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Virtual Reality to Promoting Sports Engagement and Some Technical skills in Junior Football Athletes: A 12-Week Randomized Controlled Trial

Realidad virtual para promover el compromiso deportivo y las habilidades técnicas en atletas de fútbol: un ensayo controlado aleatorio de 12 semanas

*Rusmanto Rusmanto, *Tomoliyus Tomoliyus, *Agus Sulastion, **Novri Gazali, ***Khairul Hafezad Abdullah, ****Francisco Javier Gil-Espinosa, *****Edi Setiawan

*Universitas Negeri Yogyakarta (Indonesia), **Universitas Islam Riau (Indonesia), ***Universiti Teknologi MARA (Malaysia), ****University of Malaga (Spain), *****Universitas Suryakencana (Indonesia)

Abstract. Objective: Nowadays, the implementation of technology shows enhancement in sports such as VR. However, the effectiveness of VR in increasing the level of sports engagement and technical skills in football athletes still need to be studied further, which is the gap in this study. This study aims to identify the effect of VR on increasing the level of sports engagement and technical skills in junior football athletes. Methods: This study adopted a randomized control trial for 12 weeks. Forty male athletes from Yogyakarta State University (Indonesia) were involved in this study. Sports engagement was measured with Sport Engagement Scale and technical skills through shooting and passing tests. The Mann-Whitney U test is used to test the difference in values for each variable. Results: The main findings showed that VR increased the level of sports engagement ($p < 0.05$) and technical skills ($p < 0.05$). Conclusion: Thus, this study highlights the importance of VR in football and it was proven that VR contributed a positive power to change the level of sports engagement and technical skills.

Keywords: Athlete performance, sport technology, competitive sport

Resumen. Objetivo: Hoy en día, la implementación de la tecnología muestra mejoras en deportes como la VR. Sin embargo, la efectividad de la realidad virtual para aumentar el nivel de compromiso deportivo y las habilidades técnicas en los atletas de fútbol aún debe estudiarse más a fondo, que es la brecha en este estudio. Este estudio tiene como objetivo examinar el efecto de la realidad virtual en el aumento del nivel de compromiso deportivo y las habilidades técnicas en los atletas de fútbol. Método: Este estudio adoptó un ensayo de control aleatorio durante 12 semanas. Cuarenta atletas masculinos de la Universidad Estatal de Yogyakarta (Indonesia) participaron en este estudio. El compromiso deportivo se midió con Sport Engagement Scale y las habilidades técnicas a través de pruebas de tiro y pase. La prueba U de Mann-Whitney se usa para probar la diferencia de valores para cada variable. Resultados: Los principales hallazgos mostraron que la VR aumentó el nivel de compromiso deportivo ($p < 0,05$) y las habilidades técnicas ($p < 0,05$). Conclusión: Por lo tanto, este estudio destaca la importancia de VR en el fútbol y se demostró que VR contribuyó con un poder positivo para cambiar el nivel de compromiso deportivo y habilidades técnicas.

Palabras clave: Rendimiento del atleta, tecnología deportiva, deporte de competición

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Rusmanto Rusmanto

rusmanto.2022@student.uny.ac.id

Introduction

Football is one of the most well-known competitive sports in the world (Kozina et al., 2019; Prasetya et al., 2020), and all coaches are looking for the right strategy to optimize athletes' performance (Kozina et al., 2019), such as psychological (Cieślicka et al., 2021), tactics or techniques (Kraynik, Mulyk & Okun, 2019; Popovych et al., 2021). In football, technology increase rapidly and it is often used by coaches to help athletes achieve high performance, one of which is virtual reality (VR).

VR is a sophisticated technology which has become more popular and has been used in several fields such as health (Asadzadeh, Samad-Soltani, Salahzadeh, Rezaei-Hachesu, 2021; Lindner, 2021; Peláez-Vélez, Gacto-Sánchez & Martínez-Carrasco, 2023), employment (Ho, Wu & Yen, 2023 2023), education until sports (Hoyos, Yusti & Sandon, 2022; Zhang et al., 2022; Wiebe et al., 2022). VR presents a sports activity carried out in a virtual environment. Training process with VR should be more interesting, because athletes could learn some skills from a virtual animation (Mcclure & Schofield, 2020). This was also explained by Shalan (2023), that VR provided a virtual

training environment for athletes which can optimize training objectives. Basically, VR presented movement with character animation that should be followed by athletes (Farley, Spencer & Baudine, 2020). The documented data showed one of benefits of VR, including the performance of football athletes enhanced significantly (Harrison, Potts, King & Braun-Trocchio, 2021). Other studies reported that VR could promote the level of physical health and fitness (Mologne et al., 2023). Gani et al. (2023), explained that VR is a modern technology that can be used in sports activities to improve psychological well-being among athletes. Some of the performances that are important and must be increased by football athletes using VR are sports engagement and basic techniques.

Sports engagement is an important aspect that must be possessed by a football athlete. Sports engagement is defined as a bond between individuals and sports activities which is characterized by positive cognition, attitudes and emotions (Hanifah, Ito, Yao, Suyama & Inoue, 2022). A study found that during and after the COVID-19 crisis, sports engagement decreased significantly which was due to several factors such as staying at home and not being allowed to carry out sports training activities outside (Hanifah et al., 2022). In fact, high sports engagement could provide positive effect in

triggering athletes to be more enthusiastic and passionate in training and sports (Kuokkanen, Virtanen, Hirvensalo & Romar, 2022). According to Batucan, Morales & Alcuizar (2019), the engagement of athletes in every sports training activity had a benefit as a parameter in obtaining success in the future. Other studies documented that athlete engagement in sports had a benefit in optimizing their potential and promote positive experiences (Shen et al., 2021; Jiang, Razak & Rasyid, 2023).

Technical skill is an important performance in all types of sports including football (Putra et al., 2021). A good technical skill help athletes to carry out attacks and have a greater chance to win the competition (Wang & Qin, 2020). However, if athletes has poor technical skills they will be difficult to gain high achievements (Juliantine & Setiawan, 2022). According to Soniawan, Setiawan & Edmizal (2021), technical skill is an important factor that must be fostered and improved, because they have a major contribution to athlete performance. The accuracy in passing, dribbling and shooting is an important indicator of success for a team's performance in football (Wang & Qin, 2020). Among these aspects, shooting and passing are considered qualities that need more attention in football. Data from previous research shows that to achieve scintillating performance, athletes are required to have good technical skill (Yudanto, Suherman, Nugroho, Guntur, Yudhistira, 2022).

Data from previous studies had documented about VR that was integrated into sports training (Bedir & Erhan, 2021; Geisen, Fox & Klatt, 2023; Khundam & Noël, 2021; Sohail, Firdos, Ikram & Talha, 2022; Zhang et al., 2022). In addition, previous research on VR only focused on several research methods, for example scoping reviews (Giakoni-Ramírez, Godoy-Cumillaf, Sebastián Espoz-Lazo, Duclos-Bastias & Martín, 2023; Mouatt et al., 2020), experiments (Harrison, Potts, King & Braun-Trocchio, 2021; Dolu & Camliguney, 2022; McClure & Schofield, 2020), but there has been no study about VR being associated with sports engagement and technical skills in football athletes through experimental methods. Besides that, the implementation of technology shows enhancement in sports such as VR. However, the effectiveness of VR in increasing the level of sports engagement and technical skills in junior football athletes still need to be studied further, which is the gap in this study. It is expected that thi research can contribute to the development and innovation of football training processes that involve technology in the form of VR and provide important information to coaches, lecturers or practitioners in football about the importance of using VR for junior athletes. Therefore, this study aims to identify the effect of VR on increasing the level of sports engagement and technical skills in junior football athletes.

Methods

Participants

This study involved 49 football athletes, who was re-

cruited from Yogyakarta State University with the following inclusion criteria: (i) males in good health, (ii) ages 16-20 years, (iii) beginner level athletes (they have low experience). While the exclusion criteria were: (i) athlete never trains (severely ill or lazy), (ii) had a history of injury. All participants were required to sign a letter of intent to be involved in this research activity. A total of 49 athletes were initially recruited, but 9 participants dropped out of the study (Figure 1 displays the flowchart in this study).

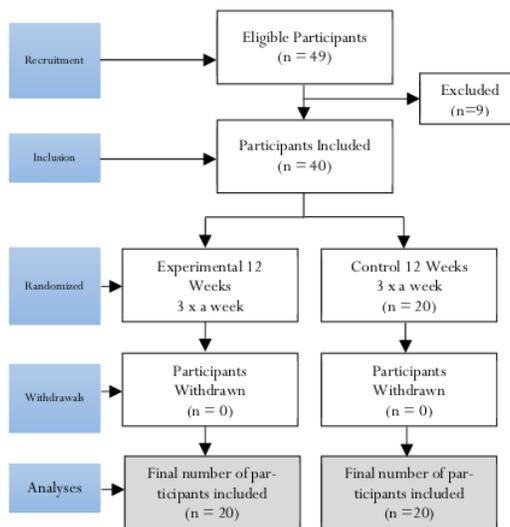


Figure 1. Flowchart of the study

Study Design

This study adopted a randomized control trial for 12 weeks. In this study, forty male participants were allocated to the experimental group who received the VR program and the control group did traditional training. The participants conducted training 3 times a week for 12 weeks. The duration of the training was around 60 minutes to increase engagement and basic techniques. Participants were prohibited to participate other activities outside of this research.

Research instrument

Sports Engagement

In this study, the Sport Engagement Scale (SES) was adopted from previous studies (Hanifah, Ito, Yao, Suyama & Inoue, 2022). SES consisted 15 question items from three sub-indicators, namely: vigor (5 items), dedication (5 items), absorption (5 items). Based on previous studies, this instrument has a Cronbach's α of 0.75. The question items were answered with Likert scale from a value of 1 = strongly disagree to 7 = strongly agree.

Technical skills

In order to measure the level of technical skills in football, several test items were adopted from previous studies (Joo & Seo, 2016), including:

Shooting test. This test aims to measure the athlete's ability to shoot. The tools used are 3 balls, meter, number paper, whistle. Participants stood 15 meters from the goal. When the whistle sounded, the participants shot at the target (numbers 1-5) in the goal (Fig. 2). Participants shot 14 times for 2 sets. The total shot was used as the final value for analysis.

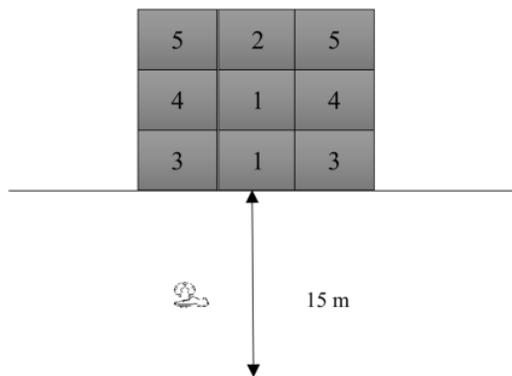


Figure 2. Shooting skill test

Pass test. The purpose of this test is to measure the athlete's passing ability and the tools used are 3 balls, cones, meter, whistle. Participants carried out passing with 10 meters distance and 1 m width which was divided into four sectors and placing a cone in each section (Fig. 3). Participants were given three chances. The results of passing were calculated as the final value.

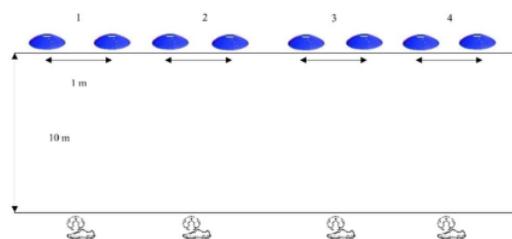


Figure 3. Passing skill test

Procedures

This research was conducted in March-May 2023 at Yogyakarta State University (Indonesia). Before carrying out the research, the research team asked permission from the Yogyakarta State University (approval number: 578/UNY/2023). In addition, this research was carried out

based on the guidelines of the World Medical Association (2013) Code of Ethics (Helsinki Declaration for Humans).

VR Program

The VR program was carried out in the morning at 08.00-09.00 at the sport field of Yogyakarta State University. Participants used the VR for 15 minutes and 5 minutes to rest, the activity was repeated 3 times. VR presented a training process of a virtual football and participants were required to carry out shooting and passing movements.

Statistical analysis

The researcher carried out test descriptive statistics which was presented in the mean \pm standard deviation (SD). The normality of the data was tested by means of the Shapiro-Wilk tests. Comparison of differences between baseline and posttest in sports engagement and technical skills in the experimental and control groups using the Mann-Whitney U test. A value of 0.05 was chosen in this study and all analyzes were performed using IBM SPSS v.25 (Armonk, NY, USA).

Results

Based on the analysis of the Shapiro-Wilk tests, the data was not normally distributed. Table 1 shows the pretest-posttest mean and SD values of the experimental and control groups. Table 2 displays the results of the Mann-Whitney U test which showed that there was a difference between the pretest (baseline) and posttest on sports engagement and technical skills in the experimental and control groups ($p < 0.05$). Figure 4 shows the differences in sports engagement and technical skills scores in the pretest and posttest on EG and CG.

Table 1.
Descriptive statistics of EG and CG

Variables	EG (n = 20)		CG (n = 20)	
	Baseline Mean \pm SD	12 weeks Mean \pm SD	Baseline Mean \pm SD	12 weeks Mean \pm SD
Sports engagement (points)				
Vigor	12.7(1.83)	25.3(2.40)	13.4(1.84)	14.4(1.53)
Dedication	13.4(1.09)	18.6(2.58)	13.5(1.14)	14.2(1.24)
Absorption	15.2(1.15)	17.65(1.75)	14.9(1.16)	15.4(1.09)
Technical skills (points)				
Shooting	9.5(1.90)	11.9(1.98)	9.7(1.72)	9.7(1.48)
Pass	4.9(1.16)	7.5(1.14)	6.3(1.30)	6.7(1.11)

Note. EG: Experimental Group; CG: Control Group; SD: Std. Deviation.

Table 2.
Sports engagement and technical skills at baseline and after 12 weeks for the EG and CG groups

Variables	EG (n=20)				CG (n=20)			
	Baseline Mean rank	12 weeks Mean rank	Z	p	Baseline Mean rank	12 weeks Mean rank	Z	p
Sports engagement (points)								
Vigor	10.50	30.50	-5.429	0.000	17.30	23.70	-1.756	0.079
Dedication	10.60	30.40	-5.387	0.000	17.65	23.35	-1.591	0.112
Absorption	12.83	28.18	-4.221	0.000	16.75	22.25	-1.339	0.124
Technical skills (points)								
Shooting	13.88	27.13	-3.626	0.000	20.13	20.88	-.207	0.836
Pass	11.70	29.30	-4.832	0.000	18.40	22.60	-1.174	0.240

Note. Significance: * $p < 0.05$.

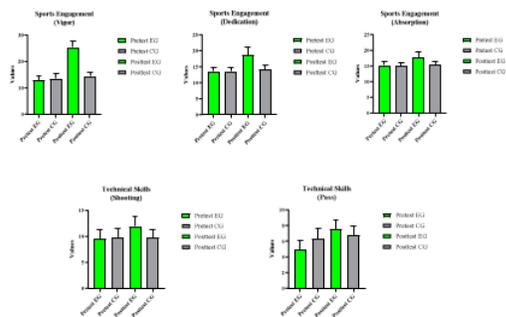


Figure 4. Differences in sports engagement and technical skills scores (Mean±SD) in the pretest and posttest on EG and CG

Discussion

Our research aims to identify the effect of VR on increasing the level of sports engagement and technical skills in junior football athletes.

The first finding in this study showed that the experimental program with VR training for 12 weeks showed more effective than the control group in increasing the level of sports engagement. This is because VR offered a lot of movement experience for athletes, so they felt happy and more actively involved in football training activities. This is in accordance with Hanifah, Ito, Yao, Suyama & Inoue (2022), game-based VR as a powerful method to create a cheerful and entertaining atmosphere to optimize the activities. On the other hand, research by Gani et al. (2023), confirms that the power of VR and AR was based on virtual animation, which can trigger athletes more interest and willing to be involved in the training process. In this modern football training, utilizing VR can create a training process by providing a visual, immersive and interactive simulation of the environment, thus this can attract athletes to be more enthusiastic (Sauchelli & Brunstrom, 2022), vigor and absorption in training sessions (Farley, Spencer & Baudinet, 2020). Other studies also explained that VR as an innovation in the training scope that has a positive effect for people who used it (Lee & Kim, 2018; Ng, Ma, Ho, Ip & Fu, 2019; McClure & Schofield, 2020). This finding is consistent with previous findings which reported that the group using VR have a higher vigor (Dolu & Camliguncy, 2022; Hanifah, Ito, Yao, Suyama & Inoue, 2022). In addition, data from previous research proved that VR was effective in improving people psychological aspects (Huang, Choi, Lai, Lu & Tian, 2022; Mouatt et al., 2020; Shaw & Lubetzky, 2021), especially sports engagement (Hanifah, Ito, Yao, Suyama & Inoue, 2022).

The second finding in our study shows that VR had a positive effect on increasing the level of technical skills in football athletes. This is because VR presented a virtual animation (Faure, Limballe, Bideau & Kulpa, 2020), which can substitute the coach in demonstrating shooting and passing movements to athletes, so that they can gradually learn every movement from easy to difficult. Bedir & Erhan

(2021), reported that VR has a strength in presenting a virtual simulated training environment, so that athletes must perform physical reaction actions such as moving or performing a technical skill in a sport. In that way, we believed that VR interventions can be useful in improving athlete performance (Bürger et al., 2022; Harrison, Potts, King & Braun-Trocchio, 2021). VR system has many advantages in sports such as being able to create more interesting environment (Geisen, Fox & Klatt, 2023), more fun than traditional training, and can provide instructional guidance to athletes on how to perform a sport skill correctly (Khundam & Noël, 2021). The finding in this study is in line with and support previous research, for example athletes can row faster with VR than without VR, thus VR is an important tool for creating meaningful sports training environments for athletes (Trewick, Neumann & Hamilton, 2022). On the other hand, Gani et al. (2023), reported similar result, VR can be a solution for trainers as an effort to create an effective training process and to achieve the target in namely developing athlete performance optimally.

Finally, this study shows the uniqueness of the novelty which is VR can effectively increase sports engagement and technical skills among junior football athletes for 12 weeks

Conclusions

In conclusion, this study highlights that the implementation of VR in football was proven to provide a significant increase in sports engagement and technical skills in junior football athletes. This research contributes as important information for coaches, lecturers or practitioners who work in football about the importance of using VR in sports. However, this study still has limitations in terms of only involved male participants. It is recommended that future research can apply VR to male and female athletes in football or different sports, such as handball, football, basketball or volleyball.

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