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Dr. Nashwan Mahmood Daoowd
Assistant Professor, University of Al Mosul, Mosul, Iraq

Corresponding Author:
Dr. Nashwan Mahmood Daoowd
Assistant Professor, University of Al Mosul, Mosul, Iraq

The effect of the (4 mat) strategy on cognitive achievement and learning a number of offensive skills in basketball

Dr. Nashwan Mahmood Daoowd

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Abstract
The researcher utilized an experimental methodology known as the equivalent group design, which involved the inclusion of both experimental and control groups. The research sample comprised 36 male fifth-grade students enrolled at Abu Hanifa Secondary School for Boys during the academic year 2022-2023. The participants were evenly allocated into two distinct groups: the experimental group (Group B) received instruction utilizing the 4mat technique, whilst the control group (Group A) adhered to the conventional curriculum delivered by the teacher. The evaluation focused on offensive basketball abilities such as chest passing, high dribbling, and shooting from a stable position. Additionally, a scale was employed to gauge cognitive achievement in basketball.
Following a six-week period of experiment implementation, the sample underwent testing to assess the research variables. After doing statistical analysis, the researcher successfully obtained data. However, the particular outcomes of the study were not presented, leaving the reader without knowledge of the most relevant discoveries.

1. The experimental group that implemented the prepared curriculum according to the (4mat) strategy outperformed the control group that followed the curriculum using the traditional method in the development of cognitive achievement for offensive basketball skills.
2. The experimental group that implemented the prepared curriculum according to the (4mat) strategy outperformed the control group that followed the curriculum using the traditional method in learning offensive basketball skills.

Keywords: (4 mat)-cognitive achievement-offensive skills in basketball

1. Introductions
Scientific theories and discoveries are currently undergoing significant activity due to advancements in scientific research techniques and technology, within the broader framework of the evolution of knowledge, areas, and specialties. Hence, educational research encounters substantial obstacles in tackling these scientific developments through the utilization of unconventional teaching methods and tactics that prioritize active learning.
In order to enhance the quality of education for pupils at various educational levels, it is imperative for a teacher to comprehend their distinct traits and cognitive processes. Comprehending the mechanics of the brain is essential in selecting the most efficient and appropriate learning activities for learners. The emergence of the Brain-Based Learning hypothesis was influenced by the discoveries of brain research, with a particular focus on individual differences. Therefore, it is imperative to establish an appropriate educational setting for every student, enabling them to actively engage in all educational tasks (Nunley, 2010). Nunley, C. (2010). "A Guide for Parents: Understanding Your Child's Brain." Translated by Mohammed Al-Rimawi. Oman: Dar Al-Maseera for Publishing and Distribution.
Conventional learning approaches, in which the student plays a passive role and the teacher is the exclusive provider of knowledge, are now deemed ineffective in attaining the intended learning objectives. The educational process has evolved to incorporate contemporary and sophisticated methodologies and models, with a move from teacher-centered to learner-centered approaches. The teacher's current job centers on providing guidance and facilitating learning, by directing students' activities in a manner that fosters independent learning. The objective of this strategy is to optimize the learning process and minimize the time required

for learning by actively engaging the learner as a crucial participant.

Through the process of empowering learners, this technique ultimately results in a tangible enhancement of their cognitive achievement. Consequently, this has a beneficial effect on the acquisition and proficiency of many educational abilities. The process of teaching and the choice of suitable models for this process are essential aspects in attaining optimal outcomes. Adopting a variety of successful and efficient educational models, methodologies, and tactics immediately enhances the educational process.

An example of a contemporary educational model is the "4MAT" model. Dikkatin Ovez uses the term "4MAT" to describe the model developed by Bernice McCarthy, which stands for "4 Mode Application Techniques." McCarthy established the 4MAT model by drawing upon the intellectual and philosophical framework of John Dewey, David Kolb, Carl Gustav, and brain-based learning research (Dikkatin, 2012, p. 2198) [26].

The 4MAT model is well recognized as one of the most extensively utilized models in the field of learning. It is a method specifically developed to disseminate knowledge in a manner that caters to the diverse learning preferences of students, enabling them to engage with and apply learning materials in a creative manner throughout each class. The 4MAT system promotes a comprehensive approach for educators, emphasizing the consideration of several factors such as the content being learned, the reasons behind the learning, and the methods employed by the learner (Qualification Project, 2015, p. 125) [20].

One of the important games and activities taught in the preparatory stage is basketball, which has experienced notable advancement due to the exceptional execution of its essential skills. Without a question, the utilization of contemporary teaching methods, approaches, and models is responsible for the advancement in instructing offensive and defensive skills. The evolution of this activity has propelled it to become a vital team sport on a global scale, owing to its exhilarating and captivating nature, which is defined by a seamless integration of physical power, agility, and technical proficiency.

The importance of this research rests in its connection with emerging theories that promote the customization of educational techniques to correspond with the characteristics of the brain. A major theory in this context is the brain-based learning theory, which includes models such as the 4MAT model. This study investigates the utilization of these theories in cognitive achievement and the acquisition of essential physical abilities. The researcher's motivation to explore this subject stems from the significant level of interest that basketball garners across different sports levels.

Hence, this study represents the researcher's endeavor to apply a specific approach, namely the 4MAT model, which is commonly employed by educators and coaches, drawing upon the researcher's expertise. This signifies the researcher's effort to contribute to the advancement of the game of basketball.

1.1 The study aimed to investigate

1. The differences in the dimensional test between the control and experimental groups in cognitive achievement in basketball for the research sample.
2. The differences in dimensional tests between the control and experimental groups in learning a number of offensive basketball skills for the research sample.

1.2 Research Problem: Despite the endeavors of scholars and specialists in the field of education to get exceptional outcomes in teaching methods and approaches, the teaching process continues to heavily depend on conventional ways for teaching and enhancing motor abilities. Despite the shift from teacher-centered to learner-centered philosophies in education, as well as advancements in teaching methods and other aspects of education, traditional teaching methods that rely on rote learning continue to be widely used. This results in a consistent teaching style over the majority of lessons. Consequently, it is crucial for individuals engaged in the educational process to employ contemporary instructional models and methodologies as educational tools for current learning theories. This entails selecting the most effective instructional approach and framework that takes into account individual variations and learner requirements, while also surmounting the obstacles encountered in this endeavor.

Basketball is a crucial component of the preparatory stage, and it is necessary to acquire its abilities in a manner that accurately corresponds to the game's demands. Therefore, it is imperative to make a concerted effort to employ novel and suitable models and methodologies that effectively facilitate the educational process. Thus, the researcher has identified the research problem by addressing the following inquiry:

Does implementing the formative assessment technique affect cognitive achievement and the acquisition of offensive skills in basketball?

1.3 Research Objectives

1. To examine the difference between pre-test and post-test scores for the control and experimental groups in cognitive achievement in basketball for the research sample.
2. To assess the difference between pre-test and post-test scores for the control and experimental groups in learning a number of offensive skills in basketball for the research sample.
3. To analyze the difference in post-test scores between the control and experimental groups in cognitive achievement in basketball for the research sample.
4. To investigate the difference in post-test scores between the control and experimental groups in learning a number of offensive skills in basketball for the research sample.

1.4 Research Hypotheses

1. There are statistically significant differences between the pre-test and post-test scores for the control and experimental groups, favoring the post-test, in cognitive achievement in basketball for the research sample.
2. There are statistically significant differences between the pre-test and post-test scores for the control and experimental groups in learning a number of offensive skills in basketball for the research sample.
3. There are statistically significant differences in post-test scores between the control and experimental groups in cognitive achievement in basketball for the research sample.

4. There are statistically significant differences in post-test scores between the control and experimental groups in learning a number of offensive skills in basketball for the research sample.

1.5 Areas of Research
1. Human Scope: Fifth-grade students at Abu Hanifa Preparatory School for Boys.
2. Temporal Scope: The period from October 3, 2022, to November 30, 2022.
3. Spatial Scope: The sports playground of Abu Hanifa School.

1.6 Definition of Terms
4 Mat Strategy: An instructional model that follows a learning cycle consisting of four sequential stages with a fixed sequence. These stages include Reflective Observation, Conceptualization, Active Experimentation, and Concrete Sensory Experiences (Al-Tunsi, 2019, p. 3) [5]. McCarthy and McCarthy (2006) [27] describe it as a learning process that moves through a series of stages in a specific order: Reflective Observation, Conceptualization, Active Experimentation, and Concrete Sensory Experiences. According to McCarthy & McCarthy (2006, p. 9) [27], each stage of the four-stage model is organized in a manner that aligns with the learner's specific learning styles.

1.7 Cognitive Achievement: Cognitive achievement, as described by Mohamed, Musa Mohamed (2016), refers to the educational outcome resulting from the influence of a program, method, strategy, or media. The method of quantitatively observing and assessing, and subsequently making judgments on the percentage of change, is associated with an objective measuring procedure (Mohamed, Musa Mohamed, 2016, p. 37).

2. Research Procedures
2.1 Research approach: The researcher utilizes the experimental approach and selects the "Equivalent Groups Design" (Experimental and Control) with random testing, incorporating pre-test and post-test with strict control. The reference for this information is Alawi and Rattab, 1999, page 217.

2.2 Research Population and Sample: The research sample was deliberately chosen and comprises 64 fifth-grade biology students enrolled at Abu Hanifa Preparatory School for the school year 2022-2023. The students are segregated into two study sections, denoted as A and B, with each part consisting of 32 pupils. Section B was selected as the experimental group by a simple random sampling approach. This group employed the 4MAT strategy to learn offensive basketball skills. On the other hand, Section A served as the control group and followed the standard curriculum provided by the teacher.
The researcher deliberately selected this research sample for multiple reasons. Basketball skills are already included in the curriculum established by the Ministry of Education and the General Directorate of Physical Education for the preparatory stage. Furthermore, students at this stage are regarded as novices in the proficiency of this game. In addition, the researcher has easy access to the required research instruments and equipment, and there is active collaboration between the school administration, the physical education teacher, and the researcher.

2.2.1 The researcher excluded several students from the research groups, including
1. Students who have previously learned these skills and have failed, totaling (4) students.
2. Students who are not committed to attendance, frequently absent, totaling (8) students.
3. Students actively involved in basketball activities and participating in sports teams, due to their higher skill level compared to other students, totaling (2) students.
4. Students participating in the pilot study, totaling (14) students.

Thus, the total number of participants in the main experimental sample is (36) students, divided into two sections, with each section consisting of (18) students. Table (1) illustrates the research groups, the methodologies used, and the total number of students in the research sample.

Table 1: Illustrates the research groups, the methodologies used, and the total number of individuals in the sample, along with their percentage distribution.

Research Groups	"The methodology used"	"The total number"	"The excluded number"	"The main experiment"	"The percentage"
"The experimental group"	"4MAT"	32	14	18	% 56.25
"The control group"	"The followed curriculum"	32	14	18	%56.25
"The total"		64	28	36	

2.3 Research Tools, Devices, and Instruments Used in the Study
2.3.1 Data Collection Methods
- Arabic and foreign sources.
- Tests and measurements.
- Personal interviews.
- The internet.
- Support team.
- Data registration forms.

2.3.2 Devices and Tools
- Personal laptop (DEEL brand).
- Whistle (quantity: 3).
- Weight and height measuring device (quantity: 1).
- 10-meter measuring tape.
- Video camera (Sony brand, quantity: 1).
- Colored adhesive tape (5 cm width).
- Markers (quantity: 12).
- Timer (Casio brand, quantity: 2).
- Wooden benches (quantity: 3).
- Regulation basketball court.
- Regulation basketballs (quantity: 5).

2.4 Sample Homogeneity
In order to ensure homogeneity among the participants, the researcher carefully selected a sample of beginner students

who were of similar ages, in the same academic stage, of the same gender, and not involved in any clubs. Additionally, failing students were excluded from the sample. The researcher also took measures to ensure homogeneity in variables such as height, age, and weight. Table (2) demonstrates the uniformity of the sample.

Table 2: Illustrates the homogeneity of the sample in variables (weight - height - age).

The statistical procedures" "The variables"	The unit of measurement	"The mean"	"The standard deviation"	"The median"	"The standard error"	Skewness coefficient	"Sample size"
"The mass"	"Kilograms"	65.86	5.69	66.21	1.24	0.17	36
"The length"	"Centimeters"	168.32	5.32	167.12	1.077	0.83	
"The age"	"Month"	212.66	6.13	213.11	0.12	0.71	

The table (2) shows that the values of the torsion coefficient are confined between (+3, -3), indicating homogeneity of the sample in those variables.

2.5 Equality in the most important physical elements for the research groups

To determine the primary factors that contribute to the development of offensive skills in basketball, the researcher conducted an extensive review of various studies, scientific references, and relevant research papers, including works by Younis (1999) [25], Abdul Rahman *et al*. (2002), Al-Hamdani (2001) [8], Al-Hakim (2004) [4], and Jouda (2007). This study was conducted to gain insights into the distinct physical components related to basketball and the assessments used to measure these components. The focus of this research was to align with the characteristics of the study and the age range of the participants.

The researcher assembled these components and their respective assessments into a questionnaire format (Appendix 1) to collect the viewpoints of proficient practitioners (Appendix 2) regarding the basketball-specific physical fitness elements. The experts subsequently chose the components and appropriate assessments in the following manner:

- Explosive arm strength: Testing involves throwing a 3 kg medicine ball with both hands from a seated position. (Al-Hamdani, 124, 2001) [8]
- Explosive leg strength: Testing involves the vertical jump. (Abdul Rahman *et al*., 2002, 172)
- Transitional speed: Testing involves sprinting 10 meters from a standing position. (Al-Samidai and others, 363, 2010)
- Agility: Testing involves serpentine running between markers over a distance of 10 meters. (Al-Hakim, 127, 2004) [4]
- Flexibility: Testing involves bending the trunk forward and downward from a standing position. (Al-Hakim, 130, 2004) [4]

The researcher applied these tests to both the experimental and control groups on October 11, 2022, and Table (3) illustrates the results of equality in physical fitness elements.

Table 3: illustrates the equality of the two research groups in physical fitness elements.

S	variable	Unit of Measurement	Control Group		Experimental Group		Computed t-value	Sig
			S	A+	-S	A+		
1	Explosive Strength of the Arm Muscles	Centimeter	238.65	13.37	234.25	12.91	0.34	0.491
3	Explosive Strength of the Leg Muscles	Centimeter	27.000	3.183	27.187	2.688	1.890	27.000
3	Agility	Second	12.375	3.283	12.250	3.235	0.122	12.375
4	Flexibility	Centimeter	9.674	1.067	10.112	0.776	1.277	9.674
5	Transitional Speed	Second	4.138	0.295	4.184	0.373	0.435	4.138

The critical (t) value at a significance level of less than 0.05 with degrees of freedom (34) is equal to 2.04.

Based on the data shown in Table (3), it is clear that there are no statistically significant disparities between the control and experimental research groups for the physical fitness characteristics. This is demonstrated by the computed (t) value being smaller than the critical (t) value, indicating that there is no significant difference between the two research groups in terms of physical fitness components.

2.6 Offensive Skills in Basketball

2.6.1 Identification of Offensive Skills in Basketball and Their Tests: In order to identify the offensive skills in basketball, the researcher consulted the curriculum of the Ministry of Education and the General Directorate of Physical Education for the Intermediate Stage (Al-Taie *et al*., 1991) [14]. Additionally, the researcher reviewed various sources and research studies in basketball, such as those conducted by Zaidan (1998), Al-Sharouk (2000), and Ismail (2003) [3]. To identify the exams that assess these talents, several sources and scholarly theses were examined, including the works of Al-Diwehji and Hamoudat (1999) and Al-Qaisi (2003) [18].

Following that, a questionnaire form (Appendix 3) was created encompassing offensive basketball abilities and a series of standardized tests to assess individual proficiency in those skills. The form was administered to a group of basketball pedagogy specialists and experts (Appendix 2) on October 3, 2022, in order to obtain their evaluations of the appropriateness of the skills and tests for the study sample, and to determine the most appropriate ones for achieving the research objectives.

Upon careful examination of the feedback, offensive abilities and their respective assessments were chosen, attaining a consensus among the experts of 75% or higher. The talents and tests that have been chosen are as follows:

The Chest Pass
(Handling the ball and passing it towards a wall from a distance of 2.70 meters). (Abdel Dayem, Hassanein, 169, 1984) [15].

High Pivot (Pivoting)
(High pivot testing for a distance of 10 meters with the dominant arm). (Youssef, 2000, 101).

Scoring from Standstill
(Scoring from a standstill test behind the free-throw line (10 attempts)). (Jawad, Ali Saloum, 2004, 179).
All of these tests adhere to standards of validity, reliability, and objectivity.

2.6.2 Determination of the Necessary Teaching Units
In order to ascertain the required number of teaching units for training the offensive abilities under investigation, the researcher devised a questionnaire (Appendix 4) which was administered to a cohort of proficient experts in teaching and motor learning techniques (Appendix 2) on October 6, 2022. The questionnaire incorporated the recommended offensive abilities provided by the experts, and the participants were requested to indicate the necessary number of instructional units for each ability, taking into account the characteristics and educational level of the sample. Upon reviewing the questionnaire responses, it was determined that the experts reached a consensus to include two teaching units for each of the offensive skills under investigation, in the following order: Chest Pass, High Pivot, Standstill Shooting.

2.7 Cognitive Achievement Scale
In order to choose a cognitive achievement scale that is suitable for the research objectives and the sample, the researcher examined multiple pertinent studies, including the works of Youssef, Hamed, *et al*. (2016), Ibrahim, Hani El Desouki, *et al*. (2017), Mousa, Adnan Mousa, *et al*. (2019), and Burak Güneş, Erdogan Yilmaz (2019). Upon thorough scrutiny of various scales, the researcher decided for the scale devised by (Youssef, Hamed, *et al*., 2016) due to its exclusive ability to assess cognitive achievement in the specific offensive skills being studied, as well as fundamental basketball knowledge.
In order to confirm the reliability and validity of the scale, the researcher administered it in the form of a questionnaire (Appendix 4) to a panel of experts in the fields of measurement, evaluation, and basketball (Appendix 2) on October 5, 2022. The specialists have verified the appropriateness of the scale. Following that, the researcher evaluated the reliability of the scale by administering it to 8 students from a separate group (not included in the research sample) on October 11, 2022. The obtained reliability coefficient (r) was 0.92, signifying the scale's reliability. Therefore, the scale is prepared to be utilized in assessing the cognitive accomplishment of the research participants.
The scale consists of 37 items, and for each item, there are four answer choices, with the total scale score ranging from 0 to 37.

2.8 Development of an Educational Curriculum Based on the Formative Assessment Model
To accomplish the research goals, the researcher devised an instructional program for each of the examined abilities (Chest Pass, High Pivot, Standstill Shooting). The curriculum was developed using specialized scientific sources and the researcher's knowledge as a specialist in physical education teaching methods at the College of Basic Education/Department of Physical Education and Sports Sciences.
The curriculum was developed by employing the literature on pedagogical approaches and basketball techniques under investigation. The experimental group received a total of six teaching modules, each lasting 45 minutes and delivered on a weekly basis. Each ability was taught through two instructional units, beginning with the Chest Pass, followed by the High Pivot, and concluding with Standstill Shooting (Appendix 5). The curriculum that was created was presented to a group of highly experienced teaching methods specialists (Appendix 2) on October 12, 2022, using the formative assessment strategy. After offering slight feedback on the proposed activities, they granted approval to the curriculum.
The researcher categorized the instructional units by segmenting the lesson into three primary divisions: the preparatory segment (lasting 12 minutes), encompassing an introduction, warm-up, and physical exercises; the main segment (lasting 30 minutes), consisting of the educational and practical activity; and the concluding segment (lasting 3 minutes), comprising cool-down exercises and dismissal.
McCarthy's model outlines four steps (Contemplative Observation, Conceptual Crystallization, Active Experimentation, Sensory Experiences) that are involved in implementing the educational program. The educational activity in the main segment consists of two distinct phases: Contemplative Observation involves the teacher providing a detailed explanation of the skill being taught, drawing on the students' own experiences with the skill, and presenting a model for reflective movement. Subsequently, pupils are afforded the chance to identify errors committed by the model. In the Conceptual Crystallization stage, the teacher further elucidates the skill's performance by explaining, demonstrating, and employing several models. The focus is on providing feedback to rectify common errors, imparting essential information to students, and presenting concepts in a structured manner. The practical activity, encompassing the phase of Active Experimentation, entails actively testing and practicing the skill through repetitive actions and the correction of errors. The teacher's responsibility is to vary the exercises and provide visual aids that align with the objective of the session. The teacher oversees the pupils' progress, provides guidance, and assists in the initial execution of the skill. During the Sensory Experiences stage, students improve their ability to do a task correctly by individually or with the teacher's help identifying and correcting their faults via repeated practice. Furthermore, inquiries are raised and resolved throughout this phase.
The control group, which will get instruction in the three offensive skills using the traditional curriculum provided by the teacher, will have a total of 6 instructional units. Each unit will last for 45 minutes. The unit was partitioned into three sections, mirroring the temporal distribution for the experimental group.

2.9 Pilot Study
To find the most effective manner to execute the field research processes, a pilot study was undertaken as a practical training for the researcher to identify the strengths

and weaknesses that may develop during the application of the instructional units. The pilot study comprised a cohort of fifth-grade biology students from the research community, who were deliberately removed from the primary sample. The number of students in this pilot project was (10), randomly picked from Class B, on October 18, 2022. The objective was to evaluate the appropriateness of the created curriculum for the specific level and to highlight any challenges the researcher may encounter when implementing the curriculum using the formative assessment approach. The researcher determined that the instructional units designed for teaching offensive basketball skills were appropriate for the research participants and could be implemented within the designated timeframe.

2.10 Pre-Tests

The research sample underwent pre-tests for both the control and experimental groups, which included the Cognitive Achievement Test as well as skill testing for chest passing, high pivot (jab step), and stationary shooting. Prior to conducting the skill tests, the researcher conducted an informative session on October 19, 2022, to explain the offensive skills being studied. This session was attended by both the control and experimental groups. The session comprised of elucidations and illustrations by the instructor to facilitate students' comprehension of the fundamental structure of the talent and its execution.

Following all testing protocols, the pre-tests for offensive skills and cognitive achievement were administered to both groups on October 20, 2019, in the courtyard of Abu Hanifa School. The tests were conducted with the aid of the supporting team (Appendix 6) and under the direct observation of the researcher.

In order to document the outcomes and offer a thorough clarification to the participants of the sample group on the procedure of each skill assessment, including the number of tries, a member of the helping team provided a detailed explanation and demonstration of the tests to the students prior to their initiation. Prior to commencing the tests, the pupils were provided with a suitable warm-up period. Table 4 displays the outcomes of the preliminary assessments for the research variables.

Table 4: illustrates the results of the pre-tests for the research variables for both research groups.

S	The variable	The unit of measurement	The control group		The experimental group		The calculated\(t\)value	Sig
			S-	A+	S-	A+		
1	Cognitive achievement	Grade	16.44	6.54	15.89	6.23	0.76	0.344
2	Chest pass	Second	17.45	1.23	17.32	1.21	0.64	0.87
3	High pivot dribble	Second	13.42	3.32	13.66	3.30	-0.29	0.21
4	Stationary Shooting	Point	2.54	0.75	2.24	0.85	1,76	0.94

The (critical) table value at a significance level of < (0.05) with degrees of freedom (34) is (2.04).

2.11 Main Experiment Procedures

Upon completing all necessary preparations for the research experiment, which involved ensuring the equal and uniform composition of the research sample and preparing the educational units for the 4MAT model (McCarthy's 4 MAT) strategy, the researcher commenced the implementation of the educational curriculum for the experimental group (4MAT model - McCarthy's 4 MAT) on Tuesday, October 25, 2022. The experimental group proceeded with the application at a consistent pace of one teaching unit each week. The implementation of the educational curriculum concluded on Tuesday, November 29, 2022.

The control group began the traditional curriculum on Tuesday, October 25, 2022, with a weekly allocation of one teaching unit. The implementation of the conventional curriculum for the control group was completed on Tuesday, November 29, 2022.

2.12 Post-Tests

After completing the implementation of the educational curriculum, post-tests were conducted for both the control and experimental groups in the targeted offensive skills and the cognitive achievement scale. The researcher ensured to create similar conditions to those of the pre-tests on November 30, 2022.

2.13 Statistical Methods

The researcher utilized the statistical package (SPSS) employing the following statistical methods:

1. Mean (Arithmetic Mean).
2. Standard Deviation.
3. Percentage.
4. Independent Samples t-Test.
5. Paired Samples t-Test.
   (Al-Naeemi, Mohammed, and Al-Bayati, Hussein, 2007, 12-227).

3. Presentation of Results and Discussion

3.1 Presentation of Results

After conducting the experiment on both research groups and performing post-tests, the results of the research tests will be presented after their statistical processing. The aim is to reach appropriate conclusions and recommendations.

3.1.1 Presentation and Analysis of the Pre-test and Post-test Results for the Control and Experimental Groups in the Cognitive Achievement Scale

Table 5: illustrates the pre-test and post-test results for the control and experimental groups in the Cognitive Achievement Scale.

S	Cognitive Achievement	Measurement Unit	Pretest		Posttest		Computed value (t)	Sig
			S-	A+	S-	A+		
1	The control group	Grade	16.44	6.54	25.86	4.33	14.34	0.945
2	The experimental group	Grade	15.89	6.23	32.42	5.13	13.63	0.147

The critical (t) value at a significance level of <(0.05) and degree of freedom (17) is (1.74).

Table (5) clearly demonstrates statistically significant disparities between the pre-test and post-test results for both the control and experimental groups in terms of cognitive achievement, with the post-test showing superior outcomes. This is demonstrated by the computed (t) value exceeding the critical (t) value.

3.1.1.1 Discussion of the Pre-test and Post-test Results for the Control and Experimental Groups in the Cognitive Achievement Scale

Table (5) shows substantial statistical changes between the pre-test and post-test scores for both the control and experimental groups on the cognitive accomplishment scale, with the post-test scores being higher. The researcher ascribes this to the efficacy of the instructional units employed in the educational curriculum for the experimental group (4MAT method) or the instructional curriculum employed for the control group (traditional curriculum). The units had a profound impact on the cognitive achievement of the research sample. They included experiences and educational circumstances that greatly helped to the improvement and growth of cognitive success.

According to Al-Hayla (1999), several research and studies have consistently shown that exposing a sample to an educational or training curriculum enhances cognitive function (Al-Hayla, 1999, p. 23). The enhancement can be ascribed to the samples' exposure to the experiences encompassed in the curriculum, particularly if the curriculum encompasses both practical and theoretical experiences. Hence, it is undeniable that the control and experimental groups in this study have indeed undergone these experiences and have subsequently changed.

3.1.2 Presentation and Analysis of the Pre-test and Post-test Results for the Control and Experimental Groups in the Targeted Offensive Skills

Table 6: illustrates the results of the pre-test and post-test for the control and experimental groups in the targeted offensive skills.

Group	Skills	Measurement Unit	Pre-test		Post-test		Calculated t-value	Sig
			S-	A+	S-	A+		
Control Group	Chest Pass	second	17.45	1.23	15.56	1.36	5.90	0.937
	High Pivot Dribble	second	13.42	3.32	12.13	1.65	11.42	0.237
	Shooting from Stability	NO.	2.54	0.75	5.15	1.18	4.23	0.247
Experimental Group	Chest Pass	second	17.32	1.21	14.13	0.91	15.42	0.937
	High Pivot Dribble	second	13.66	3.30	10.55	1.47	23.26	0.237
	Shooting from Stability	NO.	2.24	0.85	6.30	1.11	10.25	0.274

The critical (t) value at a significance level of < 0.05 with degrees of freedom (17) is equal to (1.74).

The data from Table (6) clearly indicates that there are statistically significant disparities between the pre-test and post-test scores for both the control and experimental groups in the offensive skills being studied. The computed (t) value exceeded the crucial (t) value, indicating a preference for the post-test.

3.1.2.1 Discussion of the pre-test and post-test results for the control and experimental groups in the investigated offensive skills

Table (6) displays statistically significant disparities in the assessed offensive skills between the pre-tests and post-tests for both the control and experimental groups. The post-tests were preferred, and the researcher credits this to the efficacy of the instructional methods employed with the experimental group (formative strategy) in contrast to the way utilized with the control group (traditional method). The implementation of these strategies had a significant effect on the learning process, resulting in noticeable improvement in the offensive skills performance of both the control and experimental groups. The adherence to scientific and logical procedures in the creation and execution of educational curricula inevitably leads to the occurrence of learning events.

Al-Kadhimi (2002) states that in the learning process, development is a natural occurrence as long as the teacher adheres to the appropriate stages for teaching and learning. In order to create a solid foundation for learning, it is vital to provide clear explanations, well-structured presentations, and exercises that promote right performance. This focus should be maintained until the desired level of performance is achieved and maintained consistently. Furthermore, offering the learner feedback not only boosts motivation but also fosters a willingness and enthusiasm to do correctly.

The researcher also ascribes these disparities to other variables that are intricately linked in the learning process. These include adhering to the principle of progression in learning motor skills, which involves gradually introducing exercises of increasing complexity after the teacher has explained and shown them. The combination of ongoing skill training and regular feedback has significantly enhanced student motivation, resulting in favorable outcomes throughout the learning journey.

Furthermore, the effective design of the educational curriculum implemented for both groups had a significant influence on the acquisition of offensive skills, leading to noticeable disparities between the initial assessment and the subsequent evaluation. Al-Muhdawi (2020) [21] emphasizes that by adhering to scientific procedures in the areas of planning, organizing, and implementing, and by incorporating expert viewpoints into educational curricula, the learning process is surely facilitated (Al-Muhdawi, 119, 2020) [21].

3.1.3 Presentation and Analysis of the Post-Test Results for the Control and Experimental Groups in the Cognitive Achievement Scale

Table 7: illustrates the results of the post-test for both the control and experimental groups in the cognitive achievement scale.

Variables	Measurement Unit	Control Group		Experimental Group		Calculated t Value	Sig
		S-	A+	S-	A+		
Cognitive Achievement	second	25.86	4.33	32.42	5.13	5.72	0.513

The critical (t) value at a significance level of < 0.05 with degrees of freedom (34) is equal to (2.04).

From Table (7), it is evident that there are statistically significant differences between the control and experimental groups in the cognitive achievement scale. This is indicated by the calculated (t) value being greater than the critical (t) value, favoring the experimental group.

3.1.3.1 Discussion of the Post-Test Results for the Control and Experimental Groups in the Cognitive Achievement Scale

Table (7) clearly demonstrates that there are statistically significant disparities in the post-test results between the control and experimental groups in terms of cognitive achievement. The experimental group outperformed the control group. The researcher ascribes this outcome to the efficacy of the formative strategy employed with the experimental group, as well as the inclusion of instructional units within this model. The students effectively created a conducive learning environment by adopting a procedural approach in these instructional units. The design of this setting took into account the psychological and cognitive traits of the students, leading to an enhancement in their cognitive performance.

According to Adam (2003) [2], an effective educational/learning process and superior academic achievement are facilitated by the presence of effective interaction among the teacher, student, and curriculum. Adam suggests that this interaction is responsible for the occurrence of teaching and learning, as well as good achievement. Education is the deliberate exchange of knowledge and skills between persons, occurring within a defined timeframe and location, with the aim of attaining a particular educational objective. The interaction of educational components yields a favorable outcome known as the process of teaching and learning (Adam, 2003, 2-3) [2].

Furthermore, the curriculum implemented with the experimental group (using a formative strategy) employs a four-step approach to process skill-related information, resulting in an overall improvement in cognitive achievement. The curriculum caters to pupils of all levels in the class, without focusing on any particular degree of knowledge. The 4MAT model is a widely recognized learning model that aims to cater to the diverse learning styles of students by providing information in a manner that enables them to engage in practice and creative utilization of learning materials throughout each class (Foundation Project, 25, 2015).

3.1.4 Presentation and Analysis of the Post-Test Results for the Control and Experimental Groups in the Investigated Offensive Skills

Table 8: illustrates the results of the post-test for both the control and experimental groups in the investigated offensive skills under study. In this section, we will provide an overview and analysis of these results.

Skills	Measurement Unit	Control Group		Experimental Group		The calculated t-value	Sig
		S-	A+	S-	A+		
Chest Handling	Second	15.56	1.36	14.13	0.91	3.53	0.204
High/Lobbing Overhead Shots	Second	12.13	1.65	10.55	1.47	3.33	0.314
Peaceful/Accurate Shooting	NO.	5.15	1.18	6.30	1.11	2.84	0.256

The critical (t) value at a significance level of < 0.05 with degrees of freedom (34) is equal to (2.04).

From Table (8), it is evident that there are statistically significant differences between the control and experimental groups in the investigated offensive skills. This is indicated by the calculated (t) value being greater than the critical (t) value, favoring the experimental group.

3.1.4.1 Discussion of the Post-Test Results for the Control and Experimental Groups in Offensive Skills under Study

Table (8) demonstrates statistically significant differences in the post-test between the control and experimental groups in the investigated offensive skills, favoring the experimental group.

The researcher attributes these differences to the educational methodology employed with the experimental group (the 4MAT strategy). This strategy had a profound impact on the learning process, allowing students to take responsibility and actively participate in the learning process. The stages of this model provided opportunities for students to be significantly engaged in the learning process. They were placed in educational situations that made them capable of leading the learning process, evaluating their performance, and correcting their mistakes in each step of the learning process. This approach not only increased their motivation for learning but also captured their interest.

Furthermore, the 4MAT strategy and its four stages contributed to moving students away from the traditional learning style towards a style that considers all learning styles. This, in turn, significantly enhanced the learning of skills, helping students comprehend and construct a proper understanding of the researched skills. The 4MAT strategy also accommodated individual differences among students, considering their preferences and experiences in learning new skills. It aimed to increase the recipients' experiences during the learning process, encompassing both theoretical and practical experiences. Consequently, the students developed new skills efficiently, learned with competence, and eliminated undesirable skills.

The choice of a sample of raw students, lacking a deep understanding of basketball skills or the 4MAT strategy, made the students highly interactive with this learning style—firstly among themselves and secondly with the teacher. This is in contrast to the traditional learning process, as the 4MAT strategy is based on stages, with each student having a role in each stage. The success of students in each step of each stage, whether through questions or providing answers, as well as the immediate correction of their mistakes and assessment of their progress, contributed to increasing their motivation for learning and sparking their interest.

Moreover, the immediate feedback played a crucial role in correcting errors and rebuilding the correct idea regarding the learned skill. This led to positive effects in the learning process. This is supported by Bilal and others (2023) [4], who state that learning according to the McCarthy strategy (4MAT) arouses students' interest, allowing them active

participation and the exchange of opinions with the teacher and peers. This facilitates their learning with the help of each other, leading to the formation of positive relationships among students and increasing learning opportunities among them (Bilal and others, 2023, 146) [4].

4. Conclusions and Recommendations

4.1 Conclusions

4.1.1 In light of the results obtained, the researcher concludes the following

1. The curriculum designed according to the (4MAT) strategy had a significant impact on the cognitive development of offensive basketball skills for the research sample.
2. The curriculum designed according to the (4MAT) strategy had a significant impact on learning offensive basketball skills for the research sample.
3. The experimental group that implemented the curriculum designed according to the (4MAT) strategy outperformed the control group that followed the traditional method in the cognitive development of offensive basketball skills for the research sample.
4. The experimental group that implemented the curriculum designed according to the (4MAT) strategy outperformed the control group that followed the traditional method in learning offensive basketball skills for the research sample.

4.2 Recommendations

4.2.1 In light of the results obtained, the researcher recommends the following

1. Emphasize the use of the (4MAT) strategy as one of the modern and effective teaching models for middle school students, given its positive impact on cognitive development.
2. Implement the educational curriculum designed according to the (4MAT) strategy in teaching offensive basketball skills to middle school students, recognizing its active role in enhancing the learning of the researched offensive skills.
3. Conduct further similar studies using the (4MAT) strategy, exploring its impact on cognitive outcomes for individual or group activities.
4. Organize periodic training courses for physical education teachers to train them on modern teaching programs and strategies, such as the (4MAT) strategy, which focuses on learning styles and considers individual differences among students.
5. Enhance evaluation methods to go beyond final exams and include other assessments, such as cognitive achievement tests, providing a more comprehensive understanding of students' learning outcomes.

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