The Eurasia Proceedings of
Educational & Social Sciences (EPESS)
ISSN: 2587-1730

The Eurasia Proceedings of Educational & Social Sciences (EPESS), 2022

Volume 28, Pages 54-61

IConSE 2022: International Conference on Science and Education

The Efficiency of Visual-Spatial Abilities (Memory Processes) Training through Multimedia Simulation for Soccer Strikers.

Lorabi RADHOUANE
University of Djilali Bounaama

Belaid Akil ABDELKADER
University of Djilali Bounaama

Abstract: The main aim of our work is to test the efficiency of visual-spatial abilities (memory processes) training through the multimedia simulation of soccer strikers under 23 years of age (N = 20; M age =20.85 years; SD =1.15), who have at least 5 years of experience (M experience=6.1 years; SD=1.11), and the reflection of this process on soccer strikers' comprehension of the different offensive tactical situations. We created a training program (experimental approach using the unique sample with pre- and post-testing design) for soccer strikers, based on the theory of cognitive load that can provide guidelines to help present information in a way that encourages the learner to activities that improve intellectual performance. The methodology demonstrated a noticeable improvement in the player's visual-spatial abilities, and that helped the soccer striker to improve his VSA perception, and the time of responsiveness on the different playing strategies that they had practiced before. In addition to improving the psychomotor-sensory coordination in which visual-spatial perception plays an essential role, by improving it, the player's performance develops at multiple levels (cognitive, sensory, psychological, and executive performance).

Keywords: Visual-spatial abilities, Multimedia simulation, Soccer strikers, Soccer

Introduction

Scientific research is witnessing major developments in the field of sports in general and soccer, in particular, significant developments coinciding with developments in the technological field and nearby science fields like neurobiology, and neuropsychology (Kalbfleisch & Gillmarten, 2013; Mangus et al., 2004; Witol & Webbe, 2003). However, most of the research started and focused on the practical field side, and at the same time neglected the adoption of theoretical frameworks which are considered the natural basis for starting any scientific research, as Karl Popper asserts (Popper, 2005).

The efforts exerted in the field of sports training have achieved progress in soccer. Despite that, there are still persistent problems related to the training process that requires practical scientific solutions that fall on the shoulders of coaches and specialists in soccer, as it requires research on the means and methods of modern and scientific technology enhanced by experiences (Ben Mahfoudh & Zoudji, 2022, p. 20; Lorains et al., 2013; Valls-Serrano et al., 2022) that help to raise the level of tactical intelligence of the soccer player, and thus better understanding and implementing of the various problems and situations that face us in preparing and managing the competition. Perhaps one of the major scientific developments in the field of sports training in soccer is the exploitation of multimedia as an effective means or tool to develop the various mental and skill aspects of players (Khacharem et al., 2013), and it has taken a great deal from the field of thinking of coaches and specialists in the field of training because of its importance and its effectiveness during the training process.

The interest of trainers at the high level has lately been based on the development of mental aspects more than other aspects (physical and skill), which has become a routine matter inevitable, and attention to mental and cognitive aspects during the training process is what makes the difference during the competition, similar to perception (Coutinho et al., 2018). The visual-spatial, which occupies a central role concerning the mental and cognitive state of the player and the soccer striker in particular, on one hand, this role appears in the player's perception of his position on the field, his movement with the ball, and without a ball, anticipating the playing process, and the dynamism that he must act according to the requirements of the plan and the playing strategies that have been made, practice it beforehand (Kamble et al., 2019). In addition to improving the psychomotor-sensory coordination in which visual-spatial perception plays an essential role, by improving it, the player's performance develops at multiple levels (cognitive, sensory, psychological, and executive performance). Through the above, we wanted to know the contribution of training through multimedia simulation to the development of visual-spatial perception, and its reflection on the player's perfection of tactical situations, and by building a tactical training program based on the theory of cognitive load that can provide instructions to help provide information in a way that encourages the learner to engage in activities that improve intellectual performance (Dehn et al., 2020). It is based on a cognitive architecture consisting of a finite working memory, with partially independent processing units (Visual-spatial Scratchpad, Phonological loop) providing visual and auditory information, which interacts with unlimited long-term memory. According to the theory, it is possible to circumvent the limitations of working memory by encoding multiple elements of information as one element in the cognitive scheme, and by automating rules, and using more than one view (Ginns & Leppink, 2019).

General hypothesis: Simulation (multimedia) training affects the development of the strikers' visual-spatial abilities in soccer. Partial hypothesis: Simulation (multimedia) training affects the development of visual-spatial abilities, and that helps the soccer striker to improve his VSA perception. The development of soccer strikers' visual-spatial perceptual ability in soccer contributes to a greater the time of responsiveness on the different tactical situations. Objectives of the study: 1. Knowing the impact of simulation training (multimedia) on the development of the visual-spatial perception of soccer strikers. 2. Knowing the extent to which the soccer strikers' visual-spatial perception ability in soccer contributes to a greater the time of responsiveness on the different tactical situations.

The importance and capabilities of training through multimedia technology in enhancing the cognitive abilities of the offensive soccer strikers, especially the visual perception of spatial relationships that occupy a central role concerning the mental and cognitive state of the player and the group of strikers. On the other hand, this role appears in the player`s awareness of his position on the field, his movement with the ball and without the ball, the prediction of the playing process, and the dynamics according to which he must act according to the requirements of the plan and the tactical situations that were previously trained. In addition to improving the psycho-sensory coordination in which the visual perception of spatial relationships plays a fundamental role (Garel, 2005), by improving it, the player's performance develops at multiple levels (cognitive, sensory, psychological, and executive functioning). On the other hand, the topic occupies an essential role in strengthening communication between the group of soccer strikers and improving their spatial positions in relation to each other and concerning vacant spaces in addition to the position and direction of the ball (Kamble et al., 2019), which will have fundamental repercussions on several levels (the success of the coach's tactical style, the psychological state of the team and the player, anticipating different situations, knowing the appropriate behavior, and facilitating and quickly making a decision).

Method

In this study, we used the experimental method (experimental approach using the unique sample with pre and post-testing design), by conducting a pre-measurement consisting of a test battery. and then we applied a program (visual-spatial, memorization, decision making,Techno-Tactical training) through multimedia on a sample of 20 players. We choosed it intentionally, then conduct telemetry on the sample and study the differences between the two measurements (that will be determined by the SPSS program) to arrive at an answer to the study's questions. We used the students T test to determine the results. We also considered a set of conditions: The limited functionality of the cognitive system (age, years of experience, visual-spatial abilities, responsiveness time), The complexity of contains (numbers, speed, interactions), the organization of contains (the presentation format, segmentation, Etc..), the Conditions of the location of the experiment: Screen size, Brightness, Distance of the player on the screen.. etc.

Participants

The experiment was conducted on 20 soccer player under 23 years of age (M age = 20,85 ; SD = 1,18). The sample size is less average compared to previous studies that analyzed the effect of visual-spatial abilities when using visualizations for experienced soccer players (Khacharem et al., 2014), and have playing experience of at least 5 years (M experience =6.1 years; SD =1.11), all players actively playing in various soccer clubs (the professional Algerian soccer leagues, 60% of players had participated in official games at the Algerian first professional league, 40% had participated in official games at the Algerian second professional league), and they had been playing soccer for an average of 6.1 years (SD = 1.11) and trained or played for an average of 570 min (SD = 126) per week. Participants affirmed that this was their first time participating in a laboratory experiment that included a recall reconstruction-test of soccer animations to prevent familiarity. They had no vision problems, otherwise, it was corrected with glasses or lenses. Finally, they volunteered to participate and provided informed consent. Approval for this project was granted by the local ethics committee.

Table 1. Descriptive Statistics of the sample characteristics

N	Age (years)	Experince (years)
M	20,85	6,1
SD	1,18	1,11

Instruments

One computerized test was created and displayed on a TOSHIBA Portege Z30-B laptop with a 14-inch screen. The control test consists of a test battery that contains a test of the visual-spatial perception ability (visual-spatial rotation tests) and also contains a multimedia questionnaire (Quiz) designed by a quiz maker program, that contains specific tactical situations (2D pictures, FIFA videos, animations) prepared by Clipdraw, dartfish, and the tactical pad program, with two expert soccer coaches (with over 10 years' experience, licensed by the 3rd Algerian degree of coaching football and the CAF A), one task decision making situations (videos), where we will determine the cognitive readiness and awareness of the players and the visual-spatial on memorization performance. The display was in a full 14-inch screen, with 100% screen Brightness, and a 75 cm distance of the player on the screen with a 45° viewing angle (Khacharem et al., 2014).

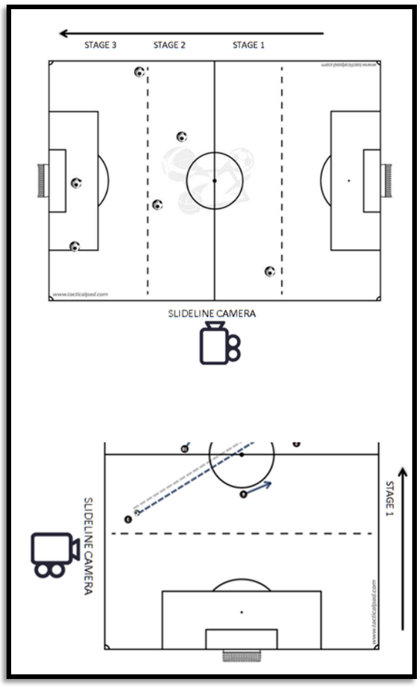

Figure 1. Schematic presentation of the empty soccer play, position of camera side-line and the direction of the play, position of passes and the stages on the soccer paly.

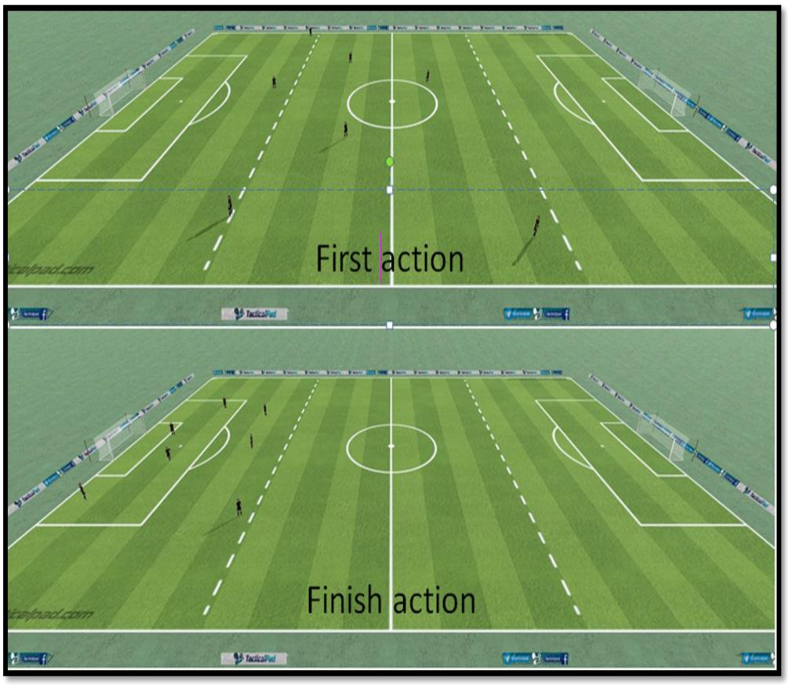

Figure 2. Schematic Representative diagram of the first and the finish 3D animation dynamic scene to memorise

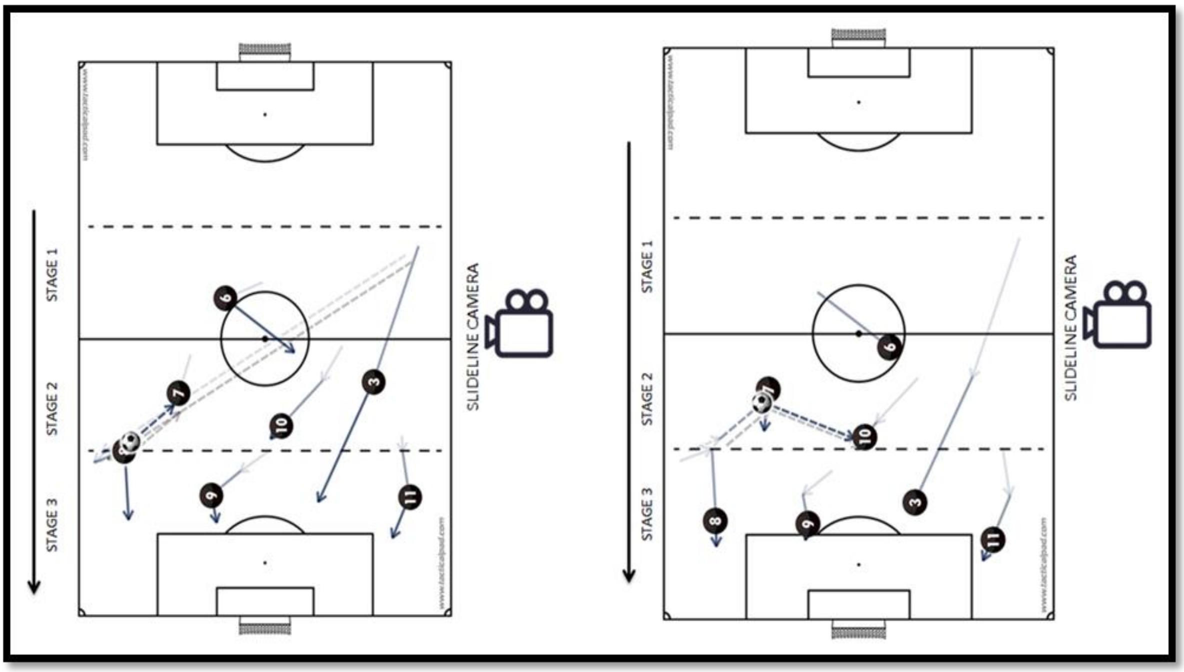

Figure 3. Schematic representative diagram of the dynamic scene to memorise at the STAGE 2. discontinuous arrows represent ball passes and continuous arrows presents players' movements.

Before selecting the offensive tactical situations 3D animations and 2D animations and schema pictures, the construction of the animations, FIFA official games videos, 2D animations and the 2D pictures, coaches were asked to create counterattack scenes that involved seven players who should carry out a tactical combination composed of five passes towards the opponent's court before a shot on goal was taken. During each pass, each player should move concerning the ball and the teammates' positions to offer an appropriate solution to the ball carrier. Each pass corresponded to a new stage made up of multiple offensive actions carried out by the players. Each animation was captured as if it was recorded by a side-line camera in an elevated position of 25°. This camera position enabled the entire field of play to be viewed (Khacharem et al., 2014).

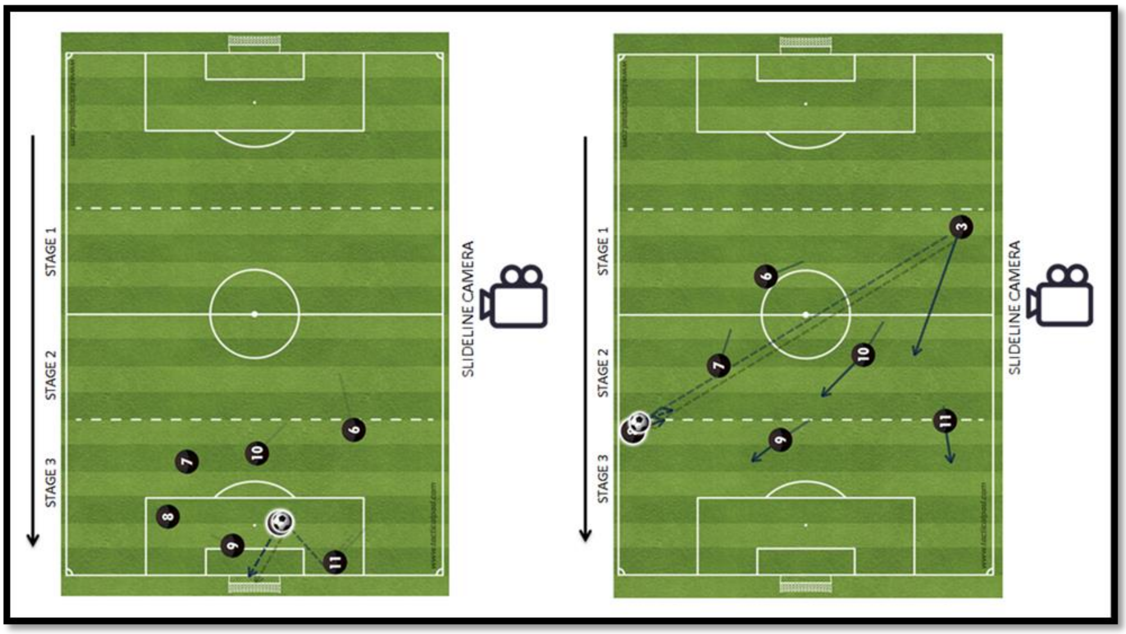

Figure 4. Schematic diagram 2D of the first and the last animation.

Subsequently, a static scene was generated from each animation that included six still frames representing the three main stages of the play, as defined by the same two coaches (i.e., who developed the scenes of the play).

These frames were displayed simultaneously in the same picture. The duration of all scenes of the play was 15 s (2s for each frame).

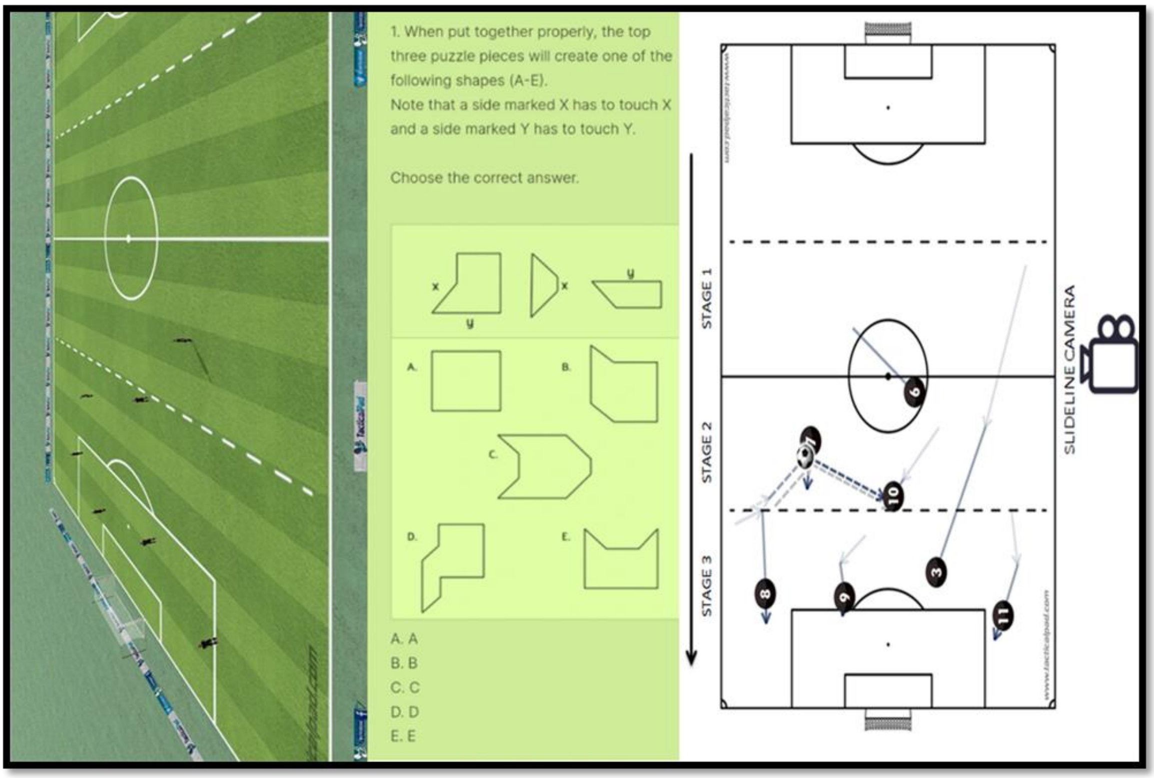

Figure 5. Representative diagram represent the different steps of the battery test.

Results and Discussion

Control Test

We arranged all the components in the form of a multimedia quiz that contains four sequences arranged and consecutive, where each series consists of ($\leq$ 5 s video, rotation task, and 3D animation). when the player presses the start button, the time starts counting down and the time is set at 300 seconds (five minutes). After watching the video of an official FIFA game video, the soccer strikers were asked to press the button corresponding to the answer he deems appropriate, A, B, or C, to collect the largest possible score, where we set a total of 10 points for the strong answer, 5 points for the medium answer and 3 points for the weak answer. After the video is finished, the player presses the NEXT button to show him another screen containing a rotation task to select the correct answers only, where for each question there are two correct answers out of four answers, we set 5 points for each correct complete answer that does not accept the partial answer (0 or 5), either Concerning the 3D animation, the player watches the 3D animation (non-returnable) to answer one of the three correct answers out of the three that appear in the form of a 2D other animations or images, so the player collects a total of 10 points for the correct answer. finely the player gets a total of 100 points for the maximum answer score (video test 40/4 points, rotation test 20/4 points, animation test 40/4) and 24 tenths as a minimum.

Immediately after the pre-measurement, we calculated the strength of the relationship between the level of experience (years) and the visual-spatial perception abilities (score1), by using the Pearson coefficient formula:

$$r=\frac{\Sigma(xi-x)(yi-\overline{y})}{\sqrt{\Sigma(xi-\overline{x})^2\,\Sigma(yi-\overline{y})^2}};\ r=0.85.$$

In our study the numerical value of correlation of coefficient (r=0.85) was between (-1 & + 1). and It is known as real number value, also the ‘r’ approaches to the side of (+ 1) and that means the relationship is strong and in a positive state.

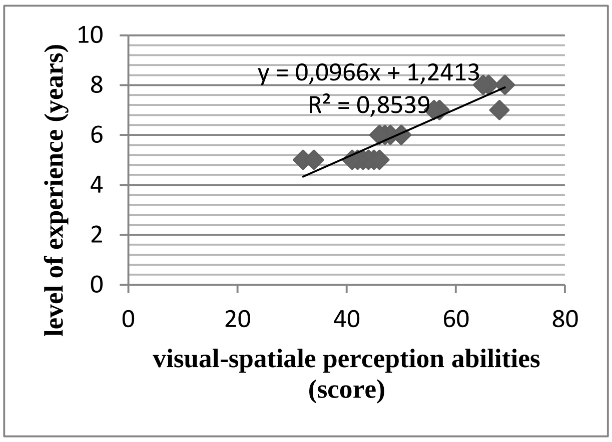

Figure 6. Linear curve represent the strength of the relationship between the level of experience (y) and the visual-spatial perception abilities (x)

The results revealed that there are statistically significant differences between the pre and post-test of the experimental group and in favor of the post-test due to the multimedia simulation training on visual-spatial abilities.

Table 2. Descriptive statistics and differences for visual-spatial abilities battery test.

Test Variables	Pre-test Score1 (points)	Time1 (s)	Post-test Score2 (points)	Time2 (s)
M	50,3	218,2	64,1	198,9
SD	10,70	22,47	9,18	23,35
t test	0,000283%			0,0034%

The difference between pre and post-test for score; M score1=50,3 point and a SD=10,70 point in the pre-measurement, while M score2 = 64,1 and SD =9,18 in the post-measurement, and the T value was 0.00028 at a degree of freedom (19) and a level of significance (0.05), and the significant value was sig (0.00), and by comparing the significant significance with the level of significance, we find that sig = 0.00 < α = 0.05, and this is statistically significant, and through the previous results, it can be said that there are statistically significant differences between the pre-measurement and the post-measurement of the sample in testing the visual-spatial abilities score for soccer strikers under 23 years old.

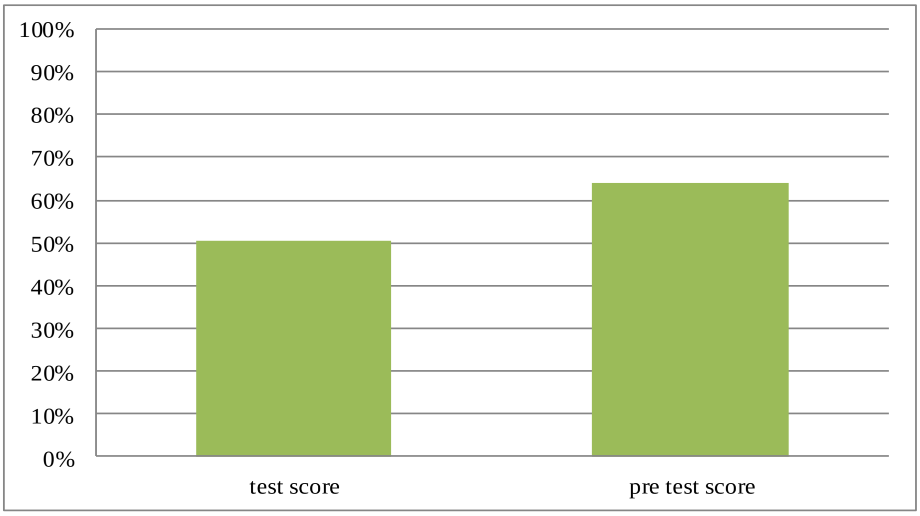

Figure 7. Arithmetic mean of the score between the pre and post-test of the sample, testing of the visual-spatial abilities of soccer strikers under 23 years old.

The difference between pre and post-test for time; M time1 =218.2 s and a SD= 22.47 s in the pre-measurement, while M time2 = 198.8 s and SD =23.35 s in the post-measurement, and the T value was 0.0034 at a degree of freedom (19) and a level of significance (0.05), and the significant value was sig (0.00), and by comparing the significant significance with the level of significance, we find that sig = 0.00 < α = 0.05, and this is statistically significant, and through the previous results, it can be said that there are statistically significant differences between the pre-measurement and the post-measurement of the sample in testing the visual-spatial abilities answer time for soccer strikers under 23 years old.

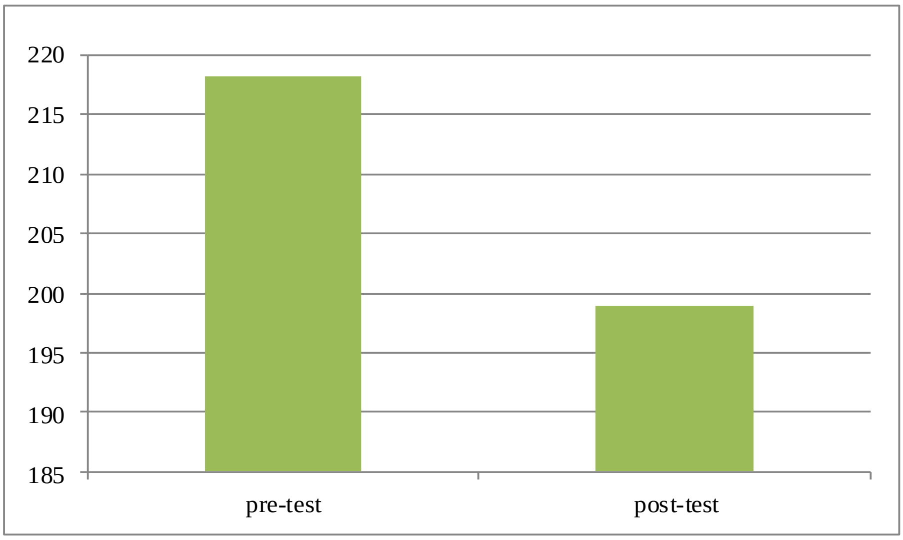

Figure 8. Arithmetic mean of the answer time between the pre and post-test of the sample, testing of the visual-spatial abilities of soccer strikers under 23 years old.

Conclusion

In this study, we investigated the effect of the efficiency of visual-spatial abilities (memory processes) training through the multimedia simulation of soccer strikers under 23 years of age who have at least 5 years of experience. The control test confirmed that the post-test showed a good improvement in terms of visual-spatial abilities. As expected, our results are in line with previous studies (Khacharem et al., 2013, 2014, 2015) which also reported better learning efficiency scores expert players. These results can be explained by the Simulation (multimedia) training affecting the development of the strikers' visual-spatial perception in football, which is positively reflected in the perfection of memorizing tactical situations. Finally, alongside adapting their tactical instructions, coaches can perform the multimedia simulation training to improve visual-spatial abilities to help the soccer players generally and soccer strikers in particular to improve their perception of their position on the field, his movement with the ball, and without it, anticipating the playing process and the dynamism that they must act according to the requirements of the plan and the playing strategies that they had practiced before, In addition to improving the psychomotor-sensory coordination in which visual-spatial perception plays an essential role, by improving it, the player's performance develops at multiple levels (cognitive, sensory, psychological, and executive performance).

Finally, we recommend to the researchers and soccer community to use the training via multimedia simulation and similar tools as video games, smartphone multimedia applications and more digital devices and games to enhance visual-spatial abilities.

Scientific Ethics Declaration

The authors declare that the scientific ethical and legal responsibility of this article published in EPESS journal belongs to the authors.

Acknowledgements

* This article was presented as an oral presentation at the International Conference on Science and Education (www.iconse.net) held in Antalya/Turkey on November 15-18, 2022.

References

Ben Mahfoudh, H., & Zoudji, B. (2022). The role of visuospatial abilities and the level of expertise in memorising soccer animations. *International Journal of Sport and Exercise Psychology*, *20*(4), 1033–1048. https://doi.org/10.1080/1612197X.2021.1940240

Coutinho, D., Gonçalves, B., Wong, D. P., Travassos, B., Coutts, A. J., & Sampaio, J. (2018). Exploring the effects of mental and muscular fatigue in soccer players' performance. *Human Movement Science*, *58*, 287–296. https://doi.org/10.1016/j.humov.2018.03.004

Dehn, L. B., Piefke, M., Toepper, M., Kohsik, A., Rogalewski, A., Dyck, E., Botsch, M., & Schäbitz, W.-R. (2020). Cognitive training in an everyday-like virtual reality enhances visual-spatial memory capacities in stroke survivors with visual field defects. *Topics in Stroke Rehabilitation*, *27*(6), 442–452. https://doi.org/10.1080/10749357.2020.1716531

Garel, J. P. (2005). Adaptations à la dyspraxie visuo-spatiale en Éducation physique et sportive. In *Bilan neuropsychologie et démarches pédagogiques* (pp. 22-27).

Ginns, P., & Leppink, J. (2019). Special issue on cognitive load theory: Editorial. *Educational Psychology Review*, *31*(2), 255–259. https://doi.org/10.1007/s10648-019-09474-4

Kalbfleisch, M. L., & Gillmarten, C. (2013). Left brain vs. right brain: findings on visual spatial capacities and the functional neurology of giftedness. *Roeper Review*, *35*(4), 265–275. https://doi.org/10.1080/02783193.2013.829549

Kamble, P. R., Keskar, A. G., & Bhurchandi, K. M. (2019). A deep learning ball tracking system in soccer videos. *Opto-Electronics Review*, *27*(1), 58–69. https://doi.org/10.1016/j.opelre.2019.02.003

Khacharem, A., Zoudji, B., & Kalyuga, S. (2015). Perceiving versus inferring movements to understand dynamic events: The influence of content complexity. *Psychology of Sport and Exercise*, *19*, 70–75. https://doi.org/10.1016/j.psychsport.2015.03.004

Khacharem, A., Zoudji, B., Kalyuga, S., & Ripoll, H. (2013). The expertise reversal effect for sequential presentation in dynamic soccer visualizations. *Journal of Sport and Exercise Psychology*, *35*(3), 260–269. https://doi.org/10.1123/jsep.35.3.260

Khacharem, A., Zoudji, B., Spanjers, I. A. E., & Kalyuga, S. (2014). Improving learning from animated soccer scenes: Evidence for the expertise reversal effect. *Computers in Human Behavior*, *35*, 339–349. https://doi.org/10.1016/j.chb.2014.03.021

Lorains, M., Ball, K., & MacMahon, C. (2013). Expertise differences in a video decision-making task: Speed influences on performance. *Psychology of Sport and Exercise*, *14*(2), 293–297. https://doi.org/10.1016/j.psychsport.2012.11.004

Mangus, B. C., Wallmann, H. W., & Ledford, M. (2004). Soccer: Analysis of postural stability in collegiate soccer players before and after an acute bout of heading multiple Soccer balls. *Sports Biomechanics*, *3*(2), 209–220. https://doi.org/10.1080/14763140408522841

Popper, K. R. (2005). *The logic of scientific discovery*. Routledge.

Valls-Serrano, C., De Francisco, C., Vélez-Coto, M., & Caracuel, A. (2022). Visuospatial working memory and attention control make the difference between experts, regulars and non-players of the videogame League of Legends. *Frontiers in Human Neuroscience*, *16*, 933331. https://doi.org/10.3389/fnhum.2022.933331

Witol, A. D., & Webbe, F. M. (2003). Soccer heading frequency predicts neuropsychological deficits☆. *Archives of Clinical Neuropsychology*, 21.

Author Information

Radhouane Lorabi
Djilali Bounaama University
Road of teniat el had Ain Defla 44225
Algeria
Contact e-mail: *radhouane.lorabi@univ-dbkm.dz*

Belaid Akil Abdelkader
Djilali Bounaama University
Road of teniat el had Ain Defla 44225
Algeria

To cite this article:

Lorabi, R. & Abdelkader, B.A. (2022). The efficiency of visual-spatial abilities (memory processes) training through multimedia simulation for soccer strikers. *The Eurasia Proceedings of Educational & Social Sciences (EPESS)*, *28*, 54-61.