Journal of Advanced Sport Technology
DOI: 10.22098/jast.2025.17621.1423
Received: 07 June 2025 Accepted: 02 November 2025

ORIGINAL ARTICLE *Open Access*

The Effectiveness of Virtual Reality in Enhancing Self-Efficacy and Intrinsic Motivation among Adolescent Football Athletes

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Kheirollahi Meidani, H., Behrooz Damirchi, F., Kamali, M., Rasoulzadeh Jedi, N., Qabousi, R. The Effectiveness of Virtual Reality in Enhancing Self-Efficacy and Intrinsic Motivation among Adolescent Athletes. Journal of Advanced Sport Technology, 2026; 10(2): -. doi: 10.22098/jast.2025.17621.1423

ABSTRACT

Background: The present study aimed to examine the effectiveness of a virtual reality intervention in enhancing self-efficacy and intrinsic motivation among adolescent Football players.
Methods: The results revealed that the virtual reality intervention significantly improved self-efficacy (P = 0.003) and intrinsic motivation (P = 0.010) in the experimental group. Furthermore, a significant time × group interaction effect was found for intrinsic motivation (P = 0.001), with post-test scores in the experimental group being 17.51% higher than those in the control group.
Results: The results revealed that the virtual reality intervention significantly improved self-efficacy (P = 0.003) and intrinsic motivation (P = 0.010) in the experimental group. Furthermore, a significant time × group interaction effect was found for intrinsic motivation (P = 0.001), with post-test scores in the experimental group being 17.51% higher than those in the control group.
Conclusions: These findings underscore the effectiveness of virtual reality as an innovative tool for enhancing key psychological factors in youth sports. The results suggest that VR-based training can serve as a foundation for designing engaging and efficient interventions in physical education, youth sports development, and mental health promotion.

KEYWORDS
Athletes, Football, Intrinsic Motivation, Self-Efficacy, Virtual Reality.

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Introduction

Adolescence represents one of the most transformative stages of human development, characterized by substantial physiological, psychological, and social changes. During this period, individuals become increasingly sensitive to social norms and peer acceptance [1, 2]. This heightened sensitivity, coupled with the physical changes of puberty, can significantly impact adolescents' body image perception, often leading to dissatisfaction with appearance and increased efforts to alter body weight and shape [3, 4]. Consequently, many adolescents, particularly those aged 12 to 21, engage in weight control behaviors that, in the absence of proper knowledge, environmental support, and effective strategies, may result in adverse physical, psychological, and social consequences [5, 6]. In Iran, as in many countries around the world, the rising prevalence of obesity among adolescents, especially in urban environments characterized by sedentary lifestyles, excessive use of digital media, and unhealthy dietary habits, has become a growing concern for public health authorities [7].

On the other hand, weight control behaviors such as restrictive dieting, excessive physical activity, or lifestyle modifications, when undertaken without scientific guidance or supportive interventions, may yield counterproductive outcomes. These may include disordered eating patterns, binge eating episodes, mood disturbances, and a diminished sense of self-worth [8, 9]. Such maladaptive behaviors often persist into adulthood and can adversely affect long-term quality of life [1, 10]. According to existing literature, the origins of these behaviors are multifaceted, emerging from the interplay of individual factors (e.g., body image and self-esteem), familial influences (such as parental eating behaviors, weight-related concerns, and family dynamics), and broader social factors (including peer norms and societal pressure) [11-14]. Furthermore, the onset of puberty marked by rapid psychological and bodily transformations is recognized as a key developmental factor contributing to the emergence of these behaviors [15].

In response to these realities, a wide range of educational and therapeutic approaches have been developed to promote healthy behavioral patterns among adolescents. Among the psychological constructs emphasized repeatedly in both theoretical and empirical literature is the concept of self-efficacy a term introduced by Bandura within the framework of Social Cognitive Theory, which refers to an individual's belief in their capacity to perform a task successfully under challenging conditions [16]. Self-efficacy serves as a facilitator across various domains, from everyday decision-making to adherence to regular physical exercise. Multiple studies have demonstrated that individuals with high levels of self-efficacy not only show improved performance in physical activities but also exhibit greater resilience in the face of setbacks and more persistence in pursuing their goals [17-19]. In the context of physical activity, self-efficacy gains even more importance among adolescents, who often face internal doubts, environmental pressures, and motivational challenges [20, 21].

Another critical determinant of health-related behavior is intrinsic motivation, as defined within the framework of Self-Determination Theory (SDT) proposed by Deci and Ryan. This theory posits that the fulfillment of three basic psychological needs competence, autonomy, and relatedness forms the foundation for developing and sustaining intrinsic motivation. When educational or training environments are structured to meet these needs, individuals are more likely

to engage in activities voluntarily and maintain their behavior over time [22]. Unlike extrinsic motivation, which is driven by external rewards, pressures, or obligations, intrinsic motivation arises from the inherent enjoyment, mastery, and personal growth associated with an activity, playing a vital role in long-term engagement in physical exercise and the adoption of an active lifestyle [23-25].

Amidst efforts to enhance adolescent participation in physical activity, virtual reality (VR) has emerged in recent years as a promising tool that has garnered increasing attention from researchers. By leveraging simulated, interactive, and goal-oriented environments, VR provides a unique opportunity to design educational and training interventions that can simultaneously influence an individual's physical, cognitive, and psychological dimensions [26-28]. Previous studies have indicated that VR-based physical training, particularly through active games such as *Wii Fit*, can improve fundamental motor skills, balance, responsiveness, and coordination [29-31]. These attributes are especially relevant in dynamic sports like Football, which require high levels of agility, rapid reaction, and precise body control [32, 33].

While the growing body of evidence has largely focused on the physiological benefits of VR, considerably less attention has been given to its psychological impact, specifically, its potential to enhance self-efficacy and intrinsic motivation in the context of real-world sports participation. Although some prior studies have sporadically explored the effects of active gaming on physical engagement or perceived competence, there remains a lack of systematic, theory-driven research that examines the impact of a structured VR intervention on both self-efficacy and intrinsic motivation, particularly among adolescent Football players. Moreover, many existing studies are limited by their focus on short-term effects, absence of theoretical integration, or failure to examine multiple psychological constructs in tandem. This gap is particularly concerning given the increasing need to design targeted, engaging, and developmentally appropriate interventions for youth, especially in the context of team sports.

Given these considerations, it is imperative to conduct research that, grounded in robust theoretical models and supported by innovative technological tools, investigates the effectiveness of VR in enhancing self-efficacy and intrinsic motivation among adolescent Football athletes. Such research could not only contribute novel empirical evidence but also inform the design of forward-thinking training strategies and policies within school settings, sports clubs, and youth health promotion programs.

Material and Methods

This study employed a quasi-experimental, applied research design utilizing a pretest–posttest format with a control group. The statistical population consisted of all adolescent Football players in Ardabil, Iran. All procedures were carried out in accordance with ethical guidelines for human research and adhered to the 26 principles of the GATE research ethics code.

Sample size was calculated using G*Power software, based on an effect size of 0.7, a confidence level of 95%, and two independent groups (experimental and control). As a result, 24 male adolescents aged between 13 and 18 were selected using purposeful sampling and were then

randomly assigned into two equal groups of 12 participants each. The inclusion criterion was a minimum of one year of club-level Football training experience.

To measure sport self-efficacy, the Kroll et al. (2007)[34] questionnaire was used. This instrument consists of 10 four-point Likert items (Never, Rarely, Sometimes, Always), scored from 1 to 4, with total scores ranging from 10 to 40. Higher scores indicate greater perceived self-efficacy and capacity for consistent training and coping with physical challenges. This scale has demonstrated excellent internal consistency in prior research, with Cronbach's alpha reported at 0.93 by Besharat (2008), 0.88 by Pourjavid et al. (2020), and 0.95 by Mazloumi Mahmoudabad et al. (2018) [21]. In the present study, the internal consistency was confirmed with a Cronbach's alpha of 0.79.

To assess intrinsic motivation, the Persian version of the Self-Regulation Questionnaire (SRQ) developed by Sørebø et al. (2009) was used [22]. While the original version included two items, the localized version expanded the scale to nine items by adding seven culturally relevant statements. Internal consistency in the pilot phase was calculated at 0.92, while in the final implementation it was 0.68. Construct validity was confirmed via Confirmatory Factor Analysis (CFA) with acceptable model fit indices reported. In the original study by Sørebø et al., the instrument showed excellent reliability (Cronbach's alpha = 0.95) and criterion validity (r = 0.95).

The virtual reality intervention was implemented using the Nintendo Wii Fit system, which includes a balance board and two motion-sensitive controllers. Following the pretest phase, participants in the experimental group engaged in VR-based training for eight consecutive weeks, with three 40-minute sessions per week (totaling 24 sessions). Each session consisted of four segments: a 10-minute warm-up, 20 minutes of active gaming (focused on motor, balance, and coordination skills), and a 10-minute cool-down period.

In the initial session, each participant created a personalized virtual avatar using parameters such as gender, age, height, weight, body dimensions, and center of gravity. This avatar was used throughout the program to track progress. Prior to each game, brief instructional tutorials were provided. Games were adapted to each participant's base level, and progression to more difficult stages was contingent on successful performance. Participants chose four games per session from a pool of twelve, with each game lasting five minutes (total active time per session: 20 minutes). The game options included: Football, Slalom Skiing, Balance Bubble, Balance Table, Track and Field, Focus, Basketball, Boxing, Badminton, Hula Hoop, Tightrope Walk, and Ski Jump.

All testing and training sessions were supervised by the principal investigator along with two physical education experts familiar with the VR protocol. Data were analyzed using SPSS version 26. Descriptive statistics (mean and standard deviation) and inferential statistics were applied, including two-way repeated-measures ANOVA and Bonferroni post-hoc tests. Prior to inferential analysis, assumptions of normality (Kolmogorov–Smirnov test) and homogeneity of variances (Levene's test) were confirmed. A significance level of $p \leq 0.05$ was used for all statistical tests.

Results

The results of the Shapiro–Wilk test indicated that the distribution of data for both self-efficacy and intrinsic motivation variables was normal, satisfying the assumptions required for conducting parametric tests.

According to the findings presented in Table 1, the main effect of time on the self-efficacy variable was statistically significant (P = 0.008, d = 0.228). Paired comparisons revealed that post-test scores of self-efficacy were significantly higher than pre-test scores. Additionally, the main effect of group on self-efficacy was also statistically significant (P = 0.003, d = 0.268), with participants in the virtual reality group scoring higher on self-efficacy than those in the control group.

Regarding the intrinsic motivation variable, the main effect of time was also statistically significant (P < 0.001, d = 0.376), indicating a notable increase in scores from pre-test to post-test. Furthermore, the main effect of group on intrinsic motivation was significant (P = 0.010, d = 0.212), with the experimental group reporting significantly higher levels of intrinsic motivation compared to the control group.

The interaction effect of time × group for intrinsic motivation was also found to be significant (P = 0.001, d = 0.344). Results from the Bonferroni post-hoc test indicated that post-test scores in the virtual reality group were 17.51% higher than those in the control group.

These findings affirm the positive and significant impact of the virtual reality intervention on enhancing both self-efficacy and intrinsic motivation among adolescent Football players.

Table 1. Comparison of Mean and Standard Deviation of Self-Efficacy and Intrinsic Motivation in Virtual Reality and Control Groups

Variable	Virtual Reality		Control		Time Effect (p, d)	Group Effect (p, d)	Time × Group Interaction (p, d)
	Pre-test (M ± SD)	Post-test (M ± SD)	Pre-test (M ± SD)	Post-test (M ± SD)			
Self-Efficacy	27.66 ± 2.76	30.73 ± 4.16	26.33 ± 1.75	27.80 ± 1.97	0.008* (d = 0.228)	0.003* (d = 0.268)	0.319 (d = 0.035)
Intrinsic Motivation	21.73 ± 3.10	27.40 ± 1.63	22.40 ± 3.31	22.60 ± 2.99	<0.001* (d = 0.376)	0.010* (d = 0.212)	0.001* (d = 0.344)

*Significance level: $p \leq 0.05$

Discussion

This study aimed to investigate the effectiveness of a virtual reality intervention in enhancing self-efficacy and intrinsic motivation among adolescent Football players. The findings indicated that the intervention, based on Nintendo's Wii Fit, led to a statistically significant improvement in both psychological constructs. Participants in the experimental group demonstrated notably higher levels of self-efficacy and intrinsic motivation in the post-test phase compared to those in the control group. These results are meaningful both within theoretical frameworks and in light of previous research.

From a theoretical perspective, Bandura's Social Cognitive Theory (1977)[35] emphasizes that successful experiences, immediate feedback, and observational learning from role models serve as key sources in the development of self-efficacy beliefs. The virtual reality training, particularly in the form of interactive games, activated all three sources. In this study, the step-by-step structure of VR gameplay, the achievable challenges, and real-time feedback created a context in which participants experienced progressive success, reinforcing their sense of control, mastery, and confidence. The significant increase in self-efficacy among participants aligns with prior research, including studies by Aflakseir & Kiani (2016)[36], Ghanbari et al. (2018)[37], and Turner-McGrievy et al. (2020) and Cariati et al. (2025), which collectively demonstrate that VR-based interventions can meaningfully support behavioral regulation and weight management through self-efficacy enhancement [38, 39].

Similarly, the observed improvement in intrinsic motivation can be interpreted through the lens of Self-Determination Theory (Deci & Ryan), which posits that fulfilling three fundamental psychological needs—competence, autonomy, and relatedness—is central to sustaining intrinsic motivation. The training environment in the present study successfully addressed all three: participants could freely choose their games (autonomy), achieve success through gradual progression (competence), and interact with their personalized avatars (relatedness). These dynamics mirror the findings of Alghadier et al. (2024), who reported that active VR environments led to cognitive enhancement and stronger intrinsic motivation in student populations [40].

Furthermore, the findings support the broader potential of VR-based training environments to enhance perceived competence and motivational engagement, even among individuals with limited physical ability. This is consistent with Bahram et al. (2024) and Xue et al. (2025), who found that children with motor disabilities experienced improvements in gross motor skills and perceived self-efficacy through VR-based exercises [31, 41].

Compared to prior studies, the present research demonstrates several novel contributions. First, it concurrently examined two central psychological constructs—self-efficacy and intrinsic motivation—within a structured, theory-driven VR intervention targeted at a specific athletic population. This represents a meaningful extension beyond earlier studies, which often focused on general users or clinical populations with atypical development. Second, the use of the Wii Fit console, which allows for adjustable difficulty, interactive feedback, and simulated physical challenges, made the intervention not only effective but also experientially engaging and motivating for participants.

From a practical standpoint, the findings offer actionable implications for coaches, sports psychologists, and youth training program designers. VR-based training can be integrated into physical education curricula, foundational sports clubs, or even rehabilitation centers. Coaches can utilize VR as a mental and physical warm-up tool, as well as for improving coordination, enhancing motivation, and reducing pre-competition anxiety. For example, games such as Tightrope Walk and Focus Bubble could complement conventional drills by simultaneously training balance, attention, and reactive control.

Conclusion

In conclusion, this study provides valuable empirical evidence on the role of virtual reality in enhancing psychological dimensions of sport participation among adolescents. The findings underscore that, when grounded in motivational theory and purposefully designed, VR technology can serve as a powerful tool for improving engagement, adherence, and psychological readiness in youth sports. No longer merely a recreational novelty, virtual reality is emerging as a multidimensional educational and motivational environment, with far-reaching implications for physical education, athletic development, and sport psychology.

Despite its strengths, this study has several limitations. The relatively small and geographically localized sample, the use of self-report questionnaires, and the short-term assessment window restrict the generalizability of the findings. Future studies should address these limitations by employing longitudinal designs, larger and more diverse samples, and mixed-method approaches that include both quantitative and qualitative data. Further, moderating factors such as baseline skill level, extrinsic motivators, and personality traits (introversion or extraversion) should also be explored in future investigations. Overall, consistent with recent trends in sports technology research (42), continued interdisciplinary research will be essential to maximize the educational and psychological benefits of virtual reality in sport.

Ethical Considerations:

Compliance with ethical guidelines

The authors commit to adhering to ethical guidelines.

Disclosure

The Authors have nothing to disclose.

During the preparation of this work, the authors used Chat GPT Plus v5 to enhance readability and language, aiding in formulating and structuring content. After using this tool, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

Funding

The authors state no funding is involved.

Conflict of Interest

The authors declared no conflict of interest.

Acknowledgment

The authors would like to sincerely express their gratitude to all those whose support, collaboration, and kind assistance contributed to the successful completion of this study.

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نشریه فناوری ورزشی پیشرفته
DOI: 10.22098/jast.2025.17621.1423
تاریخ دریافت: ۱۴۰۴/۰۳/۱۷ تاریخ پذیرش: ۱۴۰۴/۰۸/۱۱
Journal of Advanced Sport Technology

«مقاله پژوهشی»

اثربخشی واقعیت مجازی بر تقویت خودکارآمدی و انگیزه درونی ورزشکاران فوتبالیست

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چکیده

هدف: هدف از پژوهش حاضر، بررسی اثربخشی مداخله واقعیت مجازی بر ارتقاء خودکارآمدی و انگیزه درونی نوجوانان فوتبالیست بود.

روش شناسی: این مطالعه به‌صورت نیمه‌تجربی با طرح پیش‌آزمون ـ پس‌آزمون با گروه کنترل انجام گرفت. جامعه آماری شامل نوجوانان فوتبالیست شهر اردبیل بود که از میان آن‌ها ۲۴ نفر با روش نمونه‌گیری هدفمند انتخاب و به‌صورت تصادفی در دو گروه آزمایش و کنترل (هر گروه ۱۲ نفر) تقسیم شدند. مداخله واقعیت مجازی با استفاده از کنسول Wii Fit نینتندو به‌مدت ۸ هفته و در قالب ۲۴ جلسه تمرینی اجرا گردید. ابزارهای گردآوری داده‌ها شامل پرسشنامه خودکارآمدی ورزشی و پرسشنامه انگیزه درونی بود. داده‌ها با استفاده از آزمون‌های آماری تحلیل واریانس دوسویه با اندازه‌گیری مکرر و آزمون تعقیبی بونفرونی تحلیل شدند.

نتایج: نتایج نشان داد که مداخله واقعیت مجازی به‌طور معناداری موجب افزایش خودکارآمدی (P=۰۰۳/۰) و انگیزه درونی (P=۰۱۰/۰) در گروه آزمایش شد. همچنین، اثر تعاملی زمان × گروه در متغیر انگیزه درونی معنادار بود (P=۰۰۱/۰)، به‌طوری‌که میزان انگیزه درونی در پس‌آزمون گروه آزمایش ۱۷/۵۱ درصد بیشتر از گروه کنترل بود.

نتیجه گیری: نتایج این پژوهش بر نقش مؤثر واقعیت مجازی به‌عنوان ابزاری نوین در ارتقاء مؤلفه‌های روان‌شناختی ورزش نوجوانان تأکید دارد و می‌تواند مبنایی برای طراحی مداخلات تمرینی جذاب و کارآمد در حوزه تربیت‌بدنی، آموزش و سلامت روان نوجوانان فراهم آورد.

واژه‌های کلیدی

انگیزه درونی، خودکارآمدی، واقعیت مجازی، ورزشکاران فوتبالیست

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