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The Impact of Mental Imagery on Learning the Shooting Skill in Handball Among Secondary School Students

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Abstract:

This study aims to investigate the effect of mental imagery on the acquisition of handball shooting skills among secondary school students at Martyr Ben Al-Shahem Mohamed High School in Ouargla. An experimental design was implemented, with a sample of 28 students divided equally into an experimental group (14 students) and a control group (14 students). Data were collected using a mental imagery scale administered to students at both the beginning and end of the study. The control group received a series of educational units designed for learning the handball shooting skill, following the established curriculum. Meanwhile, the experimental group received the same instructional program, enhanced by the incorporation of mental visualization techniques. The educational intervention spanned a period of six weeks and comprised 12 sessions, with each session lasting 60 minutes.

Keywords: Mental imagery ; shooting skill; secondary education

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1. INTRODUCTION

The world has witnessed significant advancements across all scientific fields, including physical education and sports sciences in general, and motor and skill learning in particular. This progress has influenced various sports, including handball, which relies on fundamental motor skills as a crucial foundation for development. Teachers and educators dedicate much of their time to teaching, refining, and consolidating these skills, prioritizing them in educational and training programs. However, the process of acquiring correct motor skills in handball encompasses not only the physical and technical components but also psychological factors, contributing to the acquisition of accurate and integrated skills. Skill learning is a holistic process that involves both mental and physical elements. Mental visualization is one of the sports education and training strategies that has garnered considerable attention from specialists in this field due to its positive and effective role in enhancing performance levels, particularly as mental skills have become recognized as key to improved performance.

Morgan identified mental imagery as one of the latest training methods that influences behavior and promotes learning. Singer notes that mental visualization involves the repeated mental rehearsal of a skill, allowing athletes to internalize the skill without the need to observe it in physical motion (Rateb, 1994, p. 10).

The ability to mentally visualize is a crucial variable impacting athletic performance, as it enables athletes to internalize and rehearse skills, thereby facilitating more efficient learning of fundamental motor skills in handball. By engaging in mental visualization, athletes reinforce their neural pathways, preserving both the initial form of the skill and its stages of execution, which ultimately aids in accurate and consistent performance. Research confirms that effective mental visualization exercises can strengthen these neural connections, supporting the learner in mastering essential skills.

Among these fundamental skills, the shooting skill holds particular significance in handball, as it is often the decisive factor in securing victory. Gero Langhoff states that "the goal of attacking movements is to conclude with a shot towards the goal, achieving a score; thus, shooting is considered one of the most critical elements of handball" (Kacem 1988, p. 48).

This study seeks to address the following research questions:



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1. Are there statistically significant differences between the experimental and control groups in the results of the pre- and post-tests, favoring the post-tests, in learning certain shooting skills in handball?
2. Are there statistically significant differences between the experimental and control groups in the results of the post-tests, specifically favoring the experimental group, in learning the shooting skill in handball?

Hypotheses:

1. Statistically significant differences exist between the experimental and control groups in the results of the pre- and post-tests, with a preference for the post-tests in learning certain shooting skills in handball.
2. Statistically significant differences exist between the experimental and control groups in the results of the post-tests, specifically favoring the experimental group, in learning the shooting skill in handball.

2. Significance of the Study:

The significance of this study lies in:

- Integrating physical and mental dimensions of skill acquisition,
- Enhancing mental skills in conjunction with physical skills, and
- Emphasizing the value of mental imagery and its application to fundamental handball skills.

3. Definition of Key Terms:

3.1. Mental Imagery:

Mental imagery refers to the learning, enhancement, and stabilization of movement through focused visualization of the movement's progression without physical execution. Barrow suggests that mental imagery relies on retrieving mental images connected to prior experiences, enabling individuals to mentally reconstruct learned movements. Unlike physical practice, mental training emphasizes recalling these representations, focusing specifically on the motor aspect rather than outcomes like direction, accuracy, or distance. This approach is essential in refining athletic and technical performance by strengthening motor memory and mental visualization (Chamoun 2001, p. 51).

3.2. Shooting:

Shooting is defined as "the final act in all individual and collective attacks in handball" (El Afi 1998, p. 46). It represents a decisive action aimed at scoring, making it one of the most critical skills in handball.

3.3. Handball:

Handball is a fast-paced, dynamic game that requires intense concentration and agility. The game relies on teamwork and the application of fundamental skills, such as passing, receiving, dribbling, and shooting, to achieve scoring goals. Characterized by rapid shifts in gameplay, handball creates an atmosphere of excitement and suspense. Success in handball depends on effective coordination among team members and the ability to respond quickly to various tactics, making it a unique and challenging competitive experience (Sobhi 2012, p. 163).

4. Review of Previous Studies:

4.1. Qasimi Yassin (2005):

This study examined the impact of mental visualization on skill correction at an advanced athletic level, highlighting the importance of mental imagery as a crucial and complementary factor in training, particularly for correcting skill errors. The study emphasized that mental visualization is essential for economizing effort, preventing injuries, and enabling athletes to tap into latent abilities, develop these skills, and strategically employ them to achieve optimal performance.

4.2. Hassanein Naji Hussein (2007):

This study explored the relationship between mental visualization and the performance of fundamental skills in volleyball among elite club players. It aimed to assess the impact of mental imagery on skill performance across several basic skills in volleyball. The study analyzed the connection between mental visualization and the execution of skills such as serving, receiving, spiking, and blocking. Findings indicated that mental imagery significantly enhances players' abilities to perform these critical skills. Additionally, the study highlighted individual differences among players in mental imagery and skill performance, underscoring the role of mental visualization in advancing performance in volleyball and Individual Differences in Mental Visualization and Performance.

The study by Hassanein Naji Hussein also identified individual differences among players in the sample group regarding their mental imagery abilities and



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skill performance in volleyball. This finding underscored the variation in mental visualization aptitude and its impact on executing basic skills effectively.

4.3. Ibrahim Gesture (2014):

This study investigated the impact of sensory-kinesthetic perception and mental visualization exercises on learning basic futsal skills for girls. The research aimed to design sensory-kinesthetic and mental visualization exercises to enhance learning of fundamental skills such as rolling, dribbling, and scoring in indoor soccer. The results indicated significant improvement between the pre- and post-tests for both experimental groups, favoring the post-test results in basic futsal skills. This finding emphasized the effectiveness of combining sensory-kinesthetic perception with mental imagery exercises to improve skill acquisition.

4.4. Ahmed Yahyaoui (2015):

This study focused on the role of physical education in developing psychological skills and its relationship with social and psychological compatibility among final-year secondary school students in Mostaganem, Algeria. The findings revealed significant correlations between physical education participation and improved psychological skills, supporting the positive role of sports education in fostering psychological and social adjustment among students at this educational level. And Statistical Relationship Between Psychological Skills and Compatibility. The study by Ahmed Yahyaoui (2015) found a statistically significant relationship across various psychological skill dimensions and the psychological compatibility of students participating in physical education and sports. This finding underscores the beneficial link between physical education involvement and the enhancement of psychological well-being among students.

5. Comment on Similarities Across Studies:

The reviewed studies reveal notable similarities and differences concerning the current research topic. Most of the studies share a focus on the relationship between mental visualization and skill performance. These studies commonly incorporate mental imagery within training programs to enhance skill acquisition and performance, particularly in collective sports like volleyball and handball. This consistency underscores the experimental methodology's appropriateness for examining correlations between mental visualization and performance.

However, the studies also differ in terms of sample populations and research tools. While many studies focused on elite or advanced-level athletes, the study by Ahmed Yahyaoui (2015) uniquely explored the role of mental visualization within secondary school students in the context of physical education, thus providing a broader educational perspective.

6. Methods and Materials:

6.1. Methodology :

The nature of the subject matter dictated the choice of approach. Given that this study focuses on examining the effect of mental imagery on learning the skill of shooting in handball, an experimental approach was deemed most suitable.

6.2. Study Population and Sample

The study population was purposefully selected from second-year secondary school students, with a total of 140 students. A sample of 28 students was chosen and divided into two equal groups: 14 students in the control group and 14 in the experimental group. Several students were excluded based on disparities in performance relative to the group or due to non-compliance with attendance requirements, as well as exemptions from physical education.

The experimental group engaged in mental training exercises, whereas the control group followed the curriculum set by the Ministry of National Education.

Pre-tests assessing the impact of mental imagery on learning the handball shooting skill were conducted on January 8, 2023.

Post-tests to measure the impact of mental imagery on the skill acquisition of handball shooting were conducted on January 15, 2023.

6.3. Statistical Methods

The following statistical methods were employed in this study:

- Arithmetic mean
- Standard deviation
- t-test for unrelated arithmetic means
- t-test for related arithmetic means

6.4. Study Limitations

6.4.1. Spatial Domain



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The study was conducted at Ben Chahm Mohamed High School in Rouissat Municipality, Ouargla.

6.4.2. Time Domain

The study tools were applied over the period from January 8 to February 26, 2023.

6.4.3. Human Domain

The study involved a sample of 28 second-year secondary school students.

6.5. Data Collection Tools

6.5.1. Mental Imagery Scale

The mental imagery scale, originally prepared by Martinez (1993), was translated by Osama Kamel and revised by Diaan Jaber Muhammad in 2002.

The scale requires athletes to recall mental imagery as more than just visual perception; it involves engaging various senses along with the emotions connected to the activity. This scale assesses mental imagery across four situational contexts:

- Practicing alone
- Practicing with others
- Observing a colleague
- Competing

It also examines four sensory axes:

- Visual axis: How clearly the image is perceived
- Auditory axis: The clarity of associated sounds
- Kinesthetic (movement) axis: Physical sensations during performance
- Emotional axis: Mood and emotional state during performance

Participants respond based on a five-point scale, evaluating the clarity and presence of their mental images:

- N (No): No mental image of the activity
- U (Unclear): Image exists but is not clear
- M (Middle): Image is moderately clear
- C (Clear): Image is clear
- CV (Clear Very): Image is very clear

6.6. Statistical Analysis Methods

The study employed the following statistical methods:

- Arithmetic mean
- Standard deviation
- t-test for unrelated (independent) arithmetic means
- t-test for related (paired) arithmetic means

Data collected from the study sample were processed using the Statistical Package for the Social Sciences (SPSS) software, version 19.

7. Results and discussion :

7.1. Presentation and Analysis of Results for the First Hypothesis

The first hypothesis posited that there would be statistically significant differences between the experimental and control groups in pre- and post-test results, with a preference for the post-test outcomes in learning the skill of shooting in handball.

Data for this hypothesis were processed using the t-test for paired samples, with results presented in Table No. (01)

Table 1. Showing the differences between pre-test and post-test scores for the control group in acquiring the handball shooting skill.

variable		num ber	Arithm etic mean	Stand ard deviat ion	Degre e of freed om	Val ue (T)	Signific ance level	decisi on
Individu al practice	trib al	14	1.78	0.16	13	- 6.6 0	0.00	Dal
	Aft er me	14	2.37	0.35				
Practice with others	trib al	14	1.58	0.12	13	- 6.9 7	0.00	Dal
	Aft er me	14	2.14	0.30				
Watch colleague	trib al	14	1.60	0.34	13		0.00	Dal



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	Aft er me	14	2.07	0.38		- 4.3 1		
Perform ance in practice	trib al	14	1.62	0.25	13	- 3.6 1	0.00	Dal
	Aft er me	14	3.98	0.38				

Source : Prepared by the researcher based on the outputs of SPSS25

Analysis of Table No. (01) shows that all significance values equaled 0.00 for each pre- and post-test variable (individual practice, practice with others, observing a colleague, and performance in practice). This result is significant at the 0.05 level, indicating clear differences in the control group's learning of the shooting skill in handball between the pre- and post-tests. The post-test arithmetic averages (2.37, 2.14, 2.07, and 2.05) are notably higher than those of the pre-tests, reflecting an improvement in the control group's skill acquisition.

Table 2. Presents the differences between the pre-test and post-test scores for the experimental group in learning the shooting skill in handball.

Variable		num ber	Arithm etic mean	Stand ard deviat ion	Degr ee of freed om	Val ue (T)	Signific ance level	decisi on
Individu al practice	trib al	14	2.03	0.31	13	- 18. 93	0.00	Dal
	Aft er me	14	4.16	0.36				
Practice with others	trib al	14	1.96	0.21	13	- 29. 30	0.00	Dal
	Aft er me	14	4.16	0.28				

Watch colleague	trib al	14	1.92	0.35	13	- 19. 10	0.00	Dal
	Aft er me	14	4.23	0.37				
Perform ance in practice	trib al	14	1.98	0.37	13	- 18. 20	0.00	Dal
	Aft er me	14	3.98	0.26				

Source : Prepared by the researcher based on the outputs of SPSS25

Analysis in Table No. (02), all significance values equaled 0.00 for each of the pre- and post-tests (individual practice, practice with others, observing a colleague, and performance in practice), confirming statistical significance at the 0.05 level. This indicates clear differences in the experimental group's learning of the shooting skill in handball between the pre- and post-tests, with post-test arithmetic averages of 4.16, 4.16, 4.23, and 3.98, respectively, which are higher than the pre-test averages.

Based on the results from Tables (01) and (02), we accept the alternative hypothesis, affirming that there are statistically significant differences between the experimental and control groups in the pre- and post-test results, with the post-test scores favoring the acquisition of the shooting skill in handball.

7.2. Presentation and Analysis of Results for the Second Hypothesis

The second hypothesis posited that there would be statistically significant differences between the experimental and control groups in the post-test results, favoring the experimental group in learning the shooting skill in handball.

To test this hypothesis, a t-test for two independent samples was applied to the post-test data from both groups.

Table 3. displays the differences between the control group and the experimental group's post-test scores for the shooting skill in handball. The results highlight



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whether the experimental group, which received the mental imagery intervention, achieved significantly higher post-test scores compared to the control group.

variable		number	Arithmetic mean	Standard deviation	Degree of freedom	Value (T)	Significance level	decision
Individual Practice - Before Me	The officer	14	1.78	0.16	26	- 3.15	0.00	Dal
	empiricism	14	2.08	0.31				
Practice with others - before me	The officer	14	1.58	0.12	26	- 5.62	0.00	Dal
	empiricism	14	1.96	0.21				
Watch colleague- before me	The officer	14	1.60	0.34	26	- 2.39	0.02	Dal
	empiricism	14	1.92	0.35				
Performance in practice - Pre-workout	The officer	14	1.62	0.25	26	- 2.95	0.00	Dal
	empiricism	14	1.98	0.37				
Individual Practice - After Me	The officer	14	2.37	0.35	26	- 13.27	0.00	Dal
	empiricism	14	4.16	0.36				
Practice with others - after me	The officer	14	2.14	0.30	26	- 17.98	0.00	Dal
	empiricism	14	4.16	0.28				
Watch the colleague - after me	The officer	14	2.07	0.38	26	15.08 -	0.00	Dal
	empiricism	14	4.23	0.37				
Performance in practice - after	The officer	14	2.05	0.38	26	15.46 -	0.00	Dal
	empiricism	14	3.98	0.26				

Source: Prepared by the researcher based on the outputs of SPSS25

Analysis according to Table No. (03), all significance values for each test were equal to 0.00, meeting the significance threshold of 0.05. This confirms statistically significant differences in learning the shooting skill in handball between the control and experimental groups, favoring the experimental group. The post-test arithmetic averages for the experimental group (4.16, 4.16, 4.23, and 3.98

for individual practice, practice with others, observing a colleague, and performance in practice, respectively) were higher than those of the control group.

The post-test scores further illustrate these differences, with all significance values at 0.00 across each measure. The experimental group's arithmetic means (2.08, 1.96, 1.92, and 1.98, respectively) consistently exceed those of the control group, confirming the experimental group's superior performance.

Therefore, we accept the alternative hypothesis, acknowledging statistically significant differences between the experimental and control groups in post-test results, with the experimental group demonstrating greater improvement in learning the shooting skill in handball.

7.3. Discussion and Interpretation of Results for the First Hypothesis

The first hypothesis suggested that there would be statistically significant differences between the experimental and control groups in the pre- and post-test results, favoring the post-tests in learning the shooting skill in handball. Analysis of Tables (1 and 2) indicates that both groups demonstrated improvement in their post-test scores. The improvement observed in the control group is attributed to repeated practice of the shooting skill, which reinforced learning and contributed to skill enhancement over time.

In contrast, the experimental group's improvement is attributed to the mental visualization program incorporated into their training. This mental imagery component allowed participants to recall and mentally rehearse performing the skill, as well as revisit situations they had previously encountered or learned. Through this process, athletes in the experimental group could actively visualize elements such as imagery, sound, movement, and control, supporting their ability to perform the skill more effectively during the post-test.

7.4. Discussion and Interpretation of Results for the Second Hypothesis

The second hypothesis proposed that statistically significant differences would be found in the post-test results between the experimental and control groups, favoring the experimental group in learning the shooting skill in handball. Results from the post-tests confirm this hypothesis, as the experimental group outperformed the control group, indicating the effectiveness of the mental visualization program. This approach appears to have provided the experimental group with a structured



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way to mentally prepare and simulate the skill, enabling deeper cognitive engagement and more effective performance of the shooting skill during testing.

Analysis of Table (3), which compares the post-test results of the experimental and control groups for the handball shooting skill, shows that the experimental group achieved significantly higher scores than the control group. While the control group followed the standard instructional program—where the skill was verbally explained, demonstrated by the teacher, and then practiced comprehensively by the students—the experimental group benefited from an additional mental visualization component. This visualization program provided players with a mental blueprint for executing the skill before, during, and after the physical performance, enabling them to fully focus their minds on each phase of the skill.

The use of mental visualization thus played a significant role in enhancing the experimental group's skill development and performance in handball. By mentally visualizing the performance, players improved their understanding of various tactics and strategies, which strengthened their self-confidence and reduced psychological pressure during matches. This type of training allowed players to better embody the movement and develop the capacity to make quick decisions on the field. Free from the distractions of psychological stress, they could direct their focus toward effectively refining and executing their skills.

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