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AI Interactive Scenarios Develop Core Skills And Tactical Decisions In Basketball

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General Background Artificial intelligence (AI) transforms physical education by replacing mechanical drills with dynamic situational training environments. **Specific Background** Traditional basketball instruction relies on isolated repetition, severely limiting students' adaptive motor skills during real-game tactical situations. **Knowledge Gap** Empirical evidence remains limited regarding how AI-powered interactive scenarios specifically affect fundamental motor skill acquisition and tactical decision-making speed among physical education students. **Aims** This study assesses an 8-week educational program utilizing AI interactive scenarios to improve basic basketball skills and accelerate tactical decision-making in university students. **Results** Analysis of 60 students via ANCOVA and repeated measures ANOVA revealed that the AI experimental group achieved statistically superior skill performance and significantly reduced decision-making times (from 840 to 510 milliseconds) compared to the control group. **Novelty** This research confirms that substituting linear instruction with nonlinear AI simulations decisively accelerates the cognitive-motor coupling required for rapid athletic decisions. **Implications** Physical education faculties should integrate AI-powered digital laboratories and adaptive scenarios into curricula to better prepare students for complex team sports..

Highlights:

- Traditional isolated skill drills create a substantial deficit in students' ability to make rapid tactical decisions during dynamic basketball games.
- AI-powered interactive scenarios successfully reduced students' tactical decision-making response times from 840 to 510 milliseconds.
- Integrating digital simulations directly accelerates the cognitive-motor coupling required to seamlessly translate fundamental skills into functional game responses.

Keywords : Artificial Intelligence, Tactical Decision Making, Basketball, Teaching Methods, Cognitive-Motor Coupling

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Introduction:

Today, with the fast integration of AI technologies, the contemporary world has experienced a radical change in the sports learning and training settings, which has led to the development of new concepts of teaching methods and motor control. The traditional model of teaching and learning with indoctrination or live presentation has been expanded to the interactive digital model, which offers realistic and immediate simulation of complex situations in sport [1], [2]. Basketball is a team game with a rapid pace of play and frequent change of position, and decisions made by players in a game are highly related to safety and speed of their skills [9].

The key role of AI in interactive scenario teaching is its ability to put the learner in the shoes of tricky tactical situations close to the real game, where they must think analytically and have to make decisions between the skills and the tactics in millimetres [3], [4]. The application of AI technologies favor the quality of direct and personalized feedback, thereby reducing learning time, and strengthening the connections pathways of the neuromotor system involved in the processing of mathematical information [5].

Therefore, the significance of the current research is that a new educational and technological model is presented, which seeks to build the fundamental skills needed for rational decision making among physical education students, consistent with the trends of the present academic and field.

Research Problem:

Although there has been great development in sports science and teaching methods, the methods of teaching basketball in many academic colleges are still largely based on mechanical repetition of basic skills without considering the context of the game [7]. This separation between the skill and the tactical cognitive aspect has led to a clear gap in students, who have an acceptable limit on individual skill performance (i.e., tapping, passing, and aiming) with their low ability to make the right decision and timely it during sensitive actual play situations [8].

The problem is when there is a lack of interactive learning environment that mimics quick thinking and situational analysis, the result in traditional learning is a long time consumed but tactical mastery is still limited. Based on this, the researcher poses the main question: What effectiveness does a teaching program have which uses interactive scenarios with the help of artificial intelligence to increase the speed, accuracy and development of basic skills in basketball among students of the Faculty of Physical Education?

Research Objectives:

- Using Single Common Variance Analysis (ANCOVA) identify the differences between the pre- and post-measurements of the two groups (experimental and control) in basic skills and decision making level in basketball.
- Measuring the Effect \ Size of the AI-Powered Interactive Scenarios on Dependent Variables (Basic Skills and Decision-Making) by using the micro-square ETA coefficient .
- Measuring the interaction/effect of the teaching style and student's initial motor capacity on the final learning outcome with repeated two variance analysis (2\times 2\Repeated\Measures\ANOVA).

Research Hypothesis:

There is a statistically significant difference at the significance level (0.05) between the mean scores of the dimensionality of the two groups (experimental and control) in the basic skills tests and the basketball decision making scale after adjusting for the effect of the pre-measurement as an accompanying dependent variable.

Research Areas:

- Human Field: Students from Faculty of Physical Education - Hilla University / Third Stage.
- Time Range: For the period of the

academic year 2025-2026 .

- ❖ Spatial Field: Closed Hall and Digital Tests at the Faculty of Physical Education - Hilla University.

Research Methodology:

The research method used was the experimental method because this method is the most suitable method in solving scientific issues with a causal approach to determine how much effect on the dependent variables with the independent variables.

Experimental Design:

The two sets (before and after) were designed in the same way and applied as follows:

• Experimental group (EG): Exposed to the teaching program using interactive scenarios with AI .

• Experimental group (EG): Was exposed to the special educational program (direct/iterative method) .

Research population and sample:

• Research Population:

The population in the current research is (146) students of the third stage at the Faculty of Physical education - Hilla University for the academic year (2026-2027) divided into (4) study divisions for males only.

• Research Sample:

The research sample was obtained using Purposive Random Sampling method as follows:

Special cases (N = 26):

• Students with failing and deferred grades (n = 6) were excluded.

• Students learned basketball in the clubs and national teams were excluded to prevent the skills being evaluated from being biased (n = 8).

• This does not include the sample from the survey (n = 12).

• Net Selected Community (N = 120): 60 students were randomly selected from the original net community making up (50%) of the net community.

• Sample distribution: The students (60) were randomly split into two groups by simple lottery:

- Experimental group (n_1 = 30): Division A.
- Control group (n_2 = 30): Division B.

Tools and devices used in the research:

Codified tools were used to collect data and pass the independent variable:

1. Anthropometric and physiological measuring instruments: Stature painter, flexible tape measure and electronic medical scale.

2. Smart Projectors & Interactions: Interactive screens, tablets with digital scenario platform that is powered by adaptive AI models.

3. Sporting equipment: Legal basketballs (size 7), obstacles, coloured measuring tapes to measure angles, basketball court, high speed cameras for skill and kinetic analysis.

4. Elementary Reading Comprehension Tests:

• Passing: Count the seconds it takes to swipe on the wall for (30) seconds (to check the accuracy and speed of scrolling).

• Tapping: Testing of zigzag drum between (6) contraindications (Measurement of the control and speed of the ball).

• Aim: Test for peaceful aiming, static/medium distance aiming (4.5 m).

Computerized Decision Making Scale:

Digital testing environment where the student will view tactical moments from real basketball games, that suddenly stop, and the student will have to make the best choice of passing, shooting or tapping in a certain number of milliseconds (ms), depending on the scenario.

Steps to build the pilot program:

It is designed based on modern education design model (Addie Developed model for sports):

Analysis Stage: Identifying skill and planning requirements of students in third stage of the basketball curriculum based on the basketball vocabulary.

- ❖ Design Phase: Building Number of Educational Units: 16, Number of Weeks: 8, Number of Units per Week: 2, Unit time: 90 minutes.

- Development Phase (Integration of Digital Scenarios):

Creating a simulation of an interactive AI system which gives back responses tailored to the skill selection chosen by the student (adaptive/feedback).

Intellectual analysis and a quick skill response is required for formulating situations (2v1, 3v2, 2v2).

- Implementation Phase: The experimental group receives the interactive module in the main part of the module (20 minutes of digital scenarios + 40 minutes on the field) while the control group receives the explanation, presentation and the traditional model.
- Evaluation Phase: Conducting post-tests and cumulative evaluation.

Psychometric Characteristics of Tests:

For the current research population (n = 12), the following scientific parameters were computed to provide validity for the tests used:

1. Honesty:

- Authenticity of the content/experts: The tests and the decision making scale were presented to (7) experts in teaching methods and basketball and all of them got an agreement rate above (85.7%).
- Differential truthfulness: Tests were applied to two extremes (beginners and practitioners) and the results indicated highly significant differences ($p < 0.01$).

2. Stability: For the Test-Retest method (7) days were used. The correlation coefficients (Pearson) varied from (0.86 - 0.94) and the internal consistency coefficient (Cronbach's Alpha) for the decision making scale was computed and was (alpha = 0.89).

3. Objectivity: Both the scores were taken simultaneously by two referees, and a high score of (0.91 to 0.96) was obtained for the Spearman's rank correlation coefficient between the two scores.

Parity and homogeneity of the research sample:

• Moderation and homogeneity of growth variables and primary abilities: -The normal distribution of the data and the homogeneity of the two groups were verified using the Shapiro-Wilk test and the Levin test for the homogeneity of variance at the significance level (alpha = 0.05).

• B. The table of equivalence and homogeneity between the two groups (experimental and control)

The following statistics show the exact equivalency of tribal members in the two groups in the following areas of growth, skill performance and decision-making ability:

Table (1). Shows the equivalence and homogeneity of the experimental and control groups

Variable	Experimental Group Medium + Deviation	Control Group Medium + Deviation	Calculated T value	Significance P value	Levine Test (F)	Significance
Age (year)	21.33±0.61	21.41±0.58	-0.451	0.652	0.181	Non-D
Length (cm)	176.80±4.11	177.15±3.95	-0.335	0.737	0.092	Non-D
Weight (kg)	71.85±5,14	71.85±4.88	-0.501	0.617	0.220	Non-D
Pass Test (Score)	12.44±1.81	12.30±1.91	0.312	0.757	0.114	Non-D
Tabat test (sec)	14.81±1.14	14.95±1.21	-0.426	0.671	0.087	Non-D

Aiming Test Sco) (re	8±1.46 .59	±1.52 8.45	0.390	0.697	0.202	Non-D
Accuracy of Decision-Making Deg) (ree	1±2.85 8.23	±2.91 18.10	0.201	0.841	0.148	Non-D
Decision Time	8±62.5 40	±65.1 852	0.728 -	0.469	0.312	Non-D

The degree of freedom (58) and the value of (T) of the tabulation (2001) at the significance level (0.05), indicate that there is a parity between the two groups and naturalization is full.

Final Application of the Pilot Program:

- ❖ Tribal measurement: Measurement for the two groups were taken at the research site, with full temporal and spatial standardization.
- ❖ Implementation of Educational Modules: This program implementation was continued for (8) consecutive weeks.
- ❖ It was included (16) educational units a week, (unit time is 90 minutes).
- ❖ For the experimental group, AI interactive scenario protocol was used both in single and two person learning stations with simulated scenarios in the field that were similar to previous applications.

- Post-testing : Both the two groups were given the same tools and conditions as in the pre-tests, and the post tests were administered following the application of the (16) units.

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Advanced Statistical Methods:

To address the issue of measurement problems and minimise variance errors, the data were analysed using advanced methods, the Social Science Statistical Package (SPSS v.28) and R-Studio:

1. To ensure the moderation of the data, descriptive statistics: Arithmetic means, standard deviation, and the coefficient of kurtosis are used.

2. Single covariance analysis: It is used for the comparison of the performance of experimental group and control group in telemetry after adjusting and coordinating the effect is to reduce the experimental variance error and is also used as a pre-measurement as an accompanying variable.

3. Repeated binary variance analysis: -To measure the interaction between teaching style and temporal measurement and to evaluate the interaction with the initial abilities of the experimental and control groups.

4. Impact size .

5. To determine the amount of differences between the pre- and post-measurements, you will use 5-, Daniel Cohen's coefficient (Cohen's\d).

6. Homogeneity tests, presuppositions.

Results

1- View Research Results:

- Results of the Combined Uniform Variance (ANCOVA) for the telemetry tests: -To control the effect of the pre-measurement and the validity of the research hypothesis, the one-way/ANCOVA analysis was applied to the telemetry scores between the two groups (experimental and control).

Table (2). Results of the Combined Variance Analysis (ANCOVA) for the two groups in the skill tests and the decision-making scale (the scores of the dimension measurement adjusted according to the pre-measurement)

Dependent variable	Stacked Squares	df	Average Squares	Calculated value (F)	Moral level	Impact size	Significance
Scroll (degree)	142.67	1	142.7	48.35	0.001	0.459	D to a very large degree
Tapping (sec)	88.40	1	88.40	52.14	0.001	0.478	D to a very large degree
Orientation (degree)	116.15	1	116.15	39.82	0.001	0.411	D to a very large degree
Accuracy of Decision Making (Degree)	312.50	1	312.50	74.20	0.001	0.565	D to a very large degree
Decision Time (Degree)	145200.00	1	145200.00	61.88	0.001	0.520	D to a very large degree

- ❖ Statistically significant at (p 0.05). The tabular F value at (df1=1, df2=57) is 4.01.

- The variance analysis of the repeated scales was used to find the interaction effect between the teaching method and time (pre-post) in a binary variance analysis.

Table (3). Means, Standard Deviations and Time/Group Interaction Test for Decision Making Variables and Basic Skills

Variable	Measurement	Experimental Group Medium + Deviation	Control Group Medium + Deviation	Interaction (group× time)	Moral level	Impact size
Scroll (degree)	Before me	12.44±1.81	12.30±1.91	42.15	0.001	0.421
	Go away	18.90±1.54	1.68±14.65			
Tabata (sec)	Before me	14.81±1.14	14.95±1.21	36.80	0.001	0.388
	Go away	11.20±0.92	1.05±13.40			
Orientation (degree)	Before me	8.59±1.46	8.45±1.52	38.90	0.001	0.401
	Go away	14.75±1.22	1.35±13.40			
Accuracy of Decision-Making (Degree)	Before me	18.23±2.85	18.10±2.91	68.45	0.001	0.541
	Go away	28.40±1.95	2.10±21.15			
Decision Time	Before me	840±62.5	852±65.1	55.30	0.001	0.488
	Go away	510±41.2	50.8±715			

- ❖ Statistically significant at a significance level of (0.05).

2- Discussion:

A very significant significant superiority and effect size (Beta_p^2 > 0.14) was obtained for all skill and decision making variables between the experimental group and the control group, showing that the experimental group had better scores than the control group in all variables.

The researcher proposes that this superiority was due to the fact that the AI-based digital learning environment did not only give the learner a tactical context, but it also simulated the reality of the game, where the student found himself in complex and changing play situations, which had to be cognitively and quickly analysed and processed before the implementation of the skill. This cognitive and motor enhancement is in line with the results obtained by [4] who have verified that the training developed through interactive scenarios is a way to improve the athlete's visual and motor planning process, which is fast, and consequently, his tactical performance.

For the same reasons, AI software also achieved a 350% shorter decision time (840 to 510) and improved accuracy due to direct adaptive feedback. This is because AI software shortens the cognitive neural pathways and lessens cognitive overload. In the field, this means that easier and more accurate motion response, which is equivalent to the accuracy of motion programs that are stored in long-term memory, is achieved with instantaneous diagnostic feedback, according to [5].

Experiments showed that the core skills (passing, tapping, aiming) significantly improved due to the skill being associated with the situation. Traditional training is based on the repetition of movement and mechanical mechanism without taking into account the competitor or the time, while interactive scenarios are based on the skill in a functional planning context. According to [8], [9], "nonlinear learning models" along with "simulated scenarios" induce "self-motor control," and "skill responses" are more flexible and adapted to the changing scenarios of playing a basketball game. Related work on ecological dynamics, perceptual-cognitive training, transfer, constraints-led coaching, and adaptive feedback also provides context for interpreting these findings [10]–[15]. Recent syntheses

likewise examine perceptual-cognitive training and decision-making in team sports [16], while research on decision training in basketball provides a framework for designing virtual and augmented decision-making scenarios that preserve representative sport information [17]. Reviews of AI in physical education also highlight personalized instruction and real-time feedback while noting implementation and reliability challenges [18].

Conclusions:

1- The effect of artificial intelligence on education: Instructing physical education students using interactive scenarios with artificial intelligence is statistically significant and very large in terms of the accuracy and speed of mathematical decision making compared to the traditional method.

2- Basic skills plus schematic aspect: Interactive play situation simulations have helped increase the speed of learning basic skills (passing, tapping and aiming) and have helped to better establish them as useful motor responses to the actual play context.

3- The pilot education programme was found to have a significant effect on the reduction of response times to tactical decision making (MS), showing how students' ability to see and predict the schematic changes on the pitch has evolved.

4- The results of the various statistical tests (covariance, ANCOVA, and repetitive interaction) showed that the smart and interactive digital learning environment is better than the traditional direct iterative method in the correlation of cognitive thinking with motor skill performance.

Recommendations:

1- Adopting and disseminating interactive models and scenarios with artificial intelligence in the curricula of physical activities and sport in the practical lessons of physical education faculties, especially in team games - basketball, football, handball.

2- Furnishing digital motor learning laboratories: equipping Physical education faculties with interactive screen and tablet for the field and practical application with computer software for assessment and tactical training.

3- Running teacher and trainer training courses: Qualitative training and workshop preparation for teachers and trainers to boost their effectiveness in designing and implementing use of artificial intelligence and adaptive feedback in educational modules.

4- Integrative prospective studies: Carry out research and other studies on other neurological and physiological elements (eye-tracking, EEG etc.) to evaluate the influence of intelligent interactive learning environments in other team games and individual games.

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