intervention phase and users' commitment to use the tools in a regular manner, the analysis indicates that

Table 6. SUS Questionnaire in Indonesian version

No	Questionnaire Item	r	(p-value)
1	Saya rasa saya ingin menggunakan pengalaman PeriXa Batin ini secara rutin. *I think I want to use this PeriXa Batin experience regularly.*	0.247	**0.005**
2	Saya merasa pengalaman PeriXa Batin ini terlalu rumit tanpa alasan *I feel that this PeriXa Batin experience is unnecessarily complicated.*	0.148	0.094
3	Saya rasa pengalaman PeriXa Batin ini mudah digunakan *I find this PeriXa Batin experience easy to use.*	0.068	0.444
4	Saya pikir saya akan membutuhkan bantuan orang teknis untuk bisa menggunakan aplikasi PeriXa Batin ini. *I think I would need technical support to use this PeriXa Batin application.*	0.111	0.208
5	Saya menemukan berbagai fungsi di pengalaman PeriXa Batin ini terintegrasi dengan baik *I found that the various functions in this PeriXa Batin experience are well integrated.*	0.322	**< 0.001***
6	Saya rasa ada terlalu banyak ketidakkonsistenan di pengalaman PeriXa Batin ini *I feel there are too many inconsistencies in this PeriXa Batin experience.*	0.046	0.603
7	Saya membayangkan kebanyakan orang akan belajar menggunakan aplikasi PeriXa Batin ini dengan sangat cepat *I imagine most people will learn to use this PeriXa Batin application very quickly.*	0.139	0.115
8	Saya merasa pengalaman PeriXa Batin ini sangat merepotkan untuk digunakan *I feel that this PeriXa Batin experience is very inconvenient to use.*	0.008	0.925
9	Saya merasa sangat yakin saat menggunakan pengalaman PeriXa Batin ini *I feel very confident when using this PeriXa Batin experience.*	0.189	**0.031***
10	Saya perlu mempelajari banyak hal sebelum saya bisa memulai dengan aplikasi PeriXa Batin ini *I need to learn many things before I can start using this PeriXa Batin application.*	0.276	**0.001***

*< 0.005 indicates significancy

Table 7. Qualitative Feedbacks from Participants

Category	Count	Positive	Neutral	Negative	Examples
Impression	50	25 (50.00%)	22 (44.00%)	3 (6.00%)	- Positive: "Very good," "Helps calm the mind." - Neutral: "No comment," "Hopefully it can be better in the future." - Negative: "A bit dizzy," "My head feels a bit blurry."
Content	32	15 (46.88%)	14 (43.75%)	3 (9.38%)	- Positive: "Very fun and enjoyable," "I feel more relaxed." - Neutral: "Add more quiet places," "Add more scenery." - Negative: "The video is unclear/blurry," "The sound is not loud enough."
Technical	15	5 (33.33%)	7 (46.67%)	3 (20.00%)	- Positive: "Extend the duration," "Add more time for watching." - Neutral: "Shorten the duration," "Make the sound louder." - Negative: "Please clean the neck pillow, it makes me itchy," "The VR feels heavy."
Other	1	0 (0.00%)	1 (100.00%)	0 (0.00%)	- Neutral: "Keep up the good work."

the desire to use the PeriXa Batin routine (Item 1) has significant positive correlations with several key factors. The integration of app functionality (Item 5, 0.564, p-value 0.000) and user confidence (Item 9, 0.543, p-value 0.000) showed the strongest relationships, highlighting their importance in driving routine usage. Other significant factors included ease of use (Item 3, 0.408, p-value 0.000), willingness to learn (Item 10, 0.362, p-value 0.000), and perceived quick learning (Item 7, 0.336, p-value 0.000). Conversely, perceived hassle (Item 8, -0.181, p = 0.039) was negatively correlated with the desire for regular use. These findings suggest that fostering confidence, enhancing app functionality, and ensuring ease of use are important in motivating consistent engagement, whereas minimizing perceived obstacles can further boost user satisfaction and participation.

The qualitative analysis of participant feedback in Table 7 on the PeriXa Batin application revealed a generally positive reception, with users appreciating its calming and supportive capabilities, especially for individuals experiencing stress or bullying. However, specific areas of enhancement were also identified. Technically, participants noted discomfort, such as dizziness and issues with VR equipment weight, suggesting a need for hardware optimization and clarity in graphics and sound to enhance the immersive experience. Content-wise, users expressed a desire for more interactive features, such as the ability to move around and experience more dynamic scenery, indicating a demand for a richer and more engaging virtual environment. The comments also highlighted the potential value of incorporating motivational content to bolster emotional support, reflecting user interest in personal growth alongside relaxation. Although the overall sentiment was positive, with participants reporting increased relaxation and confidence, these insights highlight opportunities to refine both the technical and content aspects of the application, thereby elevating user satisfaction and maximizing its therapeutic potential.

Discussions

The central finding of this study presents a critical paradox: brief VR intervention was associated with a reduction in self-perceived bullying behaviors, but a concurrent increase in participants' overall difficulty scores, particularly among victims. This result highlights the double-edged sword of heightened self-awareness in the therapeutic setting. Immersive psychotherapy can be transformative, allowing individuals to recognize maladaptive thought patterns and pave the way for meaningful change (London, Sessa and Shelley, 2023). On the other hand, this awareness can lead to a temporary increase in emotional distress, especially when participants are not adequately supported (Geytenbeek *et al.*, 2017; Topalalioğlu, 2025). This phenomenon is consistent with the reported side effects in other psychotherapies (Tong *et al.*, 2017; Wittmann, Blomert and Linden, 2025) and must be interpreted with caution because of the significant limitations of this study. The brief, four-day duration was likely insufficient to guide participants beyond this initial discomfort toward resolution. Research on modalities such as Cognitive-Behavioral Therapy (CBT) and Acceptance and Commitment Therapy (ACT) emphasizes the need for prolonged support to translate awareness into sustained behavioral change (Moore, 1996; Chhatwal and Lane, 2016), with effective interventions often spanning 12 sessions or more (Colombo, Asamoa and Aggarwal, 2023; Goyal *et al.*, 2023). Therefore, longitudinal research with extended intervention periods is essential for determining whether the distress observed in this study is a temporary therapeutic step or a lasting negative outcome.

The intervention's impact appeared to diverge based on the participant's role, likely reflecting the distinct psychological profiles of the victims and bullies. Victims, who are more prone to internalize distress, may have found guided self-reflection particularly intense, causing them to confront and acknowledge their emotional struggles more directly (Farrell, Volk and Vaillancourt,

2020; Hikmat *et al.*, 2024). By contrast, adolescents who engage in bullying behavior often exhibit lower levels of empathy and a greater tendency to externalize blame, (Streng, 2018) which may act as a defense against introspection. The current VR module, which focuses on self-regulation, may have been insufficient for bypassing these externalizing defenses. This suggests that while therapy is a potent tool for fostering self-awareness, interventions specifically targeting bullying perpetrators may require the integration of more explicit components, such as guided perspective-taking or empathy-building scenarios, to achieve a similar depth of impact.

A noteworthy finding was that the intervention had a more pronounced effect on male participants, who demonstrated a significantly greater reduction in self-perceived bullying behaviors. This may be attributable to gender-based patterns in aggression: males are more likely to engage in overt, externalizing behaviors, such as physical or verbal bullying, that are more easily identified and addressed through a structured, self-reflective intervention (Mohammadi, Salmanian and Keshavarzi, 2021; Kovačević, Mijatović and Gutvjan, 2023), and the technological medium of the intervention itself may be a contributing factor. Prior research suggests that male adolescents can show greater engagement with and benefit from technology-based therapeutic tools, such as VR, which they may find more motivating than traditional methods (Kim, Choo and Ranney, 2014; Munoz Gomez *et al.*, 2022). This highlights the importance of considering gender in the design of anti-bullying programs, as the effectiveness of an intervention can be influenced by both typical behavioral patterns and affinity for the therapeutic modality.

We also need to consider the practical feasibility of VR beyond the psychological effects of the intervention. The VR application was generally well received by adolescents who reported positive usability and appreciated its calming capabilities. However, their qualitative feedback also revealed important areas for improvement, highlighting technical challenges, such as physical discomfort from the equipment and a desire for more interactive and dynamic content to enhance engagement. These usability insights, combined with the primary findings of this study, point to a critical implication for practice: VR users often experience cybersickness, ocular strain, musculoskeletal pain, and general malaise (Bouchard *et al.*, 2021; Simón-Vicente *et al.*, 2022; Souchet *et al.*, 2022; Bolan, Pozzebon and De Sá Júnior, 2024). Although they can be modest and short-lived, these side effects might affect the user experience and therefore should be considered in VR design and application. VR-based emotion regulation tools should not be implemented as standalone solutions. Given that the process of fostering self-awareness can initially increase perceived distress, even though not universally (Mak *et al.*, 2018; Matko, Sedlmeier and Bringmann, 2022), schools must integrate these interventions into a broader framework of support. Providing students with access to counselors or peer support groups is essential to help them safely process challenging emotions that may arise. A one-size-fits-all approach may also be inadequate, and tailoring the content to include explicit empathy-building exercises could be vital for effectively engaging students who perpetrate bullying.

This study provides substantial information about the success of VR-based emotion regulation therapy in dealing with bullying among high school students, but several crucial restrictions must be acknowledged. The study design, which is quasi-experimental in nature, limits its ability to demonstrate cause-and-effect relationships. The lack of randomization in group assignment can result in selection bias, as participants were allocated to groups based on school regions rather than chosen through a random sampling process. A relatively small sample size, especially in the intervention group (n = 33), could reduce the study's statistical power, thereby making it more difficult to detect smaller yet potentially meaningful effects. A 1:2 ratio between the intervention and control groups, despite being resource-efficient, may have resulted in unequal group comparisons.

Second, the short duration of the intervention (four sessions over four days) may have limited its ability to produce sustained behavioral changes. Emotional regulation and self-awareness are complex processes that often require long-term intervention to achieve lasting effects. The observed increases in perceived difficulties such as hyperactivity and emotional problems may reflect the initial discomfort of heightened self-awareness rather than actual deterioration. However, without follow-up assessment, it is unclear whether these changes represent temporary distress or long-term challenges. Future studies should consider extending the intervention duration and incorporating follow-up measures to assess the long-term outcomes.

Third, the use of self-reported data may have led to response bias. Individuals may either underreport or overreport their challenges because of a desire to be perceived favorably or a lack of self-awareness, especially among those who engage in bullying behaviors. The utility of the SDQ and other self-report measures, although validated, may not comprehensively capture the complex experiences of the participants. To learn more about the impacts of the intervention, future research might benefit from obtaining qualitative input from students regarding their self-awareness. Fourth, the study's focus on verbal and physical bullying may overlook other forms of bullying, such as relational or cyberbullying, which are becoming increasingly prevalent among adolescents. The effectiveness of this intervention in addressing these forms of bullying remains unexplored. The study was conducted in a

particular cultural and educational setting in Depok, West Java, which could restrict the applicability of the results to other areas or nations with distinct cultural values and educational systems.

Finally, technical limitations of the VR equipment, such as discomfort (e.g., dizziness and heaviness) and issues with graphics or sound quality, may have influenced the participants' experiences and engagement with the intervention. While SUS generally indicated positive feedback, these technical challenges highlight the need for further refinement of the VR platform to enhance user comfort and immersion.

Conclusion

This study demonstrated that a brief VR-based emotional regulation intervention effectively reduced self-perceived bullying behaviors among adolescents, particularly among males. However, the intervention also led to heightened awareness of emotional and peer-related difficulties, especially among victims, suggesting that while it successfully fostered self-reflection, it may have also induced temporary distress. These findings indicate that VR is a promising tool for school-based anti-bullying programs, but it should be supplemented with robust support systems, such as counseling or peer groups, to help students manage challenging emotions that can arise from increased self-awareness. Future research is essential for building on these exploratory findings. Longitudinal studies with longer intervention periods and follow-up assessments are needed to determine the long-term effects of this heightened awareness and whether it translates into sustained behavioral changes. Additionally, future studies should employ randomized controlled designs and investigate the intervention's impact on other forms of bullying, such as cyberbullying, to establish a more comprehensive evidence base.

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Declaration of Interest

We declare that there are no competing interests in our study.

Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

A Quillbot was used to improve readability during article preparation. After using this tool, the author reviewed and edited the content as required and took full responsibility for the content of the publication.

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