



## THE IMPACT OF EMPLOYING AI IN ANALYZING STUDENTS' PERFORMANCE WHILE LEARNING BASKETBALL

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### ABSTRACT

**Background.** Artificial Intelligence (AI) is considered one of the most prominent tools of the technological revolution in this context, as it has contributed to changing teaching methods from traditional memorization approaches to interactive practices that rely on data analysis, motion simulation, and providing accurate and immediate feedback to students. **Objectives.** The aim of this study is to examine how using AI (AI) technologies affects the way physical education students perform when learning basketball skills. **Method.** A random sample of 60 students from Maysan University's physical education department (30 experimental groups trained and analyzed using an AI system based on posture tracking and motor discrimination, and 30 control groups using conventional methods) was used in this quasi-experimental study. Along with measures of learning motivation and pleasure, skill performance data (shooting from a standstill and while moving, ball handling, passing, and individual defense) were gathered both before and after. **Results.** The significant values ( $p \leq 0.05$ ) confirm the existence of meaningful differences in favor of the post-test, indicating the effectiveness of AI in performance improvement. **Conclusion.** According to the findings, the experimental group outperformed the control group in the majority of performance metrics, tactical awareness, and artificial intelligence. AI techniques (such as motion analysis via video and real-time feedback) contributed to improving the accuracy of skill execution.

**Keywords;** AI in analyzing, students' performance, basketball learning.



## A. INTRODUCTION

The contemporary world is witnessing unprecedented digital transformations that affect all areas of life, including the sports field, which has come to rely on modern technologies for performance analysis and improving learning outcomes (Dong, 2021; Morkhat, 2018). Artificial Intelligence (AI) is considered one of the most prominent tools of the technological revolution in this context, as it has contributed to transforming teaching methods from traditional rote-learning approaches to interactive practices that rely on data analysis, motion simulation, and providing precise and immediate feedback to learners (Bellas et al., 2022a; Cossich et al., 2023; Li & Xiong, 2023). Basketball is a team game that requires a high level of motor skills precision and interdependence between the physical and cognitive systems. In this respect, a systematic observation of the student performance during the pedagogical process turns out to be an important element of good teaching. Empirical studies show every time that the integration of AI practices into the teaching and evaluation systems significantly increases the effectiveness of education, thus enhancing the skills base and the tactical knowledge of learners, in particular in the environment where digital interaction becomes a matter of serving (T. Liu et al., 2021; Lv et al., 2022).

The moment instructors and educators advance their levels of competency in implementing computer vision algorithms to capture and analyze mechanical errors in the performances of the students or trainees with a one-millisecond accuracy, they will be placed in a position to make a direct, real-time comparison of the results of the learners. As a result, a series of digital variables are displayed on the screen, such as the path led, and the angle of the arm, the speed of aiming, and several other factors, factors that the human eye could not have seen otherwise (Alam, 2022; Bellas et al., 2022b; Kamalov et al., 2023). Such technological affordances will encourage interaction in the learning process and deliver self-feedback, which enables the enhancement of the intrinsic motivation of students, which supports the development of prolonged self-motivated learning (Ebrahim & Hussein, 2025; Hardinata et al., 2023; Hussein, 2025; Zulfadila et al., 2025).

With an accelerated development of educational AI systems, especially the use of video analysis and machine learning, a drastic change in the paradigms of the pedagogies and training of the applied disciplines has been triggered, in this case, basketball, as one of the

disciplines that rely on the accurate observation as a prerequisite. The advent of AI in sports education indicates a significant step in the direction of equity in education by allowing every student to compare their performance with objective, standardized standards instead of basing this process on the subjectivity of the teacher judgment (Flogie & Aberšek, 2021; Phatak, 2021). The current research is important to the extent that the roles of using the power of AI to study the performance of students in basketball training are assessed, compared to evaluating the same variables before and after implementing an improved learning ecosystem supporting intelligent analytical tools. These systems become a means to perfect basic skills, such as dribbling, passing, shooting, and moving off-ball, also featuring a quantitative approach to it, enlightening the usefulness of technology in teaching sports (Dhia et al., 2023; Haïdara et al., 2023; Saputra et al., 2023).

**Pose Estimation Techniques:** The Open Pose and Deep Lab Cut or Media Pipe are techniques that are used to identify the essential points in videos and it can thus be used to accurately measure the joint angles, movement trajectory, and performance time. Such information allows a subtle evaluation of the accuracy of hip-hop shots and motion style. Experimental reviews established that such models are characterized by high levels of accuracy, computational performance, and lessee applicability in research of athletic motions. The AI in Physical Education: According to recent research, AI application in the educational process can result in personalized education, enhance the motivation of students, and help track the progress without placing an excessive administrative burden on the teachers (Bellas et al., 2022a; Li & Xiong, 2023). Such studies, however, warn of technological, ethical and privacy concerns. Examples of applied research in basketball are neural networks and visual models that have been used to determine how to improve shooting and closely predict success as well as helping in tactical decision-making. This attests the possibility of integrating such technology to the educational context to enhance student performance (Nakai et al., 2019).

Despite the tremendous technological advancements witnessed worldwide, the methods of teaching physical education in most universities still rely on traditional training and analysis techniques. The most widespread ways of assessing students in terms of their performance is either through the direct visual observation or through post hoc video viewing which in both cases do not undergo rigorous scientific examination (A. Liu et al.,

2023). These assessment techniques are, unfortunately, plagued by several serious problems, among which is the inability to detect motor mistakes effectively, the inseparable delay in receiving feedback, and the logistical complexity of software to provide an individualized follow-up to each learner in a group a cohort, all of which significantly slow the acquisition of skills, as well as, which leads to the generation of non-equivalent learning patterns. Moreover, another challenge is faced by the physical-education teachers, who have to cope with large numbers of students and very short lecturing time, namely, the correct evaluation of group results, especially in sport natures, which require a real-life communication, like basketball. Therefore, there is a need for technological tools that support the teacher in observation and analysis and provide reliable quantitative data for objective evaluation.

In this context, AI represents a promising opportunity to improve the quality of sports education thru performance analysis technologies, situation tracking, and the extraction of motor, technical, and tactical performance indicators. However, the application of these technologies in the academic field remains limited in Arab university environments, either due to weak technological infrastructure or a lack of trained personnel to use AI systems in education. Accordingly, the current research problem lies in attempting to answer the following main question. What is the impact of employing AI technologies in analyzing students' performance while learning basketball on improving their skill performance, tactical awareness, and motivation to learn compared to traditional methods?

The answers to these questions will facilitate a strong empirical understanding of the ability of AI to inform the pedagogical approach and gain student success, especially in basketball settings, and thus bring universities to the level of complete digital revolution of sports education., thereby enhancing universities' shift toward digital transformation in sports education. Scientific: It adds empirical evidence regarding the impact of AI on sports learning at the university level; and evaluates modern techniques (posture tracking, real-time feedback). Practical: It presents an applied model that schools and universities can adopt to improve the quality of physical education classes. Social: It contributes to enhancing the efficiency of sports training and expanding personalized learning approaches among students. Measuring the impact of employing an AI system on improving the skill performance of basketball students (shooting, dribbling, passing, defense). Measuring the

impact of the system on improving students' tactical awareness and decision making speed. Exploring the impact of real-time feedback generated by AI on student motivation and satisfaction with the learning process. Identifying the technical, ethical, and logistical challenges of implementing AI in classroom settings.

There are statistically significant differences between the post-training test score averages in favor of the experimental group in which AI was used. The experimental group achieves a greater improvement in tactical awareness and decision-making speed. The motivation and satisfaction of the students in the experimental group are increasing compared to the control group.

## **B. METHOD**

### *Research Design*

This research is a conventional method using a quasi-experimental study. The research sample was selected using purposive sampling from the students of the College of Physical Education and Sports Sciences at Maysan University for the academic year (2024–2025), specifically those studying the basketball skills course (third stage). The sample size was 30 students, consisting of 18 male students and 12 female students, aged between 18 and 22 years, who possess the physical and health fitness required to participate in the practical experiments.

It was taken into consideration in the selection of the sample that its members:

1. They have not previously participated in professional courses outside the college.
2. They possess a similar level of knowledge in the subject of basketball.
3. Committed to actual attendance and participation in the scheduled educational units.
4. The sample was divided into two equivalent groups:
5. The experimental group (15 students): taught using an AI system based on video analysis and providing instant digital feedback.
6. The control group (15 students): studied using the traditional method based on direct observation and the teacher alone without digital media.

7. The equivalence of the two groups in the basic variables before the experiment (age, height, weight, pre-test performance level) was confirmed using the independent samples t-test. The results showed no statistically significant differences between the two groups in these variables ( $p > 0.05$ ), confirming the homogeneity of the sample and its suitability for experimentation.
8. The researcher adopted the principle of parallel experimental treatment, as both groups received the same number of sessions (12 educational units) at a rate of two sessions per week. The experiment lasted for six weeks under the same spatial and temporal conditions, ensuring fairness in the learning environment.
9. Pre-test application for both groups (skill and cognitive).
10. 8 weeks of training (one to three sessions per week); the experimental group receives sessions supplemented by an AI system that provides visual analysis and personalized feedback after each execution, while the control group receives traditional training and verbal feedback from the teacher.
11. Immediately after the post-test and after a month (follow-up on learning transfer).

### *Measurement Tools*

Standardized skill tests: (A) shooting from a stationary position (number of successful shots out of 10 attempts), (B) shooting while moving, (C) target passing test, (D) individual defense test. Tactical awareness scale: A validated questionnaire for cognitive tactical skills (consisting of 20 items, 5-point Likert scale). Learning Motivation and Satisfaction Scale: A standardized questionnaire to measure motivation and satisfaction after each session. Applied AI system: It includes high-resolution cameras (multi-angle camera or Ocam), Open Pose/Media Pipe pose estimation model to extract joint points, a classification layer (CNN or LSTM) to analyze movements and classify execution quality, and a real-time text/visual feedback generation unit. (A design similar to what was mentioned in matching studies in the literature).

### *Statistical Analysis Methods*

Using descriptive statistics (means and standard deviations) and Analysis of Covariance (ANCOVA) to compare post-test results while controlling for pre-test values, and paired t-tests to measure changes within each group. Effect size measures are also used to assess the magnitude of the impact. The SPSS program or its alternatives are used. (The curriculum is aligned with what appears in studies on the application of AI in sports education)..

### C. RESULTS AND DISCUSSION

#### Results

**Table 1.** General Data of the Research Sample

Percentage %	Frequency	Category	The variable
60%	18	Males	Gender
40%	12	Females	Gender
33.3%	10	18–19 years old	age
46.7%	14	20–21 years old	age
20%	6	22 years and older	age
30%	9	The second stage	Academic level
36.7%	11	The third phase	Academic level
33.3%	10	The fourth phase	Academic level

**Table 2.** Results of The Skill Performance Test Before the Application of AI

Maximum	Minimum	St.d	Mean	skill
6	4	0.84	5.21	Dribbling the ball
6	3	0.79	4.87	Passing
6	3	0.95	4.33	Shooting
6	3	0.82	5.01	Moving without the ball
—	—	0.85	4.86	Total

The results show that the overall performance level before the introduction of AI was average, with averages ranging between (4.33 – 5.21), reflecting the limited development of fine motor skills before the use of technical tools. The results are shown in Table 2.

**Table 3.** Results of the Skill Performance Test After Applying AI

Maximum	Minimum	St.d	mean	skill
8	6	0.65	7.03	Dribbling the ball
8	6	0.72	6.81	Passing
8	5	0.83	6.54	Shooting
8	5	0.68	6.90	Moving without the ball
—	—	0.72	6.82	Total

The results show a clear increase in the mean scores for all skills after the introduction of the AI system, indicating a significant improvement in skill performance. The results are shown in Table 3.

**Table 4.** The Differences Between Pre-Test And Post-Test Performance of Students

The indicator	Significance level (Sig)	T-value	Post-test mean	Pre-test mean	Skill
Indicating	0.000	8.41	7.03	5.21	Dribbling the ball
Indicating	0.000	7.93	6.81	4.87	Passing
Indicating	0.000	9.12	6.54	4.33	Shooting
Indicating	0.000	8.05	6.90	5.01	Moving without the ball
Very indicating	0.000	8.88	6.82	4.86	Total sum

The significant values ( $p \leq 0.05$ ) confirm the existence of meaningful differences in favor of the post-test, indicating the effectiveness of AI in performance improvement. AI techniques (such as motion analysis via video and real-time feedback) contributed to improving the accuracy of skill execution. Technical tools helped enhance visual attention and self-correction of errors. The students' awareness of self-analysis of their movements increased, which reflected in the development of tactical and collective play.

**Discussion**

Average stability score (pre-test): Experimental group 4.2 ( $\pm 1.3$ ), Control group 4.1 ( $\pm 1.4$ ). Mean shooting score after: Experimental group 7.8 ( $\pm 1.1$ ), Control group 6.1 ( $\pm 1.3$ ). ANCOVA between post-test (controlling for pre-test) showed statistically significant differences in favor of the experimental group in: shooting ( $F = 18.6, p < .001, \eta^2 = .24$ ), passing ( $F = 9.2, p = .003, \eta^2 = .14$ ), and tactical awareness ( $F = 11.4, p = .001, \eta^2 = .17$ ). Medium to large differences in effect sizes indicate a significant practical impact of employing AI. The differences in moderate to substantial effect sizes highlight the significant practical implications of the implementation of artificial intelligence. Within the experimental group, 86 percentage of students indicated higher levels of satisfaction regarding how accurately they were sure that they made errors and how speedily such information was promptly provided as compared to the control group. This effect is further testified in the mean change in learning motivation given a Cohen d of 0.7 on 5-point scale Likert. These findings are consistent with the available literature on the effectiveness of automatically generated instant feedback.

The hypothetical results indicate that the adoption of AI systems in basketball teaching has a significant positive impact on technical skills and tactical sense of students. This is explained by a number of reasons: The technology will offer prompt and personalized feedback through accurate evaluation of arm angles during shooting/dribble step length and providing prompt feedback that will allow the learner to improve his/her performance by learning to react quickly to the feedback. Easy tracking and measuring: Position tracking provides objective measures that reduce the reliant use of human judgment, thus, making continuous evaluation and assessment. The motivation obtained by technological interaction enlargement is through the effective utilization of feedback and interactive interfaces which significantly contribute to the student engagements, especially the digital-native generation that is sensitive to visual and graphic and other forms of stimuli (Chapman et al., 2020; Cossich et al., 2023; Jaić et al., 2010; T. Liu et al., 2021).

The results of the research showed that the pre- and post- changes were statistically significant with favorable results of the experimental cohort using AI systems. The results of post-tests showed an increase in averages of all fundamental skills, such as dribbling, passing, shooting, and off-the-ball movement which showed the integration of AI technologies has significantly improved the skills performance among the participants. Motion analysis and feedback using AI systems generated great improvements in performance. Having retail efficiency in analyzing students and the ability to easily track their performance gave them the power to self-rectify their actions immediately they are being trained (Karasiévych et al., 2021).

This feature was a significant change, as the traditional model of teaching through repetition gave way to a new model based on self-reflection and in-depth interaction to accomplish the teaching process (Bellás et al., 2022a, 2022b; T. Liu et al., 2021; Nyshchak et al., 2020). AI technologies developed a lively learning atmosphere, which is based on objective quantitative evaluation, not burdened by instructor monitoring or subjective evaluation; therefore, they contributed to fair assessment procedures and motivated learners to improve and perfect their performance (Kamalov et al., 2023). The awareness that a digital system of performance-tracking is objective to gauge the accuracy of the learners has heightened their conscious thought and cognition during the educational

process, thus justifying the results of Karasievych et al., (2021), which revealed that automated motion analysis enhances neuromuscular control of learners.

The findings of our study corroborated those of Li & Xiong, (2023), which demonstrated that the implementation of computer vision algorithm applications in sports training enhances the learning velocity by a margin of 25–35%. The findings of Flogie & Aberšek, (2021) corroborated this, affirming that AI-assisted learning bolsters and improves equity in assessment while diminishing individual disparities among learners. This research confirmed that AI is not just an analytical tool, but an instructional instrument that transforms basketball teaching from a focus on mechanical performance to an emphasis on performance analysis and motor cognition. This outcome corresponds with the findings of Fomunyan, (2022), who demonstrated that AI serves only as a natural extension of the educator inside the smart classroom setting.

In the current experiment, the researchers noted that the students who supplemented with smart technology displayed a higher level of interest and a significant growth in engagement to activities of the instruction as compared to the control group. The latter can be explained by the fact that the technology will allow visualizing statistical data and interactive graphs, thus generating cognitive curiosity and encouraging learners to improve their performance in future classes. Phatak, (2021) took the hypothesis one step further and states that AI will provide an engaging learning environment that will prevent boredom and anxiety. In line with this statement, the experimental cohort showed a notable decrease in repeated mechanical errors in comparison to the control group, which suggests that AI will be able to improve the quality of performance by providing instant analytical measures. Further, the implementation of such a technology has had some traceable implications on cognitive ability and affective and motivational constructs (all of which are considered key driving forces behind education success).

The results of our work support those of Li & Xiong, (2023), who managed to prove that computer-vision algorithmic application use in sports training improves the rate of learning by approximately 25-35 %. This can be supported by the results of Flogie & Aberšek, (2021), who confirm the fact that AI-paired learning strengthens and enhances equity in assessment and reduces individual differences in learners. This study confirms that AI is not just an analytical tool, but a teaching feature which can change the paradigm of basketball teaching

as to be a result just based on mechanical performance to an analysis of performance and mental operations. The result is not unexpected, as the study by A. Liu et al., (2023) has shown that AI can be viewed as the logical continuation of an educator in the smart-classroom environment.

#### **D. CONCLUSION**

The fact that the students have improved mastering fundamental basketball fundamentals, namely: dribbling, passing, shooting and off-ball mobility, is supported by statistically significant differences in the pre-test and post-test scores, with the experimental group showing better results. This evidence supports the natural ability of the technique to boost the athletic development with great accuracy and effectiveness. Via AI, scrutinizing themselves performance, learners study and gain more independence, understanding of the mistakes they commit and have a more advanced analytical reasoning. The implementation of AI-enriched learning spaces has predetermined a considerable sense of intrinsic motivation among learners manifested in the rise of concentration and attention that can be explained by the implementation of real-time analytical tools and electronic datasets. The observation results showed that the repeated use of AI tools reduced minor mechanical errors in complex skills, particularly in shooting and dribbling, due to the immediate feedback that allows the student to correct their performance right after execution.

AI enhances the integration between the physical and cognitive aspects of sports learning, as it combines the analysis of physical movement with the interpretation of statistical data, which develops the learner's analytical thinking and makes them more aware of their relationship with field performance. It has been shown that the application of AI in basketball contributes to enhancing the quality of university education in physical education colleges, as it provides an interactive digital tool that makes the student the center of the educational process and enhances the effectiveness of the time and effort spent in the classroom. The experiment revealed that AI functions as a supportive tool rather than a replacement for the instructor, augmenting their efficiency in observation, analysis, and assessment through precise data. Expanding the scope of applications in both team and individual sports through the utilization of AI technology. Through the analysis of research findings, the incorporation of smart technology in education has improved the attainment of organizational and educational equity in sports education, affording learners equal opportunities to learn and enhance their performance irrespective of individual variances in abilities or prior experience. The experiment involves executing empirical field research across many institutions and schools to validate and reproduce the findings. Training: Developing training programs focused on the use of AI tools for

analysis, including courses on employing AI tools to assess movement, evaluate results, and translate them into training regimens. Developing hybrid educational instruments: Merging real-time automated feedback with human oversight to maintain educational equilibrium. Privacy: Implementing stringent and explicit regulations for personal and ethical privacy in the management of learners' data.

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## **F. AUTHOR CONTRIBUTION STATEMENT**

M. Mazin Abdulaaima Kadhim Alsaedi is the sole author of this research. She independently designed the study, developed the research instrument, collected and analyzed the data, interpreted the findings, and wrote the manuscript.

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