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RESEARCH ARTICLE

The Effect of Using an Electronic Program with Supplementary Tools on the Development of Futsal Officiating Performance Among Female Students of the College of Physical Education and Sport Sciences

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Abstract

Due to the numerous motor and performance skills required of female students in futsal refereeing during college lessons, along with the constant need to reposition themselves and move within the playing field, continuous monitoring and repetition are essential to minimize potential errors during performance. These errors may arise from failing to assume the correct position or delays in signalling officiating gestures. Addressing this issue necessitated the implementation of an electronic program and supplementary tools—such as electronic games, scientific posters illustrating officiating signals, and other instructional aids—since these serve as guiding tools that direct individuals toward correct performance by distinguishing between accurate and erroneous execution. Accordingly, instructional displays play a fundamental role in the learning process, particularly through explanatory video clips for third-year students in futsal lessons, aiming to reduce refereeing errors in accordance with the rules and regulations governing the sport. The research objectives were: [1, pp. 56–65] to develop an electronic program that clarifies infractions and officiating signals for female students in futsal, and [2, p. 0022] to design supplementary instructional tools, including scientific posters and electronic games, to illustrate infractions and officiating signals for female students in futsal.

The research sample was selected using a purposive sampling method, targeting third-year female students at the College of Physical Education and Sport Sciences for Women, University of Baghdad, with a total population of 52 students. The research sample was then determined through random sampling using the lottery method, selecting students from two sections (A and B). Section A consisted of 13 students, while Section B included 12 students. From each section, 10 students were randomly chosen through the lottery method to represent the experimental and control groups, with Section A assigned as the experimental group and Section B as the control group. Through data presentation and result analysis, the researchers concluded that refereeing performance improved, and errors decreased among the students while officiating during the lessons. The findings demonstrated that the electronic program contributed to enhancing students' refereeing performance, yielding significantly better results compared to those who learned refereeing without the use of the designed program. Based on these results, the study recommends the integration of the electronic program into futsal lessons, as it facilitates achieving lesson objectives in a shorter time, with less effort, and in a more engaging manner. and this achieves one of the sustainable development goals of the United Nations in Iraq which is (Quality Education)

Keywords: Futsal, Electronic program, Football officiating, Officiating aids, Development of football referees' performance

1. Introduction

Scientific research and studies in various sports constitute a fundamental pillar for advancing athletes to higher performance levels. They serve as a scientific framework that contributes to uncovering new insights, which may represent a genuine addition to the field, ultimately enhancing and refining athletic performance.

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Futsal is one of the most significant sports that has undergone substantial development, securing a prominent position among distinguished popular games that are frequently played today. As a result, it requires continuous research and development to identify the key obstacles that may hinder its advancement. Officiating is one of the fundamental pillars of any sport's success, as its effectiveness is closely tied to both its theoretical and practical aspects. It is essential to keep pace with the advancements in futsal, the ongoing developments in the game, and the key officiating rules, including violations and refereeing errors that may occur on the field. Therefore, it is crucial to explore effective methods for conveying officiating scenarios to students in a clear and accessible manner. Students are required to develop a comprehensive understanding of these changes, both in theory and application, particularly in the process of dual-refereeing. Providing students with the necessary knowledge helps them integrate new information seamlessly with their prior learning, enabling them to achieve creative thinking, which is reflected in their performance. Given the rapid shifts in player movement, referees must employ cognitive skills effectively to generate appropriate responses to various in-game situations. Due to the extensive motor skills required of referees-who, in this case, are the students-during futsal matches and lessons, their positioning on the field demands constant monitoring, rigorous training, and repeated practice to minimize errors. Mistakes often occur when referees fail to position themselves correctly or delay in assuming the correct stance before signalling a violation or foul. Addressing these challenges necessitates the use of scientific posters, explanatory videos, and other instructional aids to visually present officiating cases. These tools are essential for learning motor skills in futsal, as they serve a guiding function, directing individuals toward proper execution by clearly distinguishing correct performance from incorrect actions.

Daryoul et al. stated that "preparing students for officiating during lessons goes beyond acquiring physical fitness and mastering movement across the field; it also involves equipping them with knowledge and information that contribute to enhancing their officiating performance" [8, pp. 0026–0035].

Similarly, (Safaa et al.) added that "acquired knowledge reflects on a student's intelligence and ability to make decisions based on their stored officiating information" [3, p. 3].

Furthermore, (Hamza et al.) emphasized that "designing electronic programs is one of the techniques that effectively deliver information to students in a fast, clear, and engaging manner" [14, pp. 1–8]. The use of electronic programs has the potential to facilitate learning objectives, overcome obstacles for learners, and enhance comprehension. When officiating, students must possess a comprehensive understanding of all game rules, as well as a strong and confident personality. Given the nature of the game's regulations, referees must make quick and decisive rulings, relying primarily on sharp intuition. Additionally, they bear a significant responsibility in managing all aspects of the game, including players, fellow referees, and overall match proceedings.

The significance of this research lies in the enhancement of officiating performance in futsal, focusing on violations, penalties, officiating signals, and referee movement for the targeted student group. This is achieved by integrating technology and supplementary instructional tools to improve students' officiating skills. To this end, an electronic program has been developed, accompanied by supporting materials, including educational posters, specially designed electronic games for refereeing, and other resources. These tools aim to deliver officiating scenarios to students in a fast, clear, and engaging manner, facilitating their understanding and practical application of refereeing principles.

1.1. Research problem

A futsal referee is constantly moving within the field and throughout the course of the match. Given the need for referees to react swiftly and accurately to in-game situations, they must maintain continuous presence near the action and possess a comprehensive understanding of the game's regulations. Proper positioning on the field is essential, as it enables referees to make well-informed decisions regarding rule violations.

The research problem arises from the researchers' observations and analysis of futsal lessons and college-level matches, where they identified a clear disparity among students in making correct officiating decisions during lessons. This inconsistency decision-making is further compounded by in a noticeable weakness in understanding referee movement within the game. Consequently, this has led to delayed and inaccurate reactions from students when responding to in-game violations and officiating scenarios. This prompted the researchers to explore suitable solutions to this issue by closely monitoring students' officiating performance during lessons and matches, aiming to identify and diagnose their errors through subject instructors and a specialized evaluation form. Additionally, students were trained using a custom-designed electronic program accompanied by supplementary instructional tools, with the hope that these interventions would contribute to minimizing their errors.

The research problem is further articulated through the following key questions:

- 1. Does the use of modern technology influence the development of officiating performance among female futsal students?
- 2. Does the use of supplementary instructional tools contribute to the improvement of officiating performance among female futsal students?

1.2. Research objectives

- 1. Develop an electronic program that illustrates fouls and officiating signals for female futsal students.
- 2. Design supplementary instructional tools, including scientific posters and electronic games, to clarify fouls and officiating signals for female futsal students.
- 3. Examine the impact of the developed electronic program and supplementary instructional tools on improving officiating performance among female futsal students.

1.3. Research hypothesis

There are statistically significant differences between the pre- and post-tests in the development of officiating performance among the students of both research groups.

1.4. Research fields

- Human Field: Third-year female students at the College of Physical Education and Sport Sciences for Women, University of Baghdad, for the academic year 2023–2024.
- **Temporal Field:** From November 1, 2023, to April 14, 2024.
- **Spatial Field:** The indoor futsal court at the researched college.

2. Methodology and procedures

The researchers employed the experimental approach, as it is well-suited to addressing the research problem. As noted by *Abduljabbar-Khudhair et al.*, "It is considered the most effective and appropriate approach for achieving research objectives. Moreover, it represents the most accurate method for scientifically and theoretically solving various scientific problems" [13, pp. 43–54]. This was further affirmed by *Al-Sabaawi*, who stated that "the experimental approach examines causation and dependent variable changes by observing the resulting variations after introducing an independent variable, thereby verifying hypotheses and scientific predictions" [4, pp. 0093–0111]. Accordingly, the

researchers adopted the experimental approach using the "two-group experimental design".

2.1. Research population and sample

The selection of the research population is a crucial step in the study, as highlighted by Obaid et al., who stated that "the nature of the research, its hypotheses, and its design dictate the steps of its implementation, including the selection of appropriate tools such as necessary tests" [6, pp. 0340–0350]. The research sample must be chosen based on scientific principles to provide an accurate representation of the research problem, ensuring a precise diagnosis of its dimensions and leading to reliable results.

The research population consisted of third-year female students at the College of Physical Education and Sport Sciences for Women, University of Baghdad, for the academic year 2023–2024, totalling 52 students, distributed across four sections. The research sample was selected randomly using the lottery method, with two sections, (A) and (B), chosen for the study. Section (A) included 13 students, while Section (B) had 12 students. The researcher then randomly selected 10 students from each section to form the experimental and control groups. Section (A) was designated as the experimental group, while Section (B) served as the control group.

2.2. Data collection methods

The researchers utilized a set of auxiliary tools appropriate to the nature of the study, including Arabic and foreign sources, scientific journals, and the Internet (International Information Network).

2.3. Instruments and equipment used

- Indoor futsal court (1)
- Electronic stopwatch (1)
- Dell computers (2)
- Sony video camera (1)
- Football (8)
- Fox whistles (4)

2.4. Field research procedures

2.4.1. Development of an electronic program

The researchers designed an electronic program to be implemented during the lesson. This program included multiple videos accompanied by refereeing signals, allowing users to select from various options. The videos covered most of the infractions outlined in the futsal regulations, providing an interactive learning experience for users.

2.4.2. Preparation of supplementary learning tools

To enhance the learning experience, the researchers developed several educational aids, including a scientific poster (200×150 cm) displaying all futsal refereeing signals. Additionally, electronic games were created and shared with students via a link, offering both individual and dual-player modes. These games included matching refereeing signals with their corresponding infractions and a multiple-choice quiz to identify the meaning of each signal. Furthermore, video clips providing a detailed explanation of each infraction were distributed to students through the online classroom platform to support their understanding of the rules.

2.5. Evaluation of refereeing performance in futsal

The researchers assessed refereeing performance in futsal by relying on the scores of three referees, calculating the arithmetic mean of their evaluations to ensure accuracy and consistency in performance assessment.

2.6. Pilot study

Before conducting the main experiment, a pilot study was carried out as a fundamental step in the fieldwork of scientific research. According to Hamza and Khudair, a pilot study is defined as a preliminary (miniature and training) experimental study designed to refine field procedures before engaging in the actual data collection process [10, pp. 81–93]. Through this study, various influential factors can be identified and clarified, as they impact research duration and result accuracy. In this regard, Haider and Kadhum emphasize that a pilot study serves as a comprehensive exploration of the surrounding conditions related to the studied phenomenon, enabling researchers to better understand and control the variables under investigation [2, p. 0022]. The pilot study was conducted to identify and mitigate potential challenges that the researchers might encounter during the main experiment while also assessing both the strengths and weaknesses in the study's execution and the suitability of the equipment and tools used. To ensure accuracy, the researchers followed the necessary scientific research procedures for conducting a precise study. The pilot study was carried out on a sample of five students on Sunday, January 7, 2024, at the indoor futsal court of the College of Physical Education and Sport Sciences for Women. During this process, the researchers ensured the preparation and functionality of the required equipment and tools, assessed the suitability of the venue for conducting the tests, evaluated the efficiency of the assisting research team and the time required for the tests, and tested the electronic program and supplementary learning tools to verify their appropriateness and effectiveness for the study sample.

2.6.1. Pre-test for the research sample

Before implementing the electronic program on the experimental group, the researchers conducted an assessment of refereeing performance. To ensure accuracy, they consulted experts to evaluate the students' refereeing skills within the experimental sample. The pre-test was administered on Sunday, January 28, 2024, at 8:00 AM in the indoor futsal court of the studied college. The researchers ensured proper organization and adherence to testing conditions, conducting the evaluation for both the experimental and control groups under standardized conditions.

2.6.2. Main experiment

After reviewing scientific sources, references, and expert opinions in the field of futsal, the researchers developed an electronic program designed to enhance refereeing performance. Additionally, they created supplementary learning tools, including a scientific poster illustrating refereeing signals, interactive electronic games sent to students via mobile phones, and educational videos.

The implementation of the main experiment was guided by specialists' observations, ensuring the program's effectiveness in developing and improving refereeing performance within the research sample. The program was officially launched in the indoor futsal court of the studied college at 8:00 AM on Sunday, February 4, 2024. The program was implemented at a rate of one session per week, conducted every Sunday over a period of eight weeks, totaling eight sessions. The final session took place on March 24, 2024. Each session lasted between 90 to 105 minutes, with the electronic program being applied for 15 to 20 minutes per session.

2.6.3. Post-tests for the research sample

After completing the implementation of the electronic program and supplementary learning tools on the experimental group, the researchers sought the assistance of the same experts to evaluate the students' refereeing performance. The post-tests were conducted under the same conditions, variables, and environment as the pre-tests, ensuring consistency in assessment. The post-tests were administered on Sunday, March 31, 2024, at 8:00 AM in the indoor futsal court of the studied college. The researchers ensured identical organization and testing conditions, maintaining the same facilities and resources used during the pre-tests.

2.6.4. Statistical methods

To analyze the data, the researchers utilized the Statistical Package for the Social Sciences (SPSS) software. The statistical methods applied included percentages, arithmetic means, standard deviations, medians, skewness coefficients, and the T-test.

2.7. Presentation and discussion of results

2.7.1. Analysis of T-test results for pre- and post-refereeing performance in futsal for the control and experimental groups

Fig. 1 presents the results of the futsal refereeing performance tests for the research sample in both the pre-test and post-test for the control group.

Fig. 2 presents the results of the futsal refereeing performance tests for the research sample in the pretest and post-test for the experimental group.

2.7.2. Presentation and analysis of the T-Test results for futsal refereeing performance between the control and experimental groups

Fig. 3 presents the results of the futsal officiating performance tests for the research sample in both the pre-test and post-test for the control and experimental groups.

Table 3 shows Displays the arithmetic means, standard deviations, and the calculated (T) value for futsal refereeing performance between the control and experimental groups, that the value of



Fig. 1. Illustrates the graphical representation of the arithmetic mean for the pre-test and post-test of refereeing performance assessments for the control group.

Table 1. Displays the arithmetic means, standard deviations, and calculated T-values for refereeing performance in futsal for the control group.

Statistical Methods Variables	Pre-Test		Post-Test			Standard			
	Arithmetic Mean	Standard \pm Deviation	Arithmetic Mean	Standard \pm Deviation	Mean Differences	Deviation of Differences (SDD)	Calculated (T) Value	Significance Level	Statistical Significance*
Refereeing Performance	5.808	2.307	6.480	3.096	0.672	0.537	1.249	0.219	Non- significant

*Significant at a degree of freedom (9) and a significance level of \leq (0.05).

Table 2. Presents the arithmetic means, standard deviations, and the calculated (T) value for the refereeing performance in futsal for the experimental group.

Statistical Methods Variables	Pre-Test		Post-Test			Standard			
	Arithmetic Mean	Standard \pm Deviation	Arithmetic Mean	Standard \pm Deviation	Mean Differences	Deviation of Differences (SDD)	Calculated (T) Value	Significance Level	Statistical Significance*
Refereeing Performance	5.723	2.247	8.632	3.374	2.909	0.687	4.231	0.000	Statistically significant.

*Significant at a degree of freedom (9) and a significance level of \leq (0.05).



Fig. 2. A graphical representation of the arithmetic mean for the pre-test and post-test results of futsal refereeing performance in the experimental group.

	Control Group		Experimental Group				
Methods Variables	Arithmetic Mean	Standard \pm Deviation	Arithmetic Mean	\pm Standard Deviation	Calculated (T) Value	Significance Level	Statistical Significance*
Refereeing Performance	8.632	3.374	5.808	2.307	2.508	0.000	Statistically significant

Table 3. Displays the arithmetic means, standard deviations, and the calculated (T) value for futsal refereeing performance between the control and experimental groups.

* Significant at a degree of freedom (9) and a significance level \leq (0.05).



Fig. 3. Illustrates the graphical representation of the arithmetic mean for the refereeing performance test of both the control and experimental groups.

(T) is a moral function at the level of significance (0,000).

3. Discussion

After presenting and analyzing the test results of refereeing performance, the data from the previous tables indicate a reduction in the number of errors made by futsal students during officiating in futsal lessons. This is evidenced by the statistically significant differences between the pre-test and post-test measurements, favouring the post-test results for the experimental group. The researchers attribute this improvement to the customized electronic program and the supporting tools, particularly visual feedback. This type of feedback provides learners with essential information through continuous explanations and demonstrations of errors, in addition to showcasing correct performance. Moreover, it allows students to compare their performance with an ideal model through educational videos. From the analysis of the results presented in the tables, an improvement in students' officiating performance was observed. This aligns with the perspective of Khudair and who define performance assessment Hamza, "a systematic evaluation of an individual's as achievements in various aspects over a period of time, following a consistent and standardized approach to reach an agreement on the best methods for enhancing performance levels" [11, pp. 11–26].

The researchers attribute these improvements to the number of instructional units included in the curriculum, which provide comprehensive coverage of movements, ideal referee performance, and the selection of appropriate positions and timing for decision-making. Additionally, the use of the electronic program and supporting tools facilitated the explanation and presentation of various officiating scenarios by specialized referees, ensuring that all aspects of officiating situations were addressed [14, pp. 1–8]. This approach also contributed to correcting any errors that students might have made during their performance. Furthermore, Abdel-Fattah emphasized that "organizing feedback and its requirements, as well as aligning performance with the level of effort exerted by the referee, is among the critical aspects that must be considered during the practical training phase" [12]. The researchers concluded that the students' performance level does not deviate from the fundamental concept of a referee's performance in any match. From the perspective of Faiq and others, "the performance level of referees is the ultimate outcome of all movements and decisions made in various situations. A referee's decisions are considered final and can only be changed if the referee determines that the decision was incorrect, with the assistance of the assistant referee, and only if convinced of the error. No individual, regardless of their position, is permitted to interfere with the referee's decisions, which makes officiating an

extremely challenging and complex profession" [1, pp. 56-65]. Majeed highlighted that motor learning has been clearly explained and interpreted through practice and training, emphasizing that the results of continuous exercise and practice are stored in long-term memory, making it easier to retrieve when needed [7, p. 15]. Consequently, a referee's decisions become highly accurate when the necessary components for making correct decisions are in place. These components are developed through the referee's positioning for observing game situations, known as "mechanics." Furthermore, Huda Edan and others argued that "there is a significant correlation and specific between mechanics rule-related situations, and decision-making improves positively as one factor develops alongside the other" [5, pp. 0001-0006]. Similarly, Gary pointed out that "as an individual's knowledge base expands, their ability to solve problems-whether in theoretical understanding or practical performance-also improves" [9, p. 0157].

4. Conclusions

Based on the results of the experiment, the researchers arrived at the following conclusions:

- 1. The refereeing performance of the students improved, and the error rate during officiating within the lesson decreased. This improvement can be attributed to the implementation of the customized electronic program designed for futsal refereeing, which was tailored to match the students' proficiency levels and the requirements of the game. The program significantly enhanced the students' refereeing efficiency, particularly among those in the experimental group, compared to those in the control group.
- 2. Visual feedback through the auxiliary tools used (scientific posters and electronic games) played a crucial role in enhancing refereeing signals and overall refereeing performance among students during officiating within the lesson.

5. Recommendations

The researchers recommend the following:

- 1. Utilizing the customized electronic program for futsal lessons to achieve the lesson objectives within a shorter time frame and with minimal effort while maintaining a high level of engagement.
- 2. Leveraging online platforms, such as virtual classrooms, to share refereeing-related electronic

games and analytical videos on officiating errors with students.

3. Developing electronic programs that support learning and enhance refereeing performance across various sports.

Author's declaration

Conflicts of interest: None.

We confirm that all tables and figures in this article are ours and written by the researchers themselves.

Ethical-Clearance: This manuscript approved by local ethical committee of physical education and sport sciences college for women on (January/2023).

Author's contributions

All contributions of this study were done by the researchers (M.A. and F.A.) who get the main idea and work on writing and concluding also with number of experts, Batool Jaafar Ali in Statistics, **Dr. Ibrahim Dabayebeh** in revision, Inaam Ghalib in translating, Dr. Batoul Ahmed Salim in proofreading.

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Appendix

Table A.1. Lists the names, academic titles, and workplaces of expert professors.

No.	Names	Academic Title	Place of Work
1	Dr. Huda Shihab Jari	Professor Doctor	University of Baghdad/College of Physical Education and Sport Sciences for Women
2	Dr. Liza Rustum Yaqub	Assistant Professor Doctor	University of Baghdad/College of Physical Education and Sport Sciences for Women
3	Dr. Maysa Mahmoud	Lecturer Doctor	University of Baghdad/College of Physical Education and Sport Sciences for Women
4	Lecturer Diana Haider	Lecturer	University of Baghdad/College of Physical Education and Sport Sciences for Women