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تأثير التمرينات المعتمدة على الذكاء الاصطناعي في تعلم الميكانيك الحركي للتحكيم في كرة السلة لدى طلبة كلية التربية البدنية وعلوم الرياضة جامعة بغداد

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الكلمات المفتاحية : **الذكاء الاصطناعي، كرة السلة، تعلم المهارات، التربية البدنية.**

مستخلص البحث :

تناولت هذه الدراسة أثر التمرينات الافتراضية المولدة بواسطة الذكاء الاصطناعي على تعلم الميكانيك الحركي للتحكيم في كرة السلة لدى طلبة السنة الثانية في كلية التربية البدنية وعلوم الرياضة – جامعة بغداد .وباستخدام تصميم تجريبي، تم تقسيم 100 مشارك (٥٠ ذكور و٥٠ إناث) عشوائيًا إلى المجموعة التجريبية(n=50) ، التي شاركت في برنامج تدريبي معتمد على الذكاء الاصطناعي لمدة ثمانية أسابيع، والمجموعة الضابطة (n=50) التي اتبعت أساليب التدريب التقليدية. تم إجراء اختبارات قبلية وبعدية باستخدام أداة الملاحظة لتقييم حكم كرة السلة (IOVAB) لقياس الحركات الانتقالية، التمركز، واتخاذ القرار .أظهرت النتائج تحسنًا ملحوظًا في أداء كلا المجموعتين، مع تفوق المجموعة التجريبية في الاختبار البعدي بشكل كبير($p < 0.001$) ، مما يشير إلى فعالية الذكاء الاصطناعي في تعزيز اكتساب المهارات الحركية من خلال سيناريوهات تفاعلية وشخصية. تشير النتائج إلى أن التدريب المعتمد على الذكاء الاصطناعي يمكن أن يدعم الأساليب التقليدية، مقدمًا حلولاً قابلة للتوسع في مجال التعليم الرياضي. ومع ذلك، تشمل قيود الدراسة تطبيقها في بيئة أكاديمية قصيرة المدى، ما يستدعي مزيدًا من البحث حول التأثيرات طويلة المدى وتطبيقها في السياقات المهنية. تؤكد هذه الدراسة على الإمكانات التحويلية للذكاء الاصطناعي في التربية

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group (n=50), which underwent a training program based on AI for 8 weeks, as well as the other part of the sample population (n=50), serving traditional methods. Technical behaviors, including transitional movements, positioning or decision making were assessed in the pre- and post-tests with the Instrument of Observation for the Evaluation of a Basketball Referee (IOVAB). Results showed that both groups significantly improved their results, with experimental group being more successful ($p < 0.001$). This indicates that ChatGPT succeeded accelerating the training of motor skills when accompanying students in a personalized, interactive task. They make clear that the progress of AI enables to extend classic training means in the field introducing digital tools suitable for sports learning. Yet, as the study was not conducted in an academic environment and the time frame of this estimate, there is a need for further research in order to specify how these effects may also apply to organizational settings. The present research highlights the revolutionary aspects of AI in physical education, especially for complex motor activities such as basketball officiating.

Keywords: artificial intelligence, basketball, motor skills, physical education.

البدنية، خاصةً فيما يتعلق بالمهام الحركية المعقدة مثل التحكيم في كرة السلة.

Impact of Chat GPT-Based Exercises on Learning Officiating Movement Mechanics in Basketball among Students of the College of Physical Education and Sports Sciences, University of Baghdad

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Abstract

This research aimed at exploring the effect of training with ChatGPT-generated virtual exercises on learning officiating movement mechanics in basketball to the second-year students in college of physical education and sport science, University of Baghdad. A quasi-experimental design, 100 participants (50 males and 50 females) were randomly divided into an experimental

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In this paper, ChatGPT is employed for generating synthetic training tasks to improve the movement mechanics of officiating in basketball games. The change of refereeing positions and duties is important for decision-making in games. Previous work has found that the officials' movement affects their own performance (Mason et al., 2006). In addition, the efficacy of basketball referee training has been similarly shown to be modulated by motion analysis (Nabli et al., 2019). In more related research, crowd pressure is shown to affect referees' decision-making and thereby the need for high-level motor training to counteract this (Wann & Hackathorn, 2019). Studies with electromyography (EMG) have also shown how innovative training technology, such as gesture recognition can effectively improve the accuracy of sports referees (Pan et al., 2022). Additionally, research supports the importance of movement variability in mental imagery intervention for referees to prevent over fitting to dynamic game contexts (Lindsay et al., 2023). Last but not least, psychological and emotional adjustment of basketball referees had been established to have relationship with exercising skills ability which revealed the significance of maintaining mental stability in games (Karaçam et al., 2023).

Introduction

The use of artificial intelligence (AI) in the context of sports education is a highly innovative way to train motor skills in virtual practices and interactively gaming scenarios. It is interesting to note that AI can build awareness and students gain better knowledge in field of physical education hence generating new training methods (Chaware, 2020). Unlike other robotic and intelligent technologies that enable programmatic innovations, AI has been a transformative force in revolutionizing the field of PE (Campillo Herrero & Antón Espada, 2025). Furthermore, AI-empowered physical education applications are ready to become sustainable and effective teaching and learning tools owing to realized sustainability of educational intervention effectiveness in present interactive-based/evidence based education systems that personalized instruction for students (Lee & Lee, 2021). AI-supported fitness apps also demonstrate a promising role in helping college students to enjoy higher education success, particularly those who are unfit (Ompoc & Aguinaldo, 2025). In addition, AI is an excellent tool for adaptive personalized training programs designed to improve sports performance and support injury rehabilitation, and thus is essential in acquiring complex motor skills (Biro et al., 2024).

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Research Hypotheses

1. Statistically significant differences will emerge between the mean post-test scores of the experimental and control groups, with superior outcomes observed in the experimental group regarding officiating movement mechanics.
2. The implementation of a ChatGPT-based training regimen will yield a substantial enhancement in officiating movement mechanics relative to traditional approaches

This research adds to the increasing literature on AI in university sports training. It contributes to the formulation of theoretical models on using virtual models to teach complex motoric skills, and further promotes the application of ChatGPT in terms of sport education.

In addition, the study offers practical training models that may be applied in sport colleges aiming to improve motor and cognitive performances of students in officiating. As such, it not only enhances physical education in Iraqi universities but also prepares for the general application of AI to training programs.

The lack of available practice on the basketball court makes student's task at college of physical education and sport, University of Baghdad so hard to spanning well the correct performance related officiating movement mechanics. This problem is also aggravated with the use of traditional training protocol in which multiple cases are not considered. Therefore, the following research question was developed for this study: What is the effect of ChatGPT-based exercise on learning officiating movement mechanics in basketball among these students?

Research Objectives

1. To design and implement a virtual training protocol utilizing ChatGPT-generated exercises aimed at improving officiating movement mechanics in basketball among undergraduate students.
2. To assess the efficacy of the aforementioned training protocol in facilitating the mastery of motor skills pertinent to basketball officiating.
3. To conduct a comparative analysis of post-intervention performance metrics between the experimental group, exposed to ChatGPT-assisted exercises, and the control group, subjected to conventional training methodologies.

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participated actively in the program and did not display any restrictions of motion that could influence the motor performance, as well as those willing to practice for 8 weeks. This was sampled in order to achieve representativeness and feasibility, given the study time and geographical constraints. Baseline characteristics were measured and compared between the experimental and control groups for checking their equivalence. These variables were age, sex distribution, previous participation in basketball officiating training and movement mechanics as baseline expertise of the officiators that was determined by pre-test scores on The Observational Instrument for Assessment of Basketball Referees (IOVAB). The groups were matched to mitigate confounders and no differences between the groups at baseline have been found (statistically significant independent samples t-test or chi-square test, $p > 0.05$). Demographic and baseline characteristics of the two groups are presented in Table 1, which also shows similar nature of both groups.

Methodology

Study Design

An experimental design was used in this study, which including two similar groups: one is experimental group and the other is control group. This design was used to facilitate valid comparison of the effects of intervention(s) on the dependent variable, acquiring movement patterns related with officiating in basketball. Patients were randomly allocated to each group, thereby making the baseline data similar,and reducing the effects of confounding factors and increasing internal validity. The design consisted of pre- and post-intervention measures to assess changes due specifically to the ChatGPT-based training.

Research Population and Sample

The study population was the second-year students of the College of Physical Education and Sports Sciences, University of Baghdad where its male and female undergraduate students were about 500 in the same academic year. 100 individuals were taken to represent this population, controlling for gender. The sample was partitioned into 2 groups: the experimental group (n = 50; 25 male and 25 female) and control group (n = 50; n = 25 males and n = 25 females). The inclusion criteria were individuals who

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Table 1. *Baseline Characteristics and Equivalence of Experimental and Control Groups*

Characteristic	Experimental Group (n = 50)	Control Group (n = 50)	Statistical Test	p-value
Gender Distribution				
- Male	25 (50%)	25 (50%)	Chi-square	1.00
- Female	25 (50%)	25 (50%)		
Age (Mean ± SD, years)	20.3 ± 1.2	20.5 ± 1.1	t-test	0.47
Prior Officiating Training (Yes/No)			Chi-square	0.82
- Yes	10 (20%)	12 (24%)		
- No	40 (80%)	38 (76%)		
Pre-test IOVAB Score (Mean ± SD)	65.4 ± 8.7	66.1 ± 9.0	t-test	0.69

Note. SD = Standard Deviation, the chi-square test was used for categorical variables (gender and prior training), The independent samples t-test was used for continuous variables (age and pre-test IOVAB scores), A p-value > 0.05 indicates no statistically significant differences between groups, confirming equivalence.

Procedures

The experimental tests were carried out once a week during 8 weeks at the gymnasium of the College Physical Education and Sport Science -University of Baghdad. Training sessions were twice a week, biweekly to keep participants engaged and well rested between each session (mean duration during 60 min). This time interval was chosen based on motor learning principles discussed in sports training literature, allowing for repeated practice and recovery used to consolidate new skills (Schmidt & Lee, 1999).

Tools Used

The key component to the experimental stimulus was the AI language model ChatGPT, which generated virtual training exercises tailored to basketball officiating mechanics. These tasks comprised theoretical officiating scenarios, movement and position-oriented transfer activities, decision-making exercises, and recommendations for feedback. Generated contents was revised by professional review of three official certificated basketball referees and physical education teachers regarding content structure in relation with FIBA regulation rules, pedagogical sense. For data collection, direct observation and video recordings methods were used to assess the performance of participants with pre-established checklists undergo a standard officiating evaluation system.

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officiating drill that teaches the lead-trail-center positioning on fast break -- images and corrective feedback" were used to prompt development of interactive content. All created materials went through a validation process involving three expert referees and physical education professionals to validate accuracy, conditioning focus, and safety prior to use. The experimental group subjects rehearsed these scenarios using a combinatory method – imagining the situation in their minds before actual performance on court. Skills such as lead-trail-center triangulation, angle optimization for play observation and transitional footwork to improve anticipation placement were addressed by real-time AI-generated feedback on tablet interfaces. This approach relied on concepts of cognitive-motor integration and so facilitated perceptual as well as kinesthetic learning (Vickers, 2007).

Meanwhile, the control group did conventional teaching with training materials demonstrated by a coach, educated on applying rules with typical drills without AI assistant. Duration and frequency of these sessions were matched to the experimental group, however based around completely human-led instruction that included shadow refereeing exercises and peer feedback loops.

To provide examples of the ChatGPT-generated exercises, Table 2

Before introducing the treatment, a comprehensive pre-test covering officiating of movement mechanics was applied to both experimental and control groups. This test focused on the need for "full-time referees" as research participants were asked to assume a visuo-motor skills based simulated officiating role in carefully designed controlled basketball scrimmages closely representative of actual competition. Outcome Measures: Transitional and position accuracy (e.g., sprints between zones and optimal view) as well as decision-making performance (e.g., timely fouls) were examined utilizing a mixture of direct observation methods along with high-definition video analysis. Standardized rubrics used by certified basketball referees, who served as trained evaluators, were implemented to score performances and inter-rater reliability was measured through preliminary calibration sessions (Cohen's kappa > 0.80).

The intervention group took a custom-designed virtual training package, in which the exercises were produced real-time based on ChatGPT(OpenAI4.0) – Advanced Large Language Model used for educational purposes. The cues were carefully designed to produce situational gameplay consistent with FIBA officiating mechanics (with an emphasis on using two and three-person officiating). For instance, prompts such as "Create a basketball

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few weeks and then moved to integrated advanced scenarios in later weeks. This network should conform to progressive overload in learning tasks.

shows a selection of the training modules organized over the eight-week course. These sessions were well planned to follow the order of basic mechanics for the first

Table 2. *Sample ChatGPT-Generated Exercises for Officiating Movement Mechanics Training*

Week	Exercise	Description	Focus Area	Objectives
1-2	Basic Positioning Drill	Simulate a half-court setup where participants practice lead-trail mechanics: The lead referee positions at the baseline, trail at mid-court. Enact a slow-motion play involving a drive to the basket, rotating positions as the ball advances. AI feedback: "Adjust your angle to maintain a 45-degree view of the contact zone."	Transitional Movements and Positioning	Establish baseline awareness of two-person mechanics; improve static and dynamic positioning accuracy.
3-4	Fast Break Transition Scenario	Visualize a full-court fast break: Participants sprint from end-to-end, alternating between center and trail roles. Include decision points for foul calls on illegal screens. AI feedback: "Optimize your trail position to cover the weak side; anticipate the ball handler's path."	Speed and Anticipation	Enhance rapid transitional footwork; develop anticipatory decision-making under simulated pressure.
5-6	Zone Defense Officiating Simulation	Enact a 2-3 zone defense scenario with multiple ball reversals. Focus on center referee mechanics for monitoring post play and perimeter violations. AI feedback: "Reposition to the slot for better angle on the low post; signal travels promptly."	Angle Optimization and Team Coordination	Refine viewing angles in defensive setups; foster coordination in three-person mechanics.
7-8	Foul Call Integration Exercise	Combine physical enactment of end-game fouls (e.g., intentional vs. common) with scenario-based decision-making. Include crowd noise simulation via audio playback. AI feedback: "Ensure lead position covers the primary action; use precise signaling for unsportsmanlike fouls."	Decision-Making and Mechanics Integration	Integrate motor skills with rule application; build resilience to environmental stressors.

confidentiality in accordance with ethical clearance approval.

Statistical Methods

The data analysis involved application of descriptive and inferential statistics, testing the research hypotheses. Descriptive statistics including the mean and standard deviation calculated pre- and posttest scores. It used independent samples t-tests for inferential analysis, in order to verify which differences of post-

The same post-test procedure was applied after the conclusion of intervention, at the same level of pre-test similarity, where results were directly comparable. Performance was quantitated using observational and video-based methods as described previously, and the data were processed by statistical analysis (see next section). Ethical principles of the study were rigorously respected by obtaining informed consent from all participants, ensuring voluntary participation and anonymization of data to ensure

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and tabulated and visually presented for ease of understanding.

test's results were statistically significant between experimental and control group at the level $\alpha \leq 0.05$. In addition, intra-group differences were tested from pre-test to post-test using the paired samples t-tests. We calculated Cohen's d to express the magnitude of these differences. All analyses were conducted with SPSS (Version 28.0)

Result

Table 3. *Pre- and Post-Test IOVAB Scores for Experimental and Control Groups*

Group	Pre-Test (Mean ± SD)	Post-Test (Mean ± SD)	Change (Post - Pre)
Experimental (n=50)	65.4 ± 8.7	82.6 ± 7.2	+17.2
Control (n=50)	66.1 ± 9.0	72.3 ± 8.4	+6.2

Note. SD = Standard Deviation, Scores are based on the IOVAB scale (0–100), with higher scores indicating better officiating movement mechanics, The experimental group underwent ChatGPT-based virtual training, while the control group followed traditional training.

Table 4. *Within-Group Comparison of Pre- and Post-Test IOVAB Scores*

Group	Test	Mean ± SD	t-value	p-value	Cohen's d
Experimental (n=50)	Pre-Test	65.4 ± 8.7	12.45	0.000	2.14
	Post-Test	82.6 ± 7.2			
Control (n=50)	Pre-Test	66.1 ± 9.0	4.87	0.000	0.77
	Post-Test	72.3 ± 8.4			

Note. Paired samples t-tests were used to compare pre- and post-test scores within each group, $p < 0.05$ indicates statistically significant improvement, Cohen's d represents effect size (large: $d \geq 0.8$; medium: $d = 0.5–0.79$; small: $d < 0.5$).

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Table 5. Between-Group Comparison of Post-Test IOVAB Scores

Comparison	Mean Difference	t-value	p-value	Cohen's d
Experimental vs. Control (Post-Test)	10.3	6.32	0.000	1.29

Note. Independent samples t-test was used to compare post-test scores between groups, mean difference = Experimental Post-Test Mean (82.6) – Control Post-Test Mean (72.3), $p < 0.05$ indicates a statistically significant difference, favoring the experimental group, Cohen's d indicates a large effect size.

to further improve learning for sports scenarios like basketball officiating where skill acquisition pertains to non-trivial tasks, such as effective physical positioning (ergonomics), timely response and reactive actions. The enhanced proficiency in students' performance among the experimental group, is also corroborated by previous works where kinesthetic learning is expedited when coupled with a real-time or personalized feedback from AI-based learning tools in physical education (Zhou et al., 2024). These therapies can offer personalized case profiles to improve cognitive motor bridging, an advantage that traditional training techniques may not have because of their lower flexibility (Abdulkareem et al., 2025; Chaware, 2020).

Moreover, the remarkable within-group improvements for experimental groups as well as control group (with larger improvement in the former) demonstrate that AI-assisted training is indispensable to, but not instead of conventional skill learning. This implies a possible 'synergy'

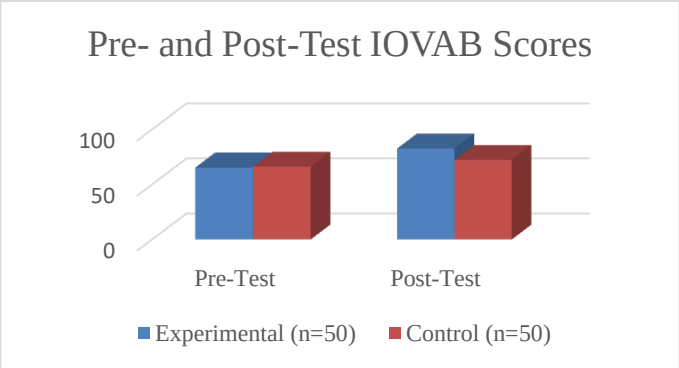

Figure 1. *Show Pre- and Post-Test IOVAB Scores for Experimental and Control Groups*

Discussion

There were also examples indicating that these improvements led to the officiating body being more dynamic, as suggested by participants' ability to adapt VR-training mechanisms delivered from ChatGPT. The control group was statistically less efficient than the experimental group after traditional training. This difference validates the complementing role of artificial intelligence

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mechanics (Biro et al., 2024). However, the laboratory nature of our study does limit implications of findings to the real world environment faced by professional officials (Strauss, 2002). Future work could examine longitudinal outcomes or hybrid models that include multimodal AI feedback for additional validation and generalization of these results, as well as based on findings that have found AI to be a groundbreaking tool for innovation in physical education and sports arbitration (V. & K. K., 2024).

Conclusions

The study confirms that using ChatGPT can increase significantly level of performance during virtual training course for teaching the motion mechanics: officiating basketball to second year students in PE College/University of Baghdad, compared with traditional methods. This is indicated by the significantly higher post-test scores of the EG. “Putting AI to work for such interventions may transform how we teach motor skills throughout the lifespan via personalized instruction and interactive, in skill acquisition – AI being complementary rather than a replacement. This is consistent with previous studies of the use of AI in physical education which used tools such as ChatGPT, to support immersive learning experiences that mimic real-life gaming situations, and increased levels of engagement and skill transfer (Campillo Herrero & Antón Espada, 2025). Specifically in the domain of basketball refereeing, the findings are in line with studies on AI-assisted referee systems which have demonstrated increased accuracy and decrease in human error through collaboration between humans and AI – particularly when it comes to correcting bias or fatigue-induced mistakes (Nieto-Acevedo et al., 2025; Pan et al., 2022). These results argue for an alternative vision of sports pedagogy which promotes the use of technology enhanced training to redress differential skill learning in diverse groups.

From a practical perspective, the superior performance of the ChatGPT-trained team has promising implications for sports program at universities to tackle resource limitation of training facilities in a low-cost manner. This is corroborated by studies on the transformative potential of AI for sports training, showing that individualised algorithms are able to maximise motor performance and recovery mechanisms including officiating

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whether it was sustained or performed in practical practice for retention over basis of long term and the intervention lasted for 8 weeks irrespective of the sustainability of the learned skills after assessing its implementation. Moreover, the investigation was performed in a gym with controlled indoor parameters, which may not simulate accurately variable or dynamic circumstances as well as uncertainty of field test conditions for basketball games like that would be during play (fan effect and asymmetry court). Finally, although the application of ChatGPT to produce training problems was novel, it is bottlenecked by the need for the expert validation of refine content in order to be accurate, and may suffer from scaling with lack quality control.

adaptive learning environments. The evidence falls in line with the revolutionary influence AI can have on sports when introduced to its educational syllabus properly.

Recommendations

Institutions of which teach the curriculum of sports science, and not limited to via artificial intelligence tools such as the ChatGPT in duration-based training can bring considerable benefits, especially for education institutions that focus on complex motor tasks like basketball officiating. Future research should examine the long-term outcomes of these interventions and see if application of multiple feedback strategies by AI can improve real-world relevance for professional referees.

Limitations

There are several potential limitations of our study that should be taken into account in the interpretation of its results. The study sample was selected by purposive samples and that’s has been done on 100 students of the second stage at College of Physical Education for Human Sciences, University of Baghdad; hence it may not be generalized to other education stages, schools and places about professional refugees. Moreover, developed skill was not explored with relation to

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