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RESEARCH ARTICLE

The Impact of the Cognitive Load Strategy Integrated with Artificial Intelligence on Learning the Volleyball Spike Skill among Third-Year Intermediate Female Students

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Abstract

The importance of this research lies in designing an educational program based on the cognitive load strategy using artificial intelligence (AI) to teach the skill of spiking in volleyball to female students. The aim is to make the learning process more beneficial and objective, enhancing skill performance in volleyball. The emergence of modern theories, strategies, and the AI revolution has brought about a fundamental transformation across various fields, becoming a turning point in teaching both practical and theoretical subjects. This is particularly relevant to deep learning in fundamental volleyball skills. Through discussions with subject professors about teaching methods, the researchers observed a weakness in learning the spiking skill in volleyball. Therefore, they proposed developing an educational program based on the cognitive load strategy with AI to help female students accurately learn this skill. The research aims to examine the impact of an educational program using the cognitive load strategy with AI on spiking performance. By exposing students to new experiences, they can better grasp new skills while reducing mental fatigue during learning and execution. This approach involves analyzing tasks, simplifying them, and breaking down complex aspects into smaller steps using AI programs, enabling students to manage them more easily. Consequently, this facilitates a precise understanding of performance details according to the cognitive load strategy, ensuring an optimal learning process. The researchers adopted an experimental method using pre- and post-tests for both the experimental and control groups to suit the nature of the study. The research sample consisted of third-year students from Al-Yarmouk Secondary School for Girls in the 2024 academic year, with a total of 60 students. A comprehensive sampling technique was used, selecting 20 students for the study and six students for the pilot sample. The students were divided into two groups: an experimental group and a control group, with 10 students in each. The educational program, designed based on the cognitive load strategy with AI, was implemented over four weeks, with two instructional sessions per week. The researchers used the SPSS statistical package to analyze the data. The study concluded that the educational program based on the cognitive load strategy with AI had a positive impact on learning the spiking skill in volleyball among female students. and this achieves one of the sustainable development goals of the United Nations in Iraq which is (Quality Education)

Keywords: Educational program, Cognitive load strategy, Artificial intelligence, Volleyball

1. Introduction

S cientific advancement is considered the hallmark of this era, and scientific research represents one of its most significant characteristics. Driven by this, researchers strive to innovate and apply modern scientific methods and tools to achieve the primary objectives of physical education classes, ultimately obtaining optimal physical outcomes. In this context, reaching these objectives demands constant exploration and the application of novel scientific approaches. Consequently, students must actively engage in research and inquiry to meet their learning goals effectively and succeed academically. Volleyball

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is considered one of the most significant competitive sports, and as such, researchers have increasingly focused on systematically analyzing its technical, tactical, and physical aspects. Achieving peak performance in sports competitions requires the use of scientifically grounded educational programs, specifically designed to enhance athletes' motor skills and technical abilities. Such programs contribute effectively to developing and refining motor and skill capabilities, enabling athletes to attain their highest level of performance in various sports activities or specific skills. Consequently, volleyball training programs aim to comprehensively improve these capabilities, ensuring athletes achieve optimal competitive outcomes. The cognitive load strategy integrated with artificial intelligence emphasizes designing instructional processes that minimize cognitive overload for female students, thereby enhancing their comprehension and assimilation. This approach aligns with Zaitoun's assertion that cognitive load strategies effectively organize information and present it in a manner that simplifies challenging mental tasks for learners [7]. Moreover, this strategy necessitates utilizing previously acquired knowledge and concepts to solve problems, systematically reorganizing and critically revisiting information for deeper understanding Herein lies the significance of the research, which aims to investigate the impact of a cognitive load strategy integrated with artificial intelligence in teaching the spike skill, making the learning process more beneficial and objective in developing female students' volleyball performance skills. The fundamental goal of the educational process is to acquire essential volleyball skills by employing innovative methods that produce positive results in skill performance generally. This is achieved through simultaneously enhancing both technical and tactical performance, thus ensuring effective and impactful learning outcomes [3]. Consequently, most learning methodologies are based on selecting appropriate strategies to achieve the objectives each instructor strives toward. Therefore, integrating the cognitive load strategy with artificial intelligence can enhance learning and reduce cognitive fatigue by employing intelligent methods to teach volleyball skills within instructional units. This integration helps create a varied educational environment that places students at the center of the learning process, where volleyball skills are demonstrated on datashow screens utilizing artificial intelligence software.

Additionally, this approach enables students to express their ideas freely without limitations, fostering creativity and encouraging the development of innovative and applicable solutions. Moreover, it enhances interaction and hands-on learning within an open and stimulating educational environment. The research problem was identified through the researchers' direct observations and practical field experience, revealing notable deficiencies in students' mastery of the volleyball spike skill. The researchers sought to develop an educational program based on the cognitive load strategy integrated with artificial intelligence to enhance the learning of the volleyball spike skill among third-year intermediate female students. This program aims to provide precise skill acquisition while encouraging students to rely on themselves in executing the skill. Additionally, it seeks to enhance students' ability to consciously regulate their thought processes, unleashing their potential and fostering diverse ideas.

The approach requires shifting from merely acquiring information to constructing, processing, and transforming it into knowledge. This transition facilitates a structured framework for organizing skill-related information while strengthening connections, promoting interaction, and fostering collaborative learning. As a result, learners can clearly comprehend the intricate details of performance based on an ideal skill model, utilizing their inherent abilities and untapped potential.

The study aims to develop an educational program based on the cognitive load strategy integrated with artificial intelligence to facilitate the learning of the volleyball spike skill among third-year intermediate female students. Additionally, it seeks to examine the impact of physical exercises designed within this strategy on enhancing students' mastery of the volleyball spike skill. The research is conducted at Al-Yarmouk Secondary School for Girls during the 2024 academic year.

Temporal Scope: The study was conducted from October 31, 2024, to December 2, 2024, in the schoolyard of Al-Yarmouk Secondary School for Girls, located in the Al-Karkh I Education Directorate, Baghdad Governorate.

2. Methodology and procedures

The researchers adopted the experimental approach using a pretest-post-test design with two equivalent groups (experimental and control) to align with the nature of the study. The research population consisted of third-year intermediate female students at Al-Yarmouk Secondary School for Girls during the 2024 academic year, totalling 20 students. A comprehensive enumeration sampling method was employed, and the sample was divided equally into two groups: the experimental group and the control group, with 10 students in each.

2.1. Sample homogeneity and equivalence

Table 1 shows the homogeneity of the sample individuals, as the statistical analysis results revealed the following:

Table 1. Presents i	he	homogeneity o	f t	he resea	rch sample.
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Variables	Measurement Unit	Arithmetic Mean	Median	Standard Deviation	Skewness Coefficient
Height	m	163.51	162	5.68	0.80
Mass	Kg	62.83	64	4.23	-0.83
Age	Year	14.410	14.000	1.786	0.39

The skewness coefficient falls within the range of ± 1 , indicating that the population distribution is approximately normal.

Table 2. Presents the results of the pretests for volleyball skill assessments between the control and experimental groups.

	Experimental Group		Control Group				
Motor Abilities	Mean	SD	Mean	SD	Calculated t-value	Error Level	Statistical Significance
Spike Accuracy Skill Performance	6.43	0.76	6.95	0.84	0.89	2.07	Not Significant

Statistically significant at a significance level of ≤ 0.05 and under 18 degrees of freedom.

Height variable: The mean was (163.51), the median was (162), the standard deviation was (5.68), and the skewness coefficient was (0.80).

Body mass variable: The mean was (62.83), the median was (64), the standard deviation was (4.23), and the skewness coefficient was (-0.83).

Age variable: The mean was (14.410), the median was (14.000), the standard deviation was (1.786), and the skewness coefficient was (0.39).

Since the values of the skewness coefficients fall within the range of ± 1 for all variables, this indicates that the distribution of the population data is approximately normal.

Table 2 shows the results of the pre-tests for the volleyball skill tests under study. The mean score for the spike skill in the experimental group was (6.43) with a standard deviation of (0.76), while the mean score for the spike skill in the control group was (6.95) with a standard deviation of (0.84). The difference is statistically significant at a significance level of ≤ 0.05 and a degree of freedom of 18.

Data Collection Methods: Observation, tests and measurements, and Arabic and foreign sources and references.

Instruments and equipment used in the research:

- Data show projector
- Artificial intelligence software
- Standard volleyball court with required accessories
- 12 official volleyballs
- 2 Japanese-made Casio stopwatches
- 1 measuring tape
- 1 Dell laptop
- 1 electronic medical scale

2.2. Tests used in the research

First Test: Volleyball Spike Skill Test ([2], p. 104)

• Test Name: Accuracy Test for Cross-Court and Straight-Line Spike Attack

- Objective: To measure the accuracy of cross-court and straight-line spike attacks.
- Measurement Unit: Number of points.
- **Performance Description:** The tested player performs a spike attack from position [4] after receiving a set from the coach positioned at centre [3]. The player must execute five spike attempts in the cross-court direction and five in the straight-line direction.

Scoring method:

- 3 points for each successful spike landing directly on the designated target area.
- 2 points for each successful spike landing in Zone (A) for cross-court spikes or Zone (B) for straight-line spikes.
- 1 point for each successful spike landing near Zone (A) for cross-court spikes or Zone (B) for straight-line spikes.
- 0 points for any failed spike attempt.

2.3. Pilot study

The researchers conducted a pilot study on six students on Thursday, October 31, 2024, in the schoolyard of Al-Yarmouk Secondary School for Girls/ Baghdad Governorate/Al-Karkh First Education Directorate. The pilot study provided valuable insights for the researchers, allowing them to:

- Assess the functionality and suitability of the equipment and tools used in the study.
- Determine the time required to conduct the tests.
- Evaluate the effectiveness of the designed exercises based on the cognitive load strategy integrated with artificial intelligence for learning the volleyball spike skill.
- Identify potential challenges the researchers might face during the implementation of the main tests.

2.4. Pretests

The researchers conducted the pretests on Sunday, November 3, 2024, at 10:00 AM in the schoolyard of Al-Yarmouk Secondary School for Girls, Baghdad Governorate, Al-Karkh First Education Directorate.

Educational program:

- The implementation of the instructional units began on November 5, 2024, and concluded on November 28, 2024.
- The educational program lasted four weeks, with two instructional units per week, conducted on Tuesdays and Thursdays.
- Each instructional unit had a duration of 45 minutes.

The educational program lasted four weeks, with two instructional units per week on Tuesdays and Thursdays.

In the instructional phase, which lasted 10 minutes, the researchers:

- 1. Displayed sequential images using artificial intelligence software and projected them via a data show.
- 2. Explained the required conditions for correct skill execution through simplified and illustrative images.
- 3. Provided a simplified explanation of skill performance by displaying instructional images on the data show, ensuring students understood the technical aspects.
- 4. Divided students into two groups to practice the exercises demonstrated on the data show.

Practical Application of a Sample Instructional Unit (Duration: 20 minutes)

- 1. A drill for setting the ball for the spike skill while standing on a 5 cm platform with a partner.
- 2. A drill for setting the ball for the spike skill while standing on a 5 cm platform near the net.
- 3. A drill for setting the ball for the spike skill while jumping from a 5 cm platform near the net.
- 4. A drill for setting the ball for the spike skill while jumping near the net.
- 2.5. Post-tests

The post tests were conducted on Monday, December 2, 2024, at 10:00 AM in the schoolyard of Al-Yarmouk Secondary School for Girls, Baghdad Governorate, Al-Karkh First Education Directorate. The researchers ensured that the testing conditions were identical to those of the pretests in terms of time, location, equipment, and testing procedures.

3. Results

Presentation and analysis of the differences between the research groups (experimental – control) for the variables under study.

Presentation, analysis, and discussion of the pretest and post-test results for volleyball skill assessments in the experimental group.

Presentation, Analysis, and Discussion of Pretest and Posttest Results for Volleyball Skill Assessments in the Control Group

Presentation, Analysis, and Discussion of Post-test Results for Volleyball Skill Assessments in the Control and Experimental Groups

Table 3. Displays the pretest and post-test results for the experimental group in the volleyball skill assessments under study.

	Pre-test		Post-test				
Physical Variables	Mean SD		Mean SD		Calculated t-value	Error Level	Statistical Significance
Spike Skill	6.43	2.67	11.84 267		6.89	0.000	Significant
				6 .0.0	E	- 6 6	
Statistically significa	ant at a si	ignifica	nce level	of ≤ 0.0	5 and under 9 degrees	or freedom.	
Statistically signification Table 4. Presents the p	ant at a si pretest and	ignifica 1 post-te	nce level est results j	of ≤0.0 for the c	ontrol group in the volle	ryball skill assess	sments.
Statistically significa Table 4. Presents the p	ant at a si pretest and Pre-test	ignifica 1 post-te	nce level est results j Post-tes	of ≤0.0 for the c	ontrol group in the volle	ryball skill assess	sments.
Statistically significa Table 4. Presents the p Physical Variables	ant at a si pretest and Pre-test Mean	ignificat 1 post-te t SD	nce level est results j Post-tee Mean	of ≤ 0.0 for the c st SD	ontrol group in the volle Calculated t-value	error Level	sments. Statistical Significanc

Table 5. Presents the post-test results for the volleyball skill assessments under study, comparing the control and experimental groups.

	Experimental Group		Control Group				
Physical Variables	Mean	SD	Mean	SD	Calculated t-value	Error Level	Statistical Significance
Spike Skill	11.84	1.22	9.64	1.73	5.18	0.001	Significant
0			6 0.05	1 1	40.1 ((1		

Statistically significant at a significance level of ≤ 0.05 and under 18 degrees of freedom.

4. Discussion

The pretest and post-test tables for the research variables in the study sample indicate the presence of significant differences in the post-test results, favouring the experimental group. The researchers attribute this improvement in skill performance to the effectiveness of instruction based on the cognitive load strategy integrated with artificial intelligence. This teaching approach captured students' attention and enhanced their focus, as it introduced a novel instructional method that actively engaged them in the learning process.

By utilizing interactive images, visual diagrams, and knowledge encoding into single-symbol representations, this strategy facilitated better information retention and retrieval, allowing students to store knowledge efficiently in their memory and recall it during skill execution. This aligns with Shaffer's perspective, which emphasizes that memorythrough encoding and retrieval processes-serves as the foundation for most thinking and learning activities. Memory plays a fundamental role in the learning process, as learning situations aim to establish connections between new ideas and previously encountered educational experiences [6]. Additionally, learning progresses from familiar to unfamiliar responses, allowing for the assessment of students' skill levels based on their reactions. Consequently, instructional programs should be diversified to accommodate the specific needs of each learner. Mastering skills ensures achieving optimal results while minimizing effort to produce positive outcomes. Therefore, designing instructional units as part of teaching the spike skill is essential in helping players score points and successfully complete attacks, making proficiency in this skill crucial for game strategies [8]. Offensive superiority enhances players' technical understanding of the game by improving coordination between the arms, legs, and torso. Learning this skill also aids in understanding spatial positioning and proper timing for execution. As a double-edged weapon, mastering the spike is a key factor in securing victory during a match [4]. This aligns with what Nihad, citing Abdul-Fattah, affirmed-that a well-structured educational plan enhances learning, as learning is the process through which skills or abilities are acquired, whether through experience or practice [5]. Similarly, Dunya and Naima emphasized that knowledge consists of a set of decisions based on information; therefore, a student with knowledge understands how to apply it in the skill-based aspect [1]. Moreover, simplified and precise learning contributes to a broader understanding, facilitating the acquisition of essential knowledge and information [6].

5. Conclusions

- The educational program based on the cognitive load strategy integrated with artificial intelligence had a positive impact on learning the volleyball spike skill among female students.
- The results demonstrated a significant improvement between the pre-test and post-test measurements, favouring the post-test, for the experimental group that followed the cognitive load strategy with artificial intelligence in learning the volleyball spike skill among third-year intermediate students.
- The teaching method adopted by the subject instructor had a positive effect on students' learning of the volleyball spike skill.
- The group that utilized the educational program based on the cognitive load strategy with artificial intelligence outperformed the group that followed the instructor's traditional teaching method.

6. Recommendations

- Emphasizing the importance of educational programs that focus on cognitive load and the use of artificial intelligence to enhance students' cognitive structures while learning the volleyball spike skill, as this contributes to improving athletic performance.
- Encouraging the conduction of similar studies on female students or in other academic subjects related to physical education and sports sciences.
- Highlighting the necessity of conducting studies on different samples and age groups to further explore the effectiveness of such educational strategies.

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/2024).

Author's contributions

All contributions of this study were done by the researchers (D.S. and S.J) who get the main idea and work on writing and concluding also with number of experts, Dania Salman in Statistics, Khitam Mousa in revision, Nibal in translating, Batoul Ahmed Salim in proofreading.

Facilitate the task: this study was supported by 20 female students at Al-Yarmouk Secondary School for Girls.

References

- Dunya Asaad Aboud, & Naima Khalaf Zidan. (2020). Cognitive skill attainment and its relationship to the skill of crushing volleyball among students of the fourth stage of the College of Physical Education and Sports Sciences for Girls. *Modern Sport*, 19(4), 0147. https://doi.org/10.54702/msj.2020.19.4.0147
- Hussein Subhan Sakhi. (2006). A Training Methodology for Developing Time and Accuracy of Prediction and Motor Response, and its Impact on the Accuracy of Some Basic Skills of Volleyball Players, PhD thesis, College of Education, University of Baghdad, p. 104.
- Tamara Ahmed Yas, & Mawahib Hameed Numan. (2020). Processing information and its relationship to the performance of the skills of preparation and receiving the serve in

volleyball for female students. *Modern Sport*, 19(1), 0127–0139. https://doi.org/10.54702/msj.2020.19.1.0127.

- 4. Nahida Abd Zaid. (1997). The level of performance of defensive and offensive skills and its relationship to the ranking of teams in volleyball, Master's thesis, College of Physical Education, University of Baghdad.
- 5. Nihad Alwan. (2010). The Impact of Concept Mapping Strategies on Learning Some Types of Volleyball Serving. *Journal of the College of Basic Education.*
- 6. Zina Hassan, & Najlaa Abbas. (2020). The effect of using the bubble mental map on learning the skills of preparation and receiving transmissions in female students' volleyball. *Modern Sport*, 19(4), 0049. https://doi.org/10.54702/msj.2020.19.4. 0049.
- 7. Zaitoun, Ayesh Mahmoud. (2007). The Constructivist Theory and Science Teaching Strategies. Dar Al-Shorouk for Distribution, Amman.
- Safa Abdul-Kareem Sadiq, & Najlaa Abbas Nseif. (2022). The relationship of three-dimensional intelligence to cognitive achievements in the subject of teaching methods. *Modern Sport*, 21(4), 0001. https://doi.org/10.54702/ms.2022.21.4.0001.

A. Appendix

Week One

Selected Model for an Instructional Unit

Objective: Teach	ing the vo	lleyball spike skill		Number of Participants: 10 players		
Unit Sections	Time	Activity or Motor Skill	Repetitions	Exercise Duration	Notes	
Preparatory Section	10 min	General body warm-up with specialized volleyball exercises			-Emphasizing attendance , organized positioning , and maintaining appropriate spacing between students, while ensuring the correct execution of physical exercises.	
Main Section	30 min				-Implementing the cognitive load strategy with artificial intelligence by displaying images on the data show through AI software, breaking down the skill into simplified segments.	
Instructional Component	10 min	 Skill Specifications Required Conditions for Correct Execution Explanation of Skill Performance Demonstration 			-Presenting exercises on the data show for peer evaluation and providing immediate feedback .	
Practical Component	20 min	• Drill for setting the ball for the spike skill while standing on a 5 cm platform with a partner.	(5) times	5 min		
		• Drill for setting the ball for the spike skill while standing on a 5 cm platform near the net.	(5) times	5 min		
		• Drill for setting the ball for the spike skill while jumping from a 5 cm platform near the net.	(5) times	5 min		
		 Drill for setting the ball for the spike skill while jumping near the net. 	(5) times	5 min		
Concluding Section	5 min	Cool-down and relaxation exercises.				
Instructional Component Practical Component	30 min 10 min 20 min 5 min	 Skill Specifications Required Conditions for Correct Execution Explanation of Skill Performance Demonstration Drill for setting the ball for the spike skill while standing on a 5 cm platform with a partner. Drill for setting the ball for the spike skill while standing on a 5 cm platform near the net. Drill for setting the ball for the spike skill while jumping from a 5 cm platform near the net. Drill for setting the ball for the spike skill while jumping from a 5 cm platform near the net. Drill for setting the ball for the spike skill while jumping near the net. 	 (5) times (5) times (5) times 	5 min 5 min 5 min 5 min	 Implementing the cognitive load strategy with artificial intelligence by displaying images on the data show through AI software, breakin down the skill into simplified segments. Presenting exercises on the data sho for peer evaluation and providing immediate feedback. 	

Day and Date: Tuesday, November 5, 2024

Duration of the Instructional Unit: 45 minutes.