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The effect of inquiry-based learning style in learning the skill of front rolling in artistic gymnastics for second-stage students in the Faculty of Physical Education and Sports Sciences according to their double coding

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Abstract

The research aims to identify the effect of employing the method of learning based on inquiries in educational exercises to learn the anterior skill in opening the technical gymnasium, and to know the effect of the method of learning based on inquiries in learning the anterior skill of opening in the artistic gymnasium for students of the second stage in the Faculty of Physical Education and Sports Sciences on According to their double coding, the experimental curriculum was adopted by the experimental design with the two experimental groups and the operational control (2 x 3) on a sample of (79) students who were traditionally chosen by (88.764%) of their community of originally (89) students represented by the students of the second stage in the College of Physical Education and Science Sports at the University of (Kirkuk) is continuing with the official urban development in the morning study for the academic year (2023/2024) for the first semester, Then they divided into implicit groups (6) within these two groups according to their double coding, and after identifying the skill test and preparing educational exercises for this experimenting method by applying tribal tests on Tuesday corresponding to the date (11/14/2023), and ended on Wednesday, the date of date (11/30/2023), the application (4) included educational units for this skill over two consecutive weeks, and then the grades were collected and statistically addressed with the SPSS system, and the conclusions were that it is possible to apply the vocabulary of the learning method based on inquiries in the lessons of physical education The volleyball operation for the second stage in the College of Physical Education and Sports Science, And that the application of the method of learning based on inquiries helps in learning the skill of the anterior argument in opening with the technical gymnastics among students of the second stage in the College of

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Physical Education and Sports Sciences more suitable for people with dual coding, followed by those with graphic coding, followed by verbal coding, and excels to learn it with students who study without them, It is necessary to focus on the practical applications of the methods of stimulating students learning to inquire more than the explanations and guidance in the educational units of the technical gymnastics to increase students 'empowerment to practice and apply based on the discovery of knowledge with performance.

Keywords: inquiries -based learning, anterior rolling in artistic gymnasium, double coding.

Introduction:

Consideration of individual differences among students in the cognitive characteristics supporting skill performance in artistic gymnastics is a paramount concern for researchers, thus making it one of the primary priorities in motor learning. This is because cognitive processes are primarily responsible for constructing the knowledge-based motor program relevant to the desired skill. This motor program inherently relies on the information received by the learner and its alignment with the required skill model. (Ahmed Muhammad AbdulkhaliqAlhasan, 2024)Additionally, the process of storing information in motor memory is subject to individual differences among learners and varies based on their individual characteristics. Some students prefer to encode information about performance visually,(Abdulhussein et al., 2024) while others lean towards symbolic encoding, and there are also those who use both methods in a dual fashion, aiming to facilitate retrieval in educational settings when applying those artistic gymnastics skill performance. It's worth noting that the requirements for performing artistic gymnastics skills are no less significant than the requirements for other games or activities. Students in physical education and sports science faculties need to achieve a commendable level of learning in each,(Kadhim, 2024b) which is simultaneously influenced by the cognitive and knowledge-related phenomena or factors when applying this performance. Considering that the learning process is individualistic,(Kadhim, 2024a) it must be organized according to each learner's characteristics, thereby becoming a constant and accepted notion that they should be prepared to meet those requirements. Consequently, this places a responsibility on academic researchers to support college students with the findings of studies that deal with numerical language, devoid of speculations or unexplored conclusions,(Kadhim et al., 2021) in accordance with the scientific research methodology. Furthermore, teachers employ various strategies in education to develop critical thinking skills, such as focusing on memory activation strategies, deep cognitive processing of information, and increasing cognitive capacity and speed during learning (Al-Taib, 2006, p. 41). In the inquiry-based learning approach, teachers are required to pose questions with multiple answers to students or answers close

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to each other (Al-Otoum et al., 2011, p. 242). In addition, in inquiry-based learning, students work in pairs or small groups to answer a question or a series of questions using shared perception, experience, and prior learning.(Easa et al., 2022) All students can be given the same questions or different questions on the same topic, and it is essential to link the questions to the main points of the skill and the objectives of the instructional unit, avoiding intimidation or belittlement and ensuring fairness in assessment and encouraging self-reflection (Inquiry-based learning). There is an old proverb that says, "I hear, and I forget; I see, and I remember; I do,(Farhan et al., 2016) and I understand." The latter part of this phrase is the essence of inquiry-based learning, which involves participation leading to understanding (Badawi, 2010, p. 309). Questions should be consecutive to facilitate learners' identification of skill components sequentially. They should be based on assumptions, providing reasons and evaluations for answers to foster creative thinking. Teachers must possess the skills to pose these questions in a way that is neither dull nor overly complex,(Mahmood & Kadhim, 2023) misleading, vague, or unproductive. They should be balanced in terms of branching or aggregation, considering their age and being able to control the lesson time, with the teacher allowing the largest number of learners to participate, whether voluntarily or not, and this is considered one of the direct learning methods (Khamis et al., 2009, p. 414) Accessing the knowledge domains of any technical skill performance requires meticulous attention to its details and specifics.(Mousa & Kadhim, 2023) Moreover, understanding learners' knowledge of these details and specifics necessitates inquiry to organize them according to their sequence in performance or their importance to facilitate encoding in the brain in a manner controlled by the individual differences among learners, thus facilitating retrieval during application.(Kazim et al., 2019) One of the most important needs for teachers of artistic gymnastics when assessing skill performance on the gymnastics floor for students is measurement with a suitable tool tailored to the specificity of the sample for this cognitive self-regulation, considering it as one of the important characteristics to support this performance.(Kadhim, 2023) Through repeated visits by the two researchers to artistic gymnastics lessons at their college at the University of Kirkuk and discussions with the teachers conducting the lessons, they noticed that many phenomena require accurate description to address the low level of performance for some skills on the gymnastics floor among students.(Salman et al., 2022) This was an initial observation by the researchers to diagnose this weakness in them. However, (Yaroub et al., 2024) it came from these discussions without measuring cognitive self-regulation or measuring the skills that showed variation in the level of students' weakness in their performance. This is considered one of the problems that require finding solutions, especially in these sports educational environment that produces outputs serving various sports formations.(Sikhe & Yasir, 2020) Upon reviewing several relevant specialized studies, the researchers observed a need to first consider individual differences in learners' cognitive characteristics in encoding knowledge about performance. Seeking to diagnose and experiment with one of the learning methods, which

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is inquiry-based learning, on these students to contribute to helping them overcome the obstacles to their skill learning in artistic gymnastics. The following two studies addressed the researched variables: Husseinawi's study (2013) titled: "The Effect of Inquiry-based and Directed Discovery Learning Styles on Learning Some Basic Skills in Volleyball." The aim of the study was to identify the effect of using the inquiry-based and directed discovery learning styles in an educational curriculum and to determine their impact on learning some basic skills in volleyball.(kanger Hamdan & Sukny, 2017) The study adopted the experimental method with the design of two experimental groups and one control group with pre- and post-tests. The study sample consisted of 33 female students from the second stage in the Department of Physical Education at the College of Basic Education, Al-Mustansiriya University,(Abed et al., 2022) divided into three groups (two experimental and one control), each experimental group subjected to an experimental variable. (Nashwan & Alzoubi, 2022)The most important conclusions were a clear improvement in learning among all three research groups (the two experimental groups and the control group) in some basic volleyball skills (serving, receiving, spiking), with the first experimental group (inquiry-based learning style) outperforming the second experimental group (directed discovery learning style) and the control group in learning these skills. The second study, conducted by Abdullah and Al-Shikhli (2020), titled: "Dual Coding and its Contribution to Learning the Skill of Setting in Volleyball among Fifth Grade Preparatory School Female Students." The aim of the study was to identify the level of learning the skill of setting in volleyball, determine the level and type of dual coding (visual-verbal) among fifth-grade preparatory school female students, and identify the type of dual coding and its contribution to learning the skill of setting in volleyball for them.(Nashwan, 2024) The study methodology adopted the descriptive research method with a correlational relationship approach of the regression type on a sample of 30 female students selected deliberately at a rate of 45.545% from their total population of 55 students, representing fifth-grade preparatory students at Al-Mustaqbal Girls' Preparatory School. The most important conclusions were that skill learning in volleyball is more effective when visual information is provided more than verbal information. Dual coding relies on the model and explanation presented in physical education classes, and skill learning in volleyball is affected by what is encoded in the learners' minds, which is evident in their actual performance. It is possible to predict learning the skill of setting through the numerical values of the type of coding they possess.(Mondher et al., 2023)

Thus, the importance of the research is evident in the necessity to follow practical procedures for inquiries about skill performance that are not exaggerated, considering the determinants of active learning that align with the nature and requirements of the front somersault skill in artistic gymnastics. Therefore, the significance of the research lies in two theoretical and practical directions. The theoretical significance is that it may benefit teachers of artistic gymnastics in improving the required learning outcomes for students by considering the individual characteristics of each learner according to their dual coding.

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The practical significance is that it may benefit second-year students in the College of Physical Education and Sports Sciences in improving the front somersault skill in artistic gymnastics, aiming to identify the impact of employing the inquiry-based learning style in instructional exercises for learning the front somersault skill in artistic gymnastics and understanding the effect of the inquiry-based learning style on learning the front somersault skill in artistic gymnastics for second-year students in the College of Physical Education and Sports Sciences according to their dual coding. Thus, the researchers assume that there are statistically significant differences between the results of learning the front somersault skill in artistic gymnastics for the pre-test and post-test of the experimental and control groups according to their dual coding. Moreover, there are statistically significant differences between the results of the front somersault skill tests in artistic gymnastics for the post-test of the experimental and control groups according to their dual coding.

Method and Tools:

The experimental research method was adopted according to the current research problem's requirements. Additionally, the classification of the main application sample according to their dual coding for the classification variable (visual, verbal, dual) and the independent research variable represented by the inquiry-based learning style were taken into account to solve the current research problem. The experimental factorial design with two experimental and control groups (2×3) was chosen, where students in the experimental research groups are subjected to the inquiry-based learning style according to their coding type. Conversely, the control groups, corresponding to the experimental groups, follow the conventional teaching method in their artistic gymnastics lesson. This is illustrated in Table (1).

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Table (1) illustrates the experimental research design:

Two Groups According to Dual Coding		The Six Groups	Pre-Test Measurement	Variable	Post-Test Measurement
Experimental	Dual	Exp (1) Dual	Tests for the Skill of Forward Roll in Artistic Gymnastics	Tests for the Skill of Forward Roll in Artistic Gymnastics	Inquiry-Based Learning Style (Experimental)
	Visual	Exp (2) Visual			
	Verbal	Exp (3) Verbal			
Control	Dual	Ctrl (1) Dual		The Method Followed in the Lesson (Non-Experimental)	
	Visual	Ctrl (2) Visual			
	Verbal	Ctrl (3) Verbal			

The experimental design serves as a roadmap for researchers to complete research procedures under controlled conditions, ensuring internal and external validity through methodological and statistical procedures. This design allows for the verification of research hypotheses and the implementation of independent variables (experimental) and the application of tests and measurements without grade inflation. Additionally, it provides a clear framework for the researcher to adhere to.

The population of this research is defined as second-year students in the College of Physical Education and Sports Sciences at the University of Kirkuk who attend regular morning classes for the academic year (2023/2024) during the first semester, totaling 89 students. These students are distributed across two classes (A) and (B), with 79 students randomly selected, representing 88.764% of the total population, to constitute the primary research sample for the application. Following the specifications of the experimental design mentioned previously, one of the classes (B) was randomly chosen to be the experimental group (39 students), while class (A) served

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as the control group (40 students). Additionally, a survey sample of 10 students, representing 11.236% of the original population, was selected from each class. The numerical distribution within each group of the main experimental and control groups is outlined in Table (2).

These specifications adhere to the current research's requirements for classifying the primary research sample based on their dual coding classification (double, pictorial, verbal) to account for individual differences among students in both the experimental and control groups. The Dual Discrimination Scale was applied to them, developed by Al-Aboudi (2019, p.114), to assess the specificity of kinesthetic learning in physical education and sports science. This scale comprises 36 items distributed across two domains: visual domain (18 items) and verbal domain (18 items). Students were classified based on their scores on this scale, with the highest score in either domain determining their coding type. In cases of equal scores across domains, students were classified as having dual coding. This application resulted in their numerical distribution within each group of the main experimental and control groups, as illustrated in Table (2).

Table (2) illustrates the numerical distribution of the research population and its samples:

<table>
<tr><th rowspan="2">Classification of Students According to Dual Coding</th><th colspan="2">Section (B) with Inquiry-Based Learning Style</th><th colspan="2">Section (A) with the Method Followed in the Lesson</th><th rowspan="2">Total Students in the Main Application Sample</th><th colspan="2">Exploratory Sample</th></tr>
<tr><td>Experimental Group</td><td>Number</td><td>Control Group</td><td>Number</td><td>Class</td><td>Number</td></tr>
<tr><td>Dual</td><td>Experimental (1) Dual</td><td>10</td><td>Control (1) Dual</td><td>13</td><td>23</td><td rowspan="2">Class (A)</td><td rowspan="2">5</td></tr>
<tr><td>Visual</td><td>Experimental (2) Visual</td><td>15</td><td>Control (2) Visual</td><td>12</td><td>27</td></tr>
<tr><td>Verbal</td><td>Experimental (3) Verbal</td><td>14</td><td>Control (3) Verbal</td><td>15</td><td>29</td><td rowspan="2">Class (A)</td><td rowspan="2">5</td></tr>
<tr><td>Total</td><td>3</td><td>39</td><td>3</td><td>40</td><td>79</td><td colspan="2">10</td></tr>
<tr><td colspan="5">Percentage</td><td>88.764%</td><td colspan="2">11.236%</td></tr>
</table>

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The experimental design necessitates maintaining internal validity by controlling for extraneous variables, the non-uniformity of which in statistically homogenous values might lead to negative biases in the results of research experimentation. Thus, the researcher ensured the homogeneity of the total primary research sample in some anthropometric variables.

Table (3) demonstrates the homogeneity of the primary research sample students in some extraneous variables:

Internal Variables on the Experimental Design and Their Unit of Measurement		Number	Mean	Standard Deviation	Torsion coefficient	Coefficient of Variation
Anthropometric	Age (months)	79	242.85	2.455	0.377	% 1.011
	Total Body Height (cm)	79	170.15	1.888	-0.541	% 1.11
	Weight - Body Mass (kg)	79	72	1.702	0.56	% 2.363

The normal distribution is accepted with a skewness coefficient of up to (+1), and the acceptance criterion for the variation coefficient is less than (%39). Skill assessment tests were adopted from: (Journal of the Iraqi Central Gymnastics Union, 2023, pp. 7-8).

- ✓ Performance Assessment: The technical performance grade of the students is evaluated by (4) judges, with the highest and lowest scores from the judges being discarded, and the remaining two scores are aggregated, then divided by (2), to obtain the final score in technical performance, measured in points.
- ✓
- ✓ The evaluation of technical performance in gymnastics is rated on a scale of (10) points. This evaluation is conducted by recording the students' performance using a video camera, storing the footage on a compact disc, and presenting it to (4) judges, as detailed below along with the pretests.
- ✓

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- ✓ Prior to preparing the instructional exercises in the inquiry-based learning style, the researchers undertook the following preparatory steps:
- ✓
- ✓ -Direct observation of the type of instructional exercises and methods followed by the teacher in teaching the students in the relevant lessons at the college.
- ✓ -Review of various specialized academic and scientific sources on motor learning methods in artistic gymnastics.
- ✓ -Consultation with a group of experts on models of some instructional exercises in the proposed inquiry-based learning style to be applied in practical lessons. These instructional exercises were developed by the researchers with minor modifications.
- ✓
- ✓ Vocabulary related to the inquiry-based learning style was applied to the students of the experimental group in the first semester of the academic year (2023-2024), in the artistic gymnastics lesson for this skill on the gymnastics mat apparatus. The instructional unit in the inquiry-based learning style was included in the practical lesson plan at the college, as follows:
- ✓
- ✓ -Total time for the instructional unit: (90) minutes divided into the preparatory section (10) minutes, main section (70) minutes with an educational aspect (10) minutes, application aspect (60) minutes by reducing the educational aspect time to align with the inquiry-based learning style, and concluding section (10) minutes.
- ✓ -The educational aspect, which lasts (10) minutes, will involve a brief explanation and demonstration of the specific skill in the instructional unit according to the predetermined criteria.
- ✓ -The application aspect, lasting (60) minutes, will include the application of the instructional unit exercises using the inquiry-based learning style and its steps in the practical lesson. The teacher will:

☼ -The teacher prepares a variety of questions related to the technical movements of the specific skill in artistic gymnastics and places them in the notes column of each instructional unit plan.

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These questions will intersperse the students' application of each section of the skill and its components.

- -The content of the instructional exercises includes sequential performance movements according to the skill sections, incorporating activities that allow for discussion, inquiry, discovery, and experimental application, followed by inquiry-feedback-comparison-analysis-processing-retrial several times for the same instructional exercise before moving on to the next exercise.
- -The teacher asks students to answer these questions with a logical explanation based on analysis and synthesis after directing the questions to them collectively or individually for each student. Their answers must be given within a specified time of less than (6) seconds per question. If a student fails to answer correctly, the teacher provides the correct answer to avoid disrupting the time allocated for the practical aspect of the instructional unit.
- -The teacher evaluates each student's answer positively for correct responses and corrects any incorrect answers using an approach that avoids coercive learning, encourages understanding, and provides immediate feedback and correction after performance, considering the specificity of fast gymnastics skills in their execution.
- -Examples of questions about artistic gymnastics skills (in the preparatory or initial position for the skill: What is the foot position? Why this position? What is the trunk position? And why this position? Where should the focus be in each of the preparatory, main, and concluding sections of the skill? And why? What is the elbow joint position? And why? How do we control the speed of performance? How do we achieve optimal performance? Why is the overall performance of the skill in this way... and other logically sequenced questions that are not overly difficult for the learner).
    - -The researchers will not intervene in the details of the preparatory and concluding sections, leaving them to the teacher. - In one academic week, two instructional units are implemented on Sundays and Tuesdays in the practical physical education lessons in artistic gymnastics, according to the weekly schedule allocated for the second stage in the college to learn the specific skill performance. The skill session consists of 4 instructional units.
    - -The allocated time for learning the skill is 2 weeks.

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- -The researchers prepared a total of 12 instructional exercises for learning the skill, distributed in each unit from 3 to 4 exercises, taking into account the number of students, the main section time of the lesson, and the type of skill. Some exercises are repeated in different instructional units.
- -The physical education teachers themselves adopted the application of instructional exercises using the inquiry-based learning method. The role of the researchers was to supervise and monitor the lessons for the students in the experimental group, while the control group students followed the conventional teaching methods in the lesson.
- -The experiment began with the application of pre-tests on Tuesday, November 14, 2023, and ended on Wednesday, November 30, 2023.
- -The results were processed using the Statistical Package for the Social Sciences (SPSS) version (V26) to automatically process the data by finding the following values: percentage, mean, standard deviation, difference coefficient, Pearson correlation coefficient, correlated samples t-test, one-way analysis of variance (ANOVA) F-test, and least significant difference (LSD) test.

Results:

Table (4) shows the results of the pre-tests between the experimental and control research groups.

Test	(Levene)	(Sig)	Source of Variation	Sum of Squares	Degrees of Freedom	Mean Squares	(F)	(Sig)	Significance of Difference
Open Forward Roll	1.608	0.169	Between Groups	4.389	5	0.878	0.44	0.819	Not Significant
			Within Groups	145.56	73	1.994			

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Unit of Measurement	Group and Numbers	Comparison	Mean	Standard Deviation	Mean Differences	Variance deviation	(t)	(Sig)	Significance of Differences
(Degree)	Experimental First Dual (10)	Pre-test	2.1	1.449	6.8	1.476	14.571	0.000	Significant
		Post-test	8.9	0.568					
	Experimental Second Visual (15)	Pre-test	1.93	1.033	6.067	1.58	14.874	0.000	Significant
		Post-test	8	0.845					
	Experimental Third Verbal (14)	Pre-test	2	1.177	5.143	1.61	11.949	0.000	Significant
		Post-test	7.14	1.027					
	Control First Dual (13)	Pre-test	2.38	1.758	3.308	2.287	5.215	0.000	Significant
		Post-test	5.69	0.855					
	Control Second Visual (12)	Pre-test	1.58	1.311	3.75	1.485	8.749	0.000	Significant
		Post-test	5.33	1.155					
	Control Third Verbal (15)	Pre-test	1.87	1.642	3.067	2.12	5.602	0.000	Significant
		Post-test	4.93	1.163					

Statistical difference is considered not significant when the (Sig) value is greater than (0.05) at a significance level of (0.05), given a total sample size of (79).

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Table (5) shows the results of the pre- and post-differences for the six experimental and control research groups

The statistical difference is significant for each group at the significance level (0.05) and the degree of freedom (n)-(1) when (Sig) > (0.05).

Skill	Source of Variation	Sum of Squares	Degrees of Freedom	Mean Squares	(F)	(Sig)	Significance of Difference
Open Forward Roll	Between Groups	158.054	5	31.611	33.451	0.000	Significant
	Within Groups	68.984	73	0.945			

Table (6) shows the results of the differences in the posttests of the forward rolling skill

* The statistical difference is significant when (Sig) > (0.05) at a significance level of (0.05).

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Table (7) shows the results of the LSD test for post-hoc comparisons between the six experimental and control groups

Comparison	Mean Differences	(Sig)	Statistical Significance	Interpretation
Experimental Dual - Experimental Visual	0.9*	0.026	Statistically Significant	Significant in favor of Experimental Dual Group
Experimental Dual - Experimental Verbal	1.757*	0.000	Statistically Significant	Significant in favor of Experimental Dual Group
Experimental Dual - Control Dual	3.208*	0.000	Statistically Significant	Significant in favor of Experimental Dual Group
Experimental Dual - Control Visual	3.567*	0.000	Statistically Significant	Significant in favor of Experimental Dual Group
Experimental Dual - Control Verbal	3.967*	0.000	Statistically Significant	Significant in favor of Experimental Dual Group
Experimental Visual - Experimental Verbal	0.857*	0.020	Statistically Significant	Significant in favor of Experimental Visual Group
Experimental Visual - Control Dual	2.308*	0.000	Statistically Significant	Significant in favor of Experimental Visual Group
Experimental Visual - Control Visual	2.667*	0.000	Statistically Significant	Significant in favor of Experimental Visual Group
Experimental Visual - Control Verbal	3.067*	0.000	Statistically Significant	Significant in favor of Experimental Visual Group

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Experimental Verbal - Control Dual	1.451*	0.000	Statistically Significant	Significant in favor of Experimental Verbal Group
Experimental Verbal - Control Visual	1.81*	0.000	Statistically Significant	Significant in favor of Experimental Verbal Group
Experimental Verbal - Control Verbal	2.21*	0.000	Statistically Significant	Significant in favor of Experimental Verbal Group
Control Dual - Control Visual	0.359	0.359	Not Significant	Not statistically significant
Control Dual - Control Verbal	0.759*	0.043	Statistically Significant	Significant in favor of Control Dual Group
Control Visual - Control Verbal	0.4	0.292	Not Significant	Not statistically significant

* The statistical difference is significant when (Sig) > (0.05) at a significance level of (0.05).

The discussion

Revealed that the results presented in Table (5) indicate an improvement in the learning of the forward roll skill in artistic gymnastics among students in both the experimental and control groups in the post-tests compared to their performance in the pre-tests. Additionally, the statistical differences in this improvement were demonstrated in Table (6), which showed less significant differences in Table (7) based on the type of classification for each group between these two groups. The students in the experimental group, particularly those who received instruction through inquiry-based learning, exhibited superior performance. Notably, the first experimental group (dual coding) outperformed the other groups, followed by the second experimental group (pictorial coding) and then the third experimental group (verbal coding).

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The researchers attributed these results to the positive impact of this instructional method and its suitability with the characteristics of students, especially those with dual coding, who benefited from forming connections between questions and answers by recalling previous experiences in observing and explaining the model. This assistance facilitated the superiority of the first experimental group (dual coding) by enabling them to perform practical applications through educational exercises, which helped increase their ability to touch the gymnastics mat with their entire bodies and provide logical explanations for their movements according to the skill sections .

The researchers also emphasized the importance of repetitive practice in the educational units, which positively influenced skill learning and enabled learners to comprehend the significance of specific movements, such as the positioning of the feet. This method particularly benefited students with pictorial and verbal coding, as the vocabulary used in the instructional material contained logical sequences in explanation and presentation. Furthermore, the nature of the educational exercise applications progressed from simple to complex and from easy to difficult, enhancing students' understanding and utilization of knowledge in activating their roles in these educational units. This was evident through their repeated attempts to reach the presented model and their efforts to comprehend and internalize the detailed technical knowledge associated with this specific performance.

The characteristics of active learning environments enable learners to become proactive, interact with peers, and express themselves with a considerable degree of freedom, thereby shifting the focus of the educational process from the teacher to the learner. Active learning environments are characterized by being rich in diverse sources of information, providing opportunities for questioning and clarification, fostering a spirit of cooperation and positive participation in work. Understanding performance requirements leads to learners easily grasping the elements of motor skills. Teachers can capitalize on learners' curiosity and motivations, guiding them towards planned educational situations that they willingly engage in, driven by activity. Sustaining this activity until learning is achieved within a plan that precisely defines the objectives, stimulates learners' curiosity and motivations towards achieving specific goals, maintains interaction between learners and teachers, ensures learning occurs, and rigorously evaluates the objectives.

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According to information processing theory, learning is not merely a connection between stimulus and response but rather a product of a series of cognitive processes that mediate between receiving the stimulus and providing an appropriate response. Scholars and proponents of information processing theory focus not on external conditions but on the mind, which they view as an information processing system responsible for linking new knowledge to existing knowledge, organizing it, and making it meaningful.

Moreover, increased repetitive attempts to perform a skill consistently lead to enhanced control, mastery, and the attainment of automaticity in performance more rapidly. If the model is effective for the learner, they strive to achieve this motor behavior by recalling the model and comparing it with their own performance after each attempt. With increased repetition, this mental image transitions into a motor program, enabling the player to progress from the crude to the refined and then to the fixed stage.

The researchers attribute the emergence of these results among the experimental group students to their application of instructional exercises using inquiry-based learning, which had a positive impact on increasing students' awareness of body positions, especially in the continuous arm swing forward to reposition them behind the legs. Consequently, learners were able to assess what is required in terms of the ability to push the ground with their hands to reach the starting position for the skill of forward rolling in artistic gymnastics. The teachers' questions played a significant role in stimulating their learning motivation and enhancing their understanding of the necessary knowledge for each skill section and the anticipated abilities before performance. This ensured the success of movements and prevented wasted attempts in each repetition of instructional exercises. The functionality of this teaching method aims to support cognitive structures to meet performance requirements, in addition to its mentioned benefits. However, the role of practice and application remains the most effective in reducing common errors hindering proper performance and achieving the desired improvement in learning this skill.

Furthermore, drawing motor skill programs corresponds to drawing a program in the brain's cortex to control nerve impulses for motor capability output, matching the requirements of the specific skill performance program. This depends on the student's ability to translate information into a picture of motor skills and efficiency, which is linked to their

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self-efficacy and psychological and physical state. Active learning principles and foundations for teaching motor skills in sports encourage learners to answer questions, pose inquiries, engage all their senses, ensure an atmosphere of mutual respect and fun during learning, and involve learners in evaluating activities.

Moreover, an individual's skill level depends on three factors: the expectation of effort, the expectation of outcome performance, and the actual outcomes. A decrease in any of these factors will negatively impact one's expectations about skill performance.

Technical performance in gymnastics is related to qualitative assessment according to the regulations governing each gymnastics skill, highlighting the importance of developing and improving skills according to the motor task required for each skill.

The researchers also attribute the emergence of these results, showing improvement in learning the skill of forward rolling in artistic gymnastics among the control group students with dual coding, to their continued attendance of instructional exercises for this skill in their lessons and their comprehension of the vocabulary used in the lesson by their teacher. This has resulted in improvements in the researched mental factor that supports motor performance. It is evident that students with dual coding excel due to their characteristics that align with the presentation and explanation in learning. Similarly, students with visual coding excel due to their ability to easily encode images. Consequently, students with dual coding outperform those with verbal coding. These results underscore the necessity and importance of applying inquiry-based learning to consider these individual differences among students and its positive impact on improving learning this skill.

Individuals are influenced in learning and educational situations by their beliefs about knowledge and learning. Cognitive beliefs affect their judgments, self-learning, the goals they strive to achieve, the cognitive strategies they employ, the types of thinking they engage in, the meaning they derive from new information, and the decisions they make.

Conclusions and Recommendations

1 .It is possible to apply the vocabulary of inquiry-based learning in practical physical education lessons for volleyball in the second stage at the College of Physical Education and Sports Sciences.

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2 .The application of inquiry-based learning aids in learning the skill of forward rolling in gymnastics among second-stage students at the College of Physical Education and Sports Sciences, with those who have dual coding being the most suitable, followed by those with visual coding, outperforming those who do not follow this method.

3 .There is a necessity to focus on practical applications of inquiry-based learning methods more than explanatory and directive processes in gymnastics lessons to increase students' engagement and motivation for practice and application based on knowledge acquisition through performance.

4 .Enhancing the capabilities of gymnastics instructors and increasing their knowledge of inquiry-based learning methods should be prioritized according to the principles of motor skill learning.

Appendix (1) shows the double-coding scale as reported from its source

Item	Statements	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1	When listening to the teacher's explanation, I usually do not form a mental image of the skill being explained.					
2	I enjoy being able to rephrase my ideas in many different ways when writing about a skill.					
3	I enjoy visuals and videos that illustrate performance more than reading.					
4	I do not have the ability to explain a skill in front of students.					
5	I enjoy tasks that require the use of explanations.					
6	I feel that mental visualization of movement is like a real experience.					
7	I use mental imagery to solve problems encountered during performance.					
8	I find it difficult to express a skill I've learned through writing.					
9	I prefer dealing with explanatory images rather than describing skills in words.					

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Item	Statements	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
10	I can form a mental image for any skill I learn.					
11	My visual impressions of skills presented are often unclear.					
12	I can easily recall the words mentioned by the teacher when explaining a skill.					
13	I am able to clearly express my thoughts about a skill.					
14	My ability to imagine a skill is above average.					
15	I find it easy to visualize skills I have learned before.					
16	I consider myself fast in reading the assigned duty.					
17	I feel that illustrative images of skills are more informative than thousands of words.					
18	When the teacher explains a skill, I can imagine it correctly.					
19	I need a lot of time to read the description of a skill until I understand it.					
20	I have the ability to explain a skill after the teacher from the first time.					
21	When I look at a picture of a skill, it's difficult for me to remember exactly how it's done.					
22	I can write in the exam without worrying about the selection of words.					
23	I am better than average in explaining a skill in front of the teacher.					
24	It's difficult for me to form a mental image of a skill when reading about it.					
25	I find it difficult to explain a skill to a colleague.					
26	The mental images I have about a skill are somewhat unclear.					
27	I prefer to read about a skill before performing it.					

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Item	Statements	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
28	I use mental images that I draw to help me remember the skill.					
29	I feel exhausted when expressing a skill verbally or in writing.					
30	Just before sleep I start imagining the skills explained by the teacher.					
31	I prefer reading instructions on how to perform a skill rather than having the teacher present it to me.					
32	I prefer to view pictures before performing any skill.					
33	I try to link between the image I see and what is stored in the memory.					
34	When trying to remember an image of a skill that was presented, I usually lose part of it.					
35	I enjoy finding new words that match my ideas.					
36	When I see any picture of a skill, I immediately remember that it is stored in memory.					

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Appendix (2) shows a model of educational units using the inquiry-based learning method

The first week: **Educational goal: Developing the spirit of cooperation among students.**

Educational Unit/First **Educational Objective/For students to learn the front roll skill.**

Time/90 minutes **Tools/Floor movement mat, educational flex**

Sections of the educational unit		Time	Activities and Skills	Notes
Preparatory Department the introduction General warm-up Special warm-up		10 min 2 min 4 min 4 min	Left to the teacher	The researcher does not interfere with the details
Main Section 70 minute	Educational aspect	10 min	The students sit in a straight line in front of the teacher to explain the skill to them, then he presents its parts to them using Flex, explaining the details of proper performance. The head is forward with the chin pressed to the head, and the chest is pressed to the body, and this is done by bending the hip joint with the knees facing towards. The front must be pushed with both feet together, and then perform a demonstration of this skill model several times, with support with a large number of ideas, and accepting all ideas, going to the greatest extent in thinking with energy and seriousness in searching for ideas, and avoiding idle thinking before performing the skill, and he also directed to take time Take a short break for the mind to generate original ideas for implementing the skill, by carefully integrating the ideas until they are integrated by linking the ideas related to the details of the performance.	☼ The explanation of the skill should not be lengthy and complete with its details, taking into account the appropriate distance when presenting the educational model. ☼ Explanation of the skill is an inquiry and conclusion based on answers from the school itself, in detailing the relationships between the sections of the skill. ☼ The teacher invests this aspect in activating students' thinking to support each student's organization of knowledge in his or her own way when applying the skill later.
	The applied aspect	60 min	-The students stand in a straight line, one after the other, facing the floor movements mat. They are (3) away from each other, rolling forward and backward in the chest towards the knees. Each student is given (30) seconds to inquire before the first application to answer the inquiries, and their application of the movement is repeated (10) times. The	☼ Inquiry consists of questions (How is the position of the feet in the initial or preparatory position for the skill? And why? What is the position of the torso? And why? Where is the consideration

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Sections of the educational unit	Time	Activities and Skills	Notes
		duration of the exercise for all students with total rest is 12.5 minutes. -The students stand in a straight line, one after the other, facing the floor movements mat, 3 meters away. They roll over from the shoulder using a jumping ladder to reach a standing position. Each student is given (30) seconds to inquire before the first application, and their application of the movement is repeated (10) times. The duration of the exercise for all students with total rest is 12.5 minutes. -The students stand in a straight line, one after the other, facing the floor movements mat. They are (3) away from taking the basic rolling position for the full performance using the jumping ladder. Each student is given (30) seconds to inquire before the first application, and their application of the movement is repeated (10) times. The duration of the exercise for all students with total rest is 12.5 minutes - The students stand in a straight line, one after the other, facing the floor movements mat, and perform the skill completely. Each student is given (20) seconds to inquire before the first application, and their application of the skill is repeated (5) times. The duration of the exercise for all students, with a total rest, is (12.5) minutes.	in the preparatory, main and final section of the skill? And why? What is the position of the elbow joint? And why? How is the speed of performance controlled? How do we get the best performance? And why is the overall performance of the skill this way... and others). ☼ Providing an atmosphere of freedom so that each student can answer within a period of (6) seconds. ☼ The teacher encourages the flow of ideas with successive questions about the skill and the search for good answers to these questions. ☼ Allowing students to ask questions.
Concluding section	10 min	- Left to the teacher	The researcher does not interfere with details.

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