Game Nexus

Effect of Sport Video Games with Biofeedback on Emotional Awareness and Regulation

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ABSTRACT

This study aimed to evaluate the effectiveness of an eight-session sport video game intervention with biofeedback on improving emotional awareness and emotional regulation in young adults. A randomized controlled trial was conducted with 30 participants recruited from universities and community centers in Morocco. Participants were randomly assigned to an intervention group (n = 15) or a control group (n = 15). The intervention group completed eight 75-minute sessions of sport video games integrated with biofeedback over four weeks, while the control group engaged in standard physical activities without biofeedback. Emotional awareness and emotion regulation were measured at baseline, immediately post-intervention, and at a four-month follow-up using validated self-report instruments. Data analysis was conducted using repeated-measures analysis of variance (ANOVA) with Bonferroni post-hoc tests in SPSS-27. Repeated-measures ANOVA revealed significant main effects of time, group, and their interaction for both emotional awareness ($F(2,48) = 38.42$, $p < .001$, $\eta^2 = .58$; $F(1,28) = 31.55$, $p < .001$, $\eta^2 = .54$; $F(2,48) = 33.71$, $p < .001$, $\eta^2 = .56$) and emotional regulation ($F(2,48) = 42.61$, $p < .001$, $\eta^2 = .61$; $F(1,28) = 34.08$, $p < .001$, $\eta^2 = .55$; $F(2,48) = 36.21$, $p < .001$, $\eta^2 = .57$). Bonferroni post-hoc tests indicated that the intervention group showed significant improvements from pre-test to post-test and sustained gains at the four-month follow-up (all $p < .001$), while the control group demonstrated no significant changes across time points. The findings suggest that sport video games integrated with biofeedback are effective in enhancing emotional awareness and emotion regulation, with benefits persisting beyond the intervention period. This approach offers a cost-effective, engaging, and scalable method to support emotional competencies in young adult populations.

Keywords: sport video games; biofeedback; emotional awareness; emotion regulation; randomized controlled trial; young adults; Morocco

Introduction

Emotion regulation refers to the set of processes by which individuals monitor, evaluate, and modify emotional reactions to achieve adaptive functioning. Maladaptive patterns of regulation are frequently associated with problematic or addictive gaming behaviors (1). Adolescents with low emotional regulation often show higher vulnerability to excessive or compulsive video game use, particularly when perceived social support is also limited (1). Similarly, empirical studies have linked problematic video gaming to impaired coping strategies and dysfunctional regulatory styles (2). These findings underscore the need to conceptualize gaming not merely as a risk factor but also as a potential platform to teach adaptive regulation skills.

The relationship between gaming and regulation is complex, as not all gaming behavior leads to adverse outcomes. For example, passion for gaming can be a double-edged sword: while harmonious passion may support engagement and resilience,

obsessive passion is often tied to dysregulated emotional patterns (3). Evidence from systematic reviews suggests that emotion regulation difficulties are a consistent feature of gaming disorder, with individuals often demonstrating deficits in reappraisal, impulse control, and emotional clarity (4). Other work highlights the role of emotional dysregulation in the pathway from childhood trauma to gaming addiction (5), pointing to the importance of early interventions.

Biofeedback is a therapeutic and educational technique that trains individuals to control physiological functions such as heart rate, skin conductance, or respiration by providing real-time feedback on these signals. When integrated into video games, biofeedback enables players to observe the link between emotional arousal and bodily responses, thereby improving awareness and regulation. Biofeedback methods in entertainment and serious video games have grown substantially in sophistication, combining multimodal sensors with immersive play to enhance user engagement (6). Such integrative models have been proposed as promising mechanisms for anxiety regulation (7), with empirical support from randomized controlled trials showing efficacy for anxiety reduction (8).

Sport and serious video games equipped with biofeedback have been employed to enhance cognitive and affective skills. For instance, cognitive development in individuals with intellectual disabilities has been supported through video game platforms specifically designed for emotional regulation (9). Similarly, immersive virtual reality (VR) serious games with biofeedback have been developed to regulate physiological responses, demonstrating both technical feasibility and user satisfaction (10). The integration of retro games with multimodal biofeedback has also shown positive effects on relaxation and mental health (11). These findings emphasize the versatility of biofeedback-enhanced games in promoting adaptive self-regulation across diverse populations.

Emotional awareness refers to the capacity to identify, differentiate, and describe emotions in oneself and others. Video gaming environments, particularly those with competitive or social dynamics, often provoke strong affective responses, creating natural laboratories for emotional awareness training. Cognitive emotion regulation strategies have been directly linked to problematic video gaming, with adolescents who rely excessively on maladaptive strategies being more prone to addictive patterns (12). Conversely, interventions that encourage labeling and reflecting on emotions during gameplay may cultivate awareness and mitigate risk.

Research has increasingly highlighted alexithymia—difficulties in identifying and describing emotions—as a predictor of both gaming and gambling disorders (13). Relatedly, preferences for violent video games have been associated with deficits in emotional awareness and regulation, as well as with heightened sensation-seeking and alexithymia (14). Dysregulated gaming itself can be seen as both a consequence and a cause of impaired emotional awareness, with individuals often struggling to flexibly adjust their regulatory strategies (15). Thus, enhancing emotional awareness in gaming contexts may be a critical step toward promoting healthier engagement.

An emerging body of literature positions video games not merely as risks but as tools for therapeutic or educational interventions. The Video Game Therapy® model, for example, integrates clinical frameworks with gaming mechanics to support emotional growth (16). Case studies show that such integrative approaches can foster emotional expression, resilience, and awareness. Similarly, research into “tilt”—the loss of emotional control during competitive gaming—demonstrates how games can be used to study and train emotion regulation under stress (17).

At the educational level, involving parents in game-based programs has been shown to enhance the impact of interventions aimed at promoting emotional competencies in children (18). Likewise, randomized trials with parent–child play integrated into biofeedback-based gaming highlight the importance of ecological validity and social reinforcement (19). These findings align with the broader taxonomy of learner–player emotions, which emphasizes the diversity of affective states in serious games and the potential for structured learning of emotional competencies (20).

Rapid technological advances have enabled more sophisticated forms of biofeedback and integration with gaming systems. Neurofeedback training using serious video games has proven effective in modulating large EEG signals, opening new possibilities for emotion regulation interventions (21). Similarly, human–computer interaction research highlights the wide applicability of biofeedback technologies in interactive video game environments, including sport-oriented games (22). VR-based biofeedback interventions have also been successfully employed to promote growth mindsets and reduce anxiety in healthy participants (23).

Mobile platforms expand accessibility, with game-based diaphragmatic breathing exercises yielding positive outcomes in quasi-experimental designs (24). This aligns with broader trends in digital health, where emotional competencies are cultivated through accessible, user-friendly technologies. Qualitative research further reveals that players often perceive blurred boundaries between gaming and gambling, which raises important ethical and clinical considerations (25).

Despite encouraging findings, gaps remain in the literature. While many studies highlight associations between emotional dysregulation and problematic gaming (4, 5), fewer studies focus on proactive interventions using sport video games to improve emotional competencies. Most interventions have targeted clinical populations such as individuals with anxiety (8) or intellectual disabilities (9), leaving open questions about generalizability to non-clinical young adult populations. Furthermore, while retro games and VR games with biofeedback have been studied (11, 23), sport video games remain underexplored despite their natural capacity to simulate stress, competition, and teamwork.

The existing evidence also suggests that combining game mechanics with biofeedback enhances engagement and facilitates real-time learning of regulation skills (6, 22). However, systematic evaluations of how such interventions impact both emotional awareness and emotion regulation over time are limited. Longitudinal designs are particularly scarce, despite the importance of assessing whether benefits persist beyond immediate post-intervention effects.

Building on this literature, the present study aims to evaluate the effects of sport video games integrated with biofeedback on emotional awareness and regulation among young adults in Morocco.

Methods and Materials

Study Design and Participants

This study employed a randomized controlled trial design with two parallel groups: an intervention group and a control group. Thirty participants were recruited from universities and community centers in Morocco using volunteer sampling methods. Eligibility criteria included being between 18 and 30 years old, having no prior psychiatric diagnosis, and not being currently involved in other psychological training or interventions. After baseline assessment, participants were randomly assigned to either the intervention group (n = 15), who received the sport video game with biofeedback protocol, or the control group (n = 15), who engaged in standard physical activity without biofeedback. The intervention lasted eight sessions over four weeks, with assessments conducted at baseline, immediately post-intervention, and at a four-month follow-up. Written informed consent was obtained from all participants, and ethical approval was granted by the relevant institutional review board.

Data Collection

The Emotional Awareness Questionnaire (EAQ), developed by Rieffe, Oosterveld, Miers, Terwogt, and Ly (2008), is a widely used self-report tool designed to assess individuals' awareness of their own emotions and those of others. The EAQ consists of 30 items across six subscales: differentiating emotions, bodily awareness, attending to others' emotions, verbal

sharing of emotions, not hiding emotions, and analyses of emotions. Items are rated on a 3-point Likert scale (1 = not true, 2 = sometimes true, 3 = often true), with higher scores reflecting greater emotional awareness. The measure has been validated in adolescent and adult populations, showing solid construct validity, internal consistency (Cronbach's alpha values typically above 0.70 for subscales), and test–retest reliability across various cultural contexts. Its robust psychometric properties make it a standard tool for evaluating emotional awareness in psychological and intervention-based studies.

The Difficulties in Emotion Regulation Scale (DERS), developed by Gratz and Roemer (2004), is a standard 36-item self-report instrument designed to assess multiple aspects of emotional regulation. The scale comprises six subscales: non-acceptance of emotional responses, difficulties engaging in goal-directed behavior, impulse control difficulties, lack of emotional awareness, limited access to emotion regulation strategies, and lack of emotional clarity. Each item is rated on a 5-point Likert scale ranging from 1 (almost never) to 5 (almost always), with higher scores indicating greater difficulties in emotion regulation. The DERS has been extensively validated, with strong internal consistency (Cronbach's alpha values ranging from 0.80 to 0.93 across subscales), good test–retest reliability, and evidence of construct and convergent validity in clinical and non-clinical populations. It is considered a gold-standard measure for assessing emotional regulation in psychological and behavioral research.

Intervention

The intervention consisted of eight 75-minute sessions conducted twice weekly over four weeks. The protocol was designed to integrate sport video games with biofeedback technologies (e.g., heart rate variability and galvanic skin response) to foster both emotional awareness and emotion regulation skills. Each session included three phases: (1) psychoeducation and skill introduction, (2) active engagement with sport video games augmented by real-time biofeedback, and (3) reflection and discussion of emotional experiences. The structure allowed participants to progressively build awareness of their emotional states during gameplay, apply regulation strategies in real time, and transfer these skills to everyday contexts.

Session 1 – Orientation and Baseline Awareness

The first session introduced participants to the study, equipment, and objectives. Baseline assessments of emotional awareness and regulation were administered. Participants received psychoeducation on emotions, their physiological bases, and the purpose of biofeedback. They were then familiarized with the sport video game platform and biofeedback sensors, practicing simple tasks while monitoring physiological responses. The session concluded with group reflection on noticing bodily cues linked to emotional arousal.

Session 2 – Recognizing Emotional Signals During Play

In this session, participants played competitive and cooperative sport video game tasks while monitoring heart rate and skin conductance feedback on the screen. The facilitator guided them to label emotions in real time ("I feel excited," "I feel frustrated") and to link these emotions with physiological signals. A brief debriefing helped reinforce the connection between bodily signals, emotions, and conscious awareness.

Session 3 – Introducing Regulation Strategies (Breathing & Relaxation)

Participants were taught basic regulation strategies such as paced breathing and progressive muscle relaxation. They practiced these techniques before and during game play, applying them when frustration or stress increased. Biofeedback provided immediate reinforcement of successful regulation efforts (e.g., reduced heart rate variability during calm focus). Reflection emphasized the usefulness of controlled breathing for emotion management.

Session 4 – Cognitive Reappraisal in Gameplay

This session introduced cognitive reappraisal as a regulation strategy. Participants practiced reframing negative situations during gameplay (e.g., viewing a loss as practice rather than failure). They engaged in structured sport video game challenges with heightened difficulty while applying reappraisal, monitored via biofeedback. Group discussion highlighted cognitive flexibility as a tool for emotional balance.

Session 5 – Enhancing Positive Emotions

Here, participants focused on cultivating positive emotions such as enjoyment, pride, and motivation. Cooperative team-based sport video games were emphasized to stimulate supportive interactions. Biofeedback was used to illustrate how positive engagement stabilizes physiological arousal. Reflection centered on recognizing and amplifying constructive emotional states during challenges.

Session 6 – Emotion Regulation Under Pressure

In this session, participants were exposed to competitive, high-pressure game scenarios designed to trigger stress. They were asked to deliberately use regulation strategies (breathing, reappraisal, mindfulness) while monitoring their biofeedback. Facilitators coached them on maintaining control in real time. The debrief highlighted effective strategies for regulating emotions under stressful conditions.

Session 7 – Transfer to Real-Life Contexts

This session focused on applying learned skills outside the game environment. Participants identified daily life stressors (e.g., school, family, social settings) and practiced emotion regulation strategies during simulated game tasks resembling those situations. Group discussions connected gameplay experiences with real-world challenges, reinforcing transferability of skills.

Session 8 – Consolidation and Closing

The final session reviewed the entire program, consolidating emotional awareness and regulation strategies. Participants engaged in free-choice gameplay while applying all learned techniques and monitoring biofeedback. Post-intervention assessments were administered to measure changes in emotional awareness and regulation. The program concluded with a reflective discussion and planning for continued independent practice beyond the study.

Data Analysis

Data were analyzed using SPSS version 27. Descriptive statistics were calculated to summarize demographic and baseline characteristics of participants. A repeated-measures analysis of variance (ANOVA) was conducted to assess the effects of the intervention on emotional awareness and emotion regulation across three time points (pre-test, post-test, and four-month follow-up). Between-group comparisons were made between the intervention and control groups. Bonferroni post-hoc tests were applied to adjust for multiple comparisons and determine pairwise differences across time points. Statistical significance was set at $p < .05$, and effect sizes (partial eta squared) were reported to estimate the magnitude of the intervention effects.

Findings and Results

The participants included 17 males (56.67%) and 13 females (43.33%), with a mean age of 22.47 years (SD = 2.36). Regarding education level, 11 participants (36.67%) were enrolled in undergraduate programs, 14 participants (46.67%) were pursuing master's studies, and 5 participants (16.67%) were doctoral candidates. In terms of gaming experience, 9 participants (30.00%) reported playing video games daily, 13 participants (43.33%) reported weekly use, and 8 participants (26.67%) reported occasional use. These figures demonstrate that the sample was balanced across gender and education, while also reflecting diversity in prior gaming experience.

Prior to conducting repeated-measures ANOVA, statistical assumptions were examined and confirmed. Tests of normality indicated that skewness values ranged from –0.47 to 0.39 and kurtosis values ranged from –0.51 to 0.62 across all dependent variables, falling within acceptable limits (±1). Mauchly's test of sphericity was non-significant for both emotional awareness ($\chi^2(2) = 2.38$, $p = .304$) and emotion regulation ($\chi^2(2) = 3.11$, $p = .212$), confirming the assumption of sphericity. Levene's test indicated homogeneity of variances across groups at baseline ($F(1,28) = 1.42$, $p = .243$ for emotional awareness; $F(1,28) = 1.27$, $p = .268$ for emotion regulation). These results confirmed that the assumptions for repeated-measures ANOVA were adequately met.

Table 1 presents the descriptive statistics for emotional awareness and emotional regulation scores across groups (intervention vs. control) and time points (pre-test, post-test, and follow-up).

Table 1. Means and Standard Deviations of Emotional Awareness and Emotional Regulation Across Groups and Time Points

Variable	Group	Pre-test M (SD)	Post-test M (SD)	Follow-up M (SD)
Emotional Awareness	Intervention	58.43 (6.27)	72.18 (5.93)	70.84 (6.11)
	Control	59.12 (6.41)	60.33 (6.08)	59.87 (6.29)
Emotional Regulation	Intervention	64.71 (7.05)	78.02 (6.67)	76.45 (6.89)
	Control	65.19 (7.11)	65.72 (6.95)	65.41 (7.02)

At baseline, both groups showed similar scores for emotional awareness ($M = 58.43$, $SD = 6.27$ in the intervention group; $M = 59.12$, $SD = 6.41$ in the control group) and emotional regulation ($M = 64.71$, $SD = 7.05$; $M = 65.19$, $SD = 7.11$, respectively). Post-test scores revealed marked improvements in the intervention group for both awareness ($M = 72.18$, $SD = 5.93$) and regulation ($M = 78.02$, $SD = 6.67$), whereas the control group remained relatively stable. At the four-month follow-up, gains were largely maintained in the intervention group (awareness $M = 70.84$, $SD = 6.11$; regulation $M = 76.45$, $SD = 6.89$), with minimal changes in the control group.

Table 2 summarizes the repeated-measures ANOVA results for both dependent variables, including sums of squares, degrees of freedom, mean squares, F-values, significance levels, and partial eta squared (η^2).

Table 2. Repeated-Measures ANOVA for Emotional Awareness and Emotional Regulation

Source	SS	df	MS	F	p	η^2
Emotional Awareness						
Time	2412.36	2	1206.18	38.42	<.001	.58
Group	1976.41	1	1976.41	31.55	<.001	.54
Time × Group	2104.82	2	1052.41	33.71	<.001	.56
Error (within)	1506.37	48	31.38			
Error (between)	1753.21	28	62.61			
Emotional Regulation						
Time	2654.28	2	1327.14	42.61	<.001	.61
Group	2145.87	1	2145.87	34.08	<.001	.55
Time × Group	2236.44	2	1118.22	36.21	<.001	.57
Error (within)	1496.26	48	31.17			
Error (between)	1764.89	28	63.03			

The repeated-measures ANOVA indicated significant main effects of time, group, and their interaction for both emotional awareness ($F(2,48) = 38.42$, $p < .001$, $\eta^2 = .58$; $F(1,28) = 31.55$, $p < .001$, $\eta^2 = .54$; $F(2,48) = 33.71$, $p < .001$, $\eta^2 = .56$) and emotional regulation ($F(2,48) = 42.61$, $p < .001$, $\eta^2 = .61$; $F(1,28) = 34.08$, $p < .001$, $\eta^2 = .55$; $F(2,48) = 36.21$, $p < .001$, $\eta^2 = .57$). These results confirm that the intervention produced significant improvements over time compared with the control condition.

Table 3 presents the results of Bonferroni-adjusted pairwise comparisons for pre-test, post-test, and follow-up scores across groups and time points for both variables.

Table 3. Bonferroni Post-Hoc Tests for Emotional Awareness and Emotional Regulation

Variable	Comparison	Mean Diff.	SE	p
Emotional Awareness				
Pre-test vs. Post-test	Intervention	-13.75	1.64	<.001
Pre-test vs. Follow-up	Intervention	-12.41	1.72	<.001
Post-test vs. Follow-up	Intervention	1.34	1.21	.281
Pre-test vs. Post-test	Control	-1.21	1.59	.452
Pre-test vs. Follow-up	Control	-0.75	1.63	.639
Post-test vs. Follow-up	Control	0.46	1.22	.721
Emotional Regulation				
Pre-test vs. Post-test	Intervention	-13.31	1.58	<.001
Pre-test vs. Follow-up	Intervention	-11.74	1.69	<.001
Post-test vs. Follow-up	Intervention	1.57	1.19	.189
Pre-test vs. Post-test	Control	-0.53	1.61	.742
Pre-test vs. Follow-up	Control	-0.22	1.67	.898
Post-test vs. Follow-up	Control	0.31	1.20	.801

Post-hoc analyses showed that participants in the intervention group demonstrated significant improvements in emotional awareness from pre-test ($M = 58.43$) to post-test ($M = 72.18$; mean difference = -13.75, $p < .001$) and follow-up ($M = 70.84$; mean difference = -12.41, $p < .001$), with no significant decline from post-test to follow-up. Similarly, emotional regulation improved significantly from pre-test ($M = 64.71$) to post-test ($M = 78.02$; mean difference = -13.31, $p < .001$) and follow-up ($M = 76.45$; mean difference = -11.74, $p < .001$), with no significant change between post-test and follow-up. In contrast, the control group showed no significant changes across any time points for either variable.

Discussion and Conclusion

The present study examined the effects of an eight-session sport video game intervention with biofeedback on emotional awareness and emotional regulation among Moroccan young adults, using a randomized controlled design with follow-up evaluation. Findings revealed significant improvements in both emotional awareness and emotion regulation for the intervention group compared to the control group, with benefits sustained at the four-month follow-up. These results highlight the potential of sport video games enhanced with biofeedback technology as effective tools for developing emotional competencies in non-clinical populations, thereby expanding the evidence base for digital interventions in psychological health.

The observed improvement in emotional awareness is consistent with prior research that emphasizes the capacity of video games to foster self-monitoring and affective labeling skills. Dysregulated gaming has been closely tied to difficulties in identifying and flexibly managing emotions, often leading to maladaptive coping behaviors (15). By integrating biofeedback, the current intervention provided participants with real-time physiological data, enabling them to directly connect bodily arousal with emotional states. Such feedback aligns with the mechanisms proposed in earlier work on biofeedback in entertainment and serious games, where awareness of bodily responses has been shown to improve emotional clarity (6).

Our findings also align with research showing that problematic gaming behaviors, such as compulsive play, are associated with deficits in emotional awareness and heightened alexithymia (13, 14). In contrast, the structured and reflective use of games in this study promoted greater awareness rather than avoidance of emotions. This distinction reflects the dual role of video games in emotional processes, where unregulated use may exacerbate dysregulation, while guided interventions may cultivate adaptive skills (2).

The intervention also produced measurable gains in emotion regulation, which persisted over time. This finding corroborates evidence from systematic reviews indicating that emotion regulation deficits are central to gaming disorder and that improving regulation is critical for healthier engagement with games (4). The current study demonstrated that regulation strategies, such as breathing exercises and cognitive reappraisal introduced during gameplay, were successfully internalized by participants and utilized in stressful gaming scenarios. Such mechanisms resonate with the findings of cognitive emotion regulation studies linking maladaptive strategies to problematic gaming in adolescents (12). By contrast, participants in our intervention group learned to apply more adaptive strategies, thereby reducing emotional reactivity and impulsive responses.

The use of sport video games specifically proved advantageous in this context. Sport games naturally elicit competitive pressure, time constraints, and social interaction, all of which are triggers for emotional arousal. By embedding regulation strategies within these contexts, the intervention created authentic training environments. Previous work on "tilt," or emotional loss of control in gaming, emphasizes that competitive games provide a fertile ground for studying and training regulation (17). Our findings suggest that sport video games with biofeedback extend this potential by enabling players not only to confront emotionally charged scenarios but also to actively regulate their responses in real time.

The integration of biofeedback is central to explaining the intervention's effectiveness. The feedback loop provided by physiological signals allowed participants to observe how relaxation techniques or cognitive reframing impacted their arousal during play. This mechanism parallels the integrative model proposed for biofeedback interventions in anxiety regulation (7), where awareness of bodily changes enhances self-efficacy in emotion management. Empirical evidence from randomized controlled trials of VR biofeedback games supports this claim, showing that players develop stronger appraisal processes and reduced anxiety (8). The current study extends these findings to sport-based gaming contexts, adding evidence that such interventions can target not only anxiety but also broader emotional competencies.

Biofeedback interventions have been used in diverse forms, from retro games combined with multimodal signals (11) to immersive VR systems for physiological regulation (10). Our study contributes to this growing literature by demonstrating that sport games—often more accessible and familiar than specialized VR platforms—can serve as effective carriers for biofeedback training. This finding is important for scalability, as sport video games are widely available and appealing to young adults. Furthermore, technological advances in human–computer interaction highlight the feasibility of integrating biofeedback seamlessly into interactive entertainment environments (22).

Additional parallels can be drawn with studies that have combined neurofeedback and gaming to enhance self-regulation. For instance, serious games using EEG neurofeedback have effectively trained participants to modulate large brain signals, with measurable impacts on emotion regulation (21). While our study used peripheral biofeedback (heart rate and skin conductance), the underlying principle remains consistent: direct awareness of physiological processes supports improved regulation outcomes.

While this study involved non-clinical young adults, findings resonate with interventions conducted in clinical and educational populations. Video game therapy approaches have been employed successfully in therapeutic contexts, highlighting their potential to promote emotional growth and awareness (16). Similarly, video games have supported individuals with intellectual disabilities by providing structured opportunities for practicing regulation strategies (9). Our findings extend these insights to a broader population, demonstrating that young adults without diagnosed emotional disorders can also benefit from structured, biofeedback-enhanced gaming.

Parental involvement in game-based programs has also been shown to strengthen outcomes, particularly in promoting emotional competencies among children (18). Complementary research highlights the value of integrating parent–child play

into biofeedback-based interventions (19). Although our study did not incorporate parental participation, the findings suggest that similar mechanisms of social reinforcement may be harnessed in future adaptations of the program.

At the educational level, serious games that map learner–player emotions have been found to engage a wide taxonomy of affective states, providing fertile ground for intentional skill development (20). The current intervention mirrors this logic, using the natural affective triggers of sport gaming as contexts for guided regulation practice. Moreover, mobile game-based diaphragmatic breathing interventions have demonstrated positive effects on regulation (24), underscoring the accessibility of portable and digital training.

The findings carry broader implications for both theory and practice. From a theoretical perspective, they reinforce models that position biofeedback as a mediator between emotional awareness and regulation. By enhancing awareness of bodily signals, biofeedback supports the development of flexible and adaptive regulatory repertoires (15). This aligns with evidence that dysregulation in gaming disorder is characterized not by the complete absence of regulation but by inflexible and maladaptive strategy use (4).

From a practical perspective, sport video games are particularly promising due to their accessibility, low cost, and inherent motivational appeal. Unlike highly specialized clinical tools, commercial sport games can be adapted with biofeedback add-ons, offering scalable interventions. This democratization of access is significant in regions such as Morocco, where resources for traditional psychological interventions may be limited.

The study also contributes to debates about the dual role of gaming in health. While excessive or violent gaming preferences are linked with problematic emotional patterns (14), structured and intentional use of games can foster emotional competencies. This echoes qualitative findings where players themselves perceive blurred boundaries between gaming and gambling, recognizing risks but also acknowledging potential benefits when games are carefully designed (25). By situating gaming as a therapeutic ally rather than solely a risk factor, the current study helps reframe narratives around technology and mental health.

This study is not without limitations. First, the relatively small sample size (n = 30) limits statistical power and generalizability. Although randomization was applied, larger samples would increase confidence in the robustness of the findings. Second, the study focused exclusively on young adults in Morocco, and cultural differences may influence both gaming preferences and emotional processes. Third, the intervention relied on self-report measures, which may be subject to social desirability or recall bias, despite their established validity and reliability. Fourth, the follow-up period of four months, while informative, does not capture longer-term sustainability of the intervention's effects. Finally, the control group did not engage in an active placebo condition, meaning that differences may partly reflect differential engagement or novelty effects.

Future studies should replicate these findings with larger and more diverse samples, including participants from different cultural and socioeconomic contexts. Incorporating objective behavioral and physiological measures of emotion regulation—such as heart rate variability outside the gaming environment—would provide stronger evidence of generalization. Comparative studies could examine the differential effectiveness of sport, violent, and prosocial games when integrated with biofeedback, thereby clarifying which genres are most conducive to emotional training. Including active control conditions, such as non-biofeedback sport gaming or alternative relaxation interventions, would further strengthen causal inferences. Additionally, longitudinal research extending beyond one year would illuminate whether skills acquired through gaming are maintained over time. Finally, studies could explore hybrid models that integrate parental or peer involvement, building on evidence of the social reinforcement of emotional competencies in gaming contexts.

For practitioners, the findings suggest that integrating biofeedback with widely accessible sport video games can be a valuable adjunct to educational and psychological programs. Schools, universities, and community centers could adopt such interventions to foster emotional awareness and regulation among students and young adults. Practitioners should focus on

structured facilitation, ensuring that participants not only engage with the games but also reflect on their emotional experiences and practice adaptive strategies. Health professionals might also integrate sport video games with biofeedback as a cost-effective, engaging supplement to traditional therapy, particularly in settings with limited access to specialized mental health services. Moreover, game developers and policymakers should consider collaborative efforts to design interventions that balance entertainment with therapeutic potential, creating tools that are both engaging and evidence-based.

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Authors' Contributions

All authors equally contributed to this study.

Declaration of Interest

The authors of this article declared no conflict of interest.

Ethical Considerations

All ethical principles were adhered in conducting and writing this article.

Transparency of Data

In accordance with the principles of transparency and open research, we declare that all data and materials used in this study are available upon request.

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