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The Effectiveness of Using the Six Thinking Hats in Acquiring Physical Concepts among Tenth Graders Based on their Achievement Motivation

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Abstract

Objectives: The study aims to investigate the effectiveness of using the Six Thinking Hats Strategy in acquiring physical concepts for tenth grade students in the light of their achievement motivation compared to the traditional method.

Methods: quantitative descriptive Approach was employed.The study sample consisted of (55) female students, that were selected from one school within the Education Directorate in Madaba for the academic year 2020/2021. The sample was divided into two groups: experimental group (28) students which studied using the Six Thinking Hats strategy, and a controlled group (27) students which studied using the traditional method. Data were collected by classifying students according to their achievement motivation into high and low achievement motivation based on the achievement motivation scale. The researcher used the quasi-experimental approach. The test of acquiring physical concepts was applied after determining the validity and reliability of the study tool.

Results: The result showed that there were statistically significant differences (α=0.05) due to the method of teaching in acquiring physical concepts in favor of the experimental group. The results also showed that there were statistically significant differences (α=0.05) attributed to achievement motivation in favor of female students with high achievement motivation, and there was no statistically significant difference in the interaction between them.

Conclusions: The need of universities to carry out further studies in order to enforce the result of the study.

Keywords: Six thinking hats strategy, acquiring physical concepts, achievement motivation.

فاعلية استخدام قبعات التفكير الست في اكتساب المفاهيم الفيزيائية لدى طالبات الصف العاشر في ضوء دافع الإنجاز لديهم

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ملخّص

الأهداف: هدفت الدراسة الحالية إلى تقصي فاعلية استخدام قبعات التفكير الست في اكتساب المفاهيم الفيزيائية, لدى عينة من طالبات الصف العاشر الأساسي في ضوء دافع الإنجاز لديهن مقارنة بالطريقة الاعتيادية

المنهجية: تم توظيف المنهج الكمي الوصفي، حيث تكونت عينة الدراسة من (55) طالبة من طالبات الصف العاشر الأساسي, تم اختيارهن قصديا من مدارس مديرية التربية والتعليم لمحافظة مأدبا، تم توزيعهم عشوائيا إلى مجموعتين: مجموعة تجريبية تضم (28) طالبة درست باستخدام استراتيجية قبعات التفكير الست, والأخرى ضابطة تضم (27) طالبة درست باستخدام الطريقة الاعتيادية. جمعت البيانات من خلال تصنيف الطالبات في كل شعبة حسب مستويي دافع الإنجاز إلى: ذوات إنجاز أكاديمي مرتفع، وذوات إنجاز اكاديمي منخفض بناء على مقياس دافع الإنجاز المعد لذلك. وقد تم تطبيق اختبار اكتساب المفاهيم الفيزيائية بعد التحقق من صدقه وثباته.

النتائج: أظهرت نتائج الدراسة وجود فروق ذات دلالة إحصائية تعزى لطريقة التدريس في اكتساب المفاهيم الفيزيائية لصالح المجموعة التجريبية. كما أظهرت النتائج وجود فروق ذات دلالة إحصائية تعزى الى دافع الإنجاز ولصالح الطالبات ذوات دافع الإنجاز العالي وعدم وجود فرق دال إحصائيا في التفاعل بينهما.

التوصيات: ضرورة إجراء دراسات أخرى للتحقق من نتائج هذه الدراسة.

الكلمات الدالة : استراتيجية قبعات التفكير الست، اكتساب المفاهيم الفيزيائية، دافع الإنجاز.

Introduction

Scientific and technological development in our contemporary world has led to a review of science curricula and teaching methods to ensure that they keep pace with the latest developments and contemporary trends in order to play their desired role in facing the challenges of the twenty-first century. Accordingly, caring for the learner and his participation in the teaching-learning process has become one of the objectives of practical education and science teaching. All the reform movements that the science curricula have undergone emphasized the importance of acquiring scientific concepts for students and focusing on the learner's positivity and activity to achieve the goals and objectives of the study and learning of science (Weiss, Knapp, Hollweg, & Burrill, 2002; Donaldson,. 2015).

Recent trends in educational sciences also emphasized that teaching physics is not just a transfer of knowledge to the student, but rather a natural and applied science with a mental, skill, emotional and social structure that is related to the student's life and society.which made educators emphasize on the importance of the learner's role in the successful educational process. (Zarrouqi, 2015; Zekri et al., 2016; Twining, 2020).

Physical concepts are among the most complex levels in the field of cognitive psychology, as they are what the individual has of meaning and understanding that leads him to develop and grow his ability to think and build ideas, enough to understand his experiences about the world of things around him (Birbeck, 2010; Qatami, 2013).

Acquisition of physical concepts for learners at different educational levels requires an appropriate teaching method that includes the integrity of their formation, survival and retention, as the ability to help the learner to acquire scientific concepts in the correct manner provides them with opportunities for success and the ability to solve problems (Zaytoun, 2010; Qatami, 2013).

Accordingly the increasing interest in acquiring scientific concepts in general, and physical concepts in particular, has led to the emergence of many models and strategies that have made a qualitative leap in the learning and teaching process. Among these strategies is the Six Thinking Hats strategy, which the current study attempts to investigate its effectiveness in acquiring physical concepts for tenth grade students (Mishra & Koehler, 2006).

The six thinking hats strategy is considered one of the most advanced and effective global techniques in terms of strength and speed of influence and in terms of ensuring quality in thinking as well. This strategy was invented by Edward de Bono who employed his knowledge in brain and thinking research. Also this strategy directs the person to think in a certain way and then switch to another way, that is, the person can wear any of the six colored hats, each of which represents a kind of thinking (Zarrouqi, 2015; Phuntsho & Wangdi, 2020)

The idea of the six hats is to divide thinking into six patterns, each of which represents a hat that the individual wears or takes off according to his way of thinking at that moment (Mary & Joanes, 2004; Salah Eldin & Maher, 2016).

The six hats are not real hats in the literal sense, but rather symbolize a certain way of thinking that matches the color of the hat and the significance of its characteristics, the white hat indicates the information and data that are given objectively, and the red hat indicates feelings and emotions without logical justification, the yellow hat refers to positive thinking, highlighting the positive aspects of the subject, and generating constructive ideas with logical justifications, and the black hat refers to pessimistic thinking, where the negatives, problems and shortcomings in the subject stand out to be treated, the green hat refers to creative thinking through the search for new ideas and solutions that have not been presented before. and the blue hat indicates holistic thinking and contributes to giving a final judgment on the subject to take the necessary decisions.(Salah Eldin & Maher, 2016)

Debono believes that the justifications for using the six hats are based on the fact that the hats are closest to the head and the head contains the brain that performs the function of thinking, and one hat is not always used, it's soon abandoned due to changing circumstances. The Six Hats thinking method can be applied in several situations, where it uses the method of brainstorming, problem solving, lateral thinking and constructive thinking..(Mishra & Koehler,2006). The following is an explanation of each type of thinking about the meaning of the color represented by these hats:

White Hat: The white color indicates complete neutrality and objectivity, so it symbolizes neutral or objective thinking based on a set of questions with the aim of obtaining numbers, focusing on facts and information, and detachment from

emotions and opinion. And represent the role of the computer in giving information without interpreting it. The white hat is the basis of hats, and it is often the first hat to be put forward because it is related to collecting information. One of the characteristics of a thinker who wears a white hat is that he is objective, very calm, disciplined, and suffers from inertia (Qatami, 2010; Al-Sharari, 2021).

The Red Hat: It symbolizes affective or emotional thinking, based on what lies in the depths of emotions and feelings, and the characteristics of a thinker who wears a red hat is focuses on: showing feelings (not necessarily justification), showing an irrational human side, often characterized by bias or guesswork that does not reach the point of making them hypotheses (Qatami, 2010; Al-Sharari, 2021).

The Black Hat: It symbolizes negative (or critical) thinking: whether in his perception of the future situations, or his assessment of the conditions of his past, and although it seems logical, it is not always fair. This type of thinking has its positive aspects, as it identifies the risks that can occur when taking any opinion. The person who wear this hat focuses on: criticizing and rejecting opinions using logic and clarifying the reasons that may lead to failure, focusing on obstacles, problems and failed experiences, and not using emotions and feelings clearly, but using logic and expressing opinion in a negative way (Setyaningtyas, & Radia, 2019; Phuntsho & Wangdi, 2020).

The Yellow Hat: It symbolizes positive thinking, it is a mixture of optimism and the desire to see things achieved and obtain benefits, and it needs strong arguments so that it does not turn into a kind of guesswork, and despite its importance in the way of thinking, it is not enough and needs negative criticism to achieve balance. The thinker who wear this hat focuses on: optimism, courage, and willingness to experiment, supporting and accepting opinions using logic and showing the reasons for success, clarifying the strengths of the idea and focusing on its positive aspects. The love of production and achievement is dominated by its owner, not necessarily creativity (Setyaningtyas, & Radia, 2019)

The Green Hat: It symbolizes the creative thinking that goes far behind the positive evaluation and overlooks making mental judgments so that those judgments do not restrict him from finding the new thing, the person who uses the Six Hats is characterized by the following: Being keen on new ideas and opinions, searching for alternatives for every matter and being ready to practice the new ones, trying to develop new or strange ideas, and using creativity and its means (Al-Owaidi, 2020)

Blue Hat: It symbolizes directional (holistic) thinking: the owner of the blue hat decides which hats should be active and when they should work. He lays out the plan for different hats thinking and proceeds to give instructions in a certain order. The task of the blue hat thinker is to notice any departure from the topic around which the research and thinking revolve. So the blue hat suggests organized or directed thinking and its owner is characterized by interest in the following: programming, arranging, steps of implementation and achievement, directing dialogue, thought and discussion to come up with practical matters, focusing on the subject's focus and avoiding exaggeration or deviation from the topic, organizing and directing the thinking process, directing other hat owners (and Often by questions) and to prevent controversy between them, summarizing, compiling and crystallizing opinions, its owner tends to manage the meeting even if he is not the chair of the session (Kenny, 2003; Setyaningtyas, & Radia, 2019).

The six hats are distinguished by their use of six patterns of thinking, and when the individual discusses or thinks, he uses one of these six patterns, and each pattern is expressed in a certain color. Debono believes that these colors have connotations that give a psychological atmosphere to thinking, and the six colors were chosen to give a kind of psychological atmosphere. On the process of thinking, the red color symbolizes love and passion, so it was chosen to indicate emotional thinking, and the yellow color was taken from the color of the sun, which has a great role in life and development, as it is a source of all kinds of energy, so it was chosen to indicate positive thinking, while the black color symbolizes pessimism, negativity and deficiency.

Therefore, it was chosen to denote negative thinking. The white color symbolizes purity, so it was chosen to denote neutral thinking that does not have any positive or negative orientations, while green symbolizes creative thinking, which is taken from the color of the plant because of the greatness and creativity of the Creator, while the blue color symbolizes holistic thinking, (Kenny, 2003; kaya, 2013; Qatami & Al- Subai'i, 2008; Al-Owaidi,2020). In this context, the use of the Six Hats strategy in teaching achieves educational values and advantages in thinking and achievement, and its use reflects

a positive return for both learners or teachers, and among these values are the following:

- Drawing attention to six types of thinking from which six different visions of issues and ideas can be produced.
- It frees thinking from the limitations of the self, which is responsible for most practical errors of thinking.
- It prevents mixing of ideas, so that each style of thinking takes its share of attention, and in a parallel line.
- Helps learners to use all hats instead of only one pattern.
- Easy to handle as a symbolic language, and in particular in the presence of colors.
- It has an effect on brain chemistry and people's psyche, and thus helps diversify thinking.
- Give time to make effort and creative ideas.
- The Six Hats guide learners towards creative solutions.
- It helps to treat the subject in a holistic manner, and enables the mind to be free.
- It distances learners from sterile arguments, and enables them to cooperate in discovering constructive ways of dialogue.
- It makes learners more focused towards solving the problem, or generating a set of solutions (Al-Barakati, 2008; Al-Omari, 2014).

The assumptions on which the Six Thinking Hats strategy is based are:

- It is not permissible to wear one hat all the time.
- Wearing one hat restricts the mind and thinking.
- Since the human mind grows and develops, the hats must be changed from time to time.
- Wearing a hat depends on the situation in which the individual is.
- Individuals have different preferences at different times, so this is met by wearing different hats.
- The hat is the most shaped of the head, so it can do what the brain does (Debono, 2008; Al-Owaidi,2020).

There is also no binding arrangement in teaching using the six thinking hats strategy to move from one hat to another, but there is flexibility in wearing hats and moving between them, which facilitates the use of this strategy, but it is preferable to start with the white hat to collect information, and the blue one at the end, and it is better to make the green hat Follow the yellow hat, because creativity needs a positive spirit, and the yellow hat contains the positives, and there is no obligation to use all the hats in one lesson, where a number of hats can be chosen for a particular lesson, and any of the previous hats can be repeated if necessary, with focus On learner positivity, effectiveness and activity while using these hats (Paterson, 2006; Debono, 2008)

The issue of using the Six Thinking Hats strategies has also attracted the attention of some researchers recently at the international and regional levels. Many studies have been conducted on the impact of using the Six Thinking Hats strategy in teaching science in general and teaching physics in particular.

Al-Owaidi (2020) aimed to measure the effectiveness of a study unit based on the Six Thinking Hats program in developing creative teaching skills for female student teachers in the areas of: planning, implementation, evaluation and their attitudes towards it. The study sample consisted of 25 female students enrolled in the General Diploma in Education program. There are statistically significant differences between the means of the pre- and post-measurement in the achievement test in favor of the post-measurement, and the effect size of the study unit according to the value of the Eta square (η2) was very large.

Hassan (2019) conducted a study aimed to investigate the effect of using the six hats strategy in acquiring chemical concepts for fourth grade students. The study sample consisted of (58) students, they were randomly distributed into two experimental groups that were taught the six hats strategy and a control group taught in the usual way, with a total of (29) students for both groups.A test was used to acquire chemical concepts The results showed:that The students of the experimental group outperformed the students of the control group in the students' acquisition of chemical concepts.

And The study of Shalaby (2019) aimed to investigate the effect of the Six Thinking Hats in science teaching on the development of creative thinking among second-grade students (in Ma'an. The study sample consisted of (50) male and female students equally divided into two experimental and control divisions. The results showed that there were statistically

significant differences in the students' performance on the test Creative thinking is attributed to the six hats program, while there were no statistically significant differences due to the interaction between the training program and the academic average.

Salah Eldeen & Maher, (2016) conducted a study that aimed to investigate the effect of using the Six Thinking Hats strategy in teaching the health and fitness course on developing creative thinking and academic achievement among first-year students in the College of Education. The study sample consisted of (76) female students. It was divided randomly into two groups: an experimental group consisting of (37) students who studied using the Six Thinking Hats strategy, and the control group consisting of (39) students who studied using the traditional method. The study tools were the academic achievement test and the creative thinking test. The data were analyzed statistically and the results resulted in superiority The experimental group that studied using the six thinking hats strategy over the control group that studied in the usual way in developing achievement and creative thinking.

Allawi's study (2015) aimed to identify the impact of the six hats strategy on the development of Deductive thinking among fourth grade female students in Iraq the study sample consisted of 56 students, with 28 for both the experimental and control groups, and one of the most important results of the study is the presence of statistically significant differences between the mean scores of the two study groups in the inferential thinking test in favor of the experimental group students.

Tawfiq (2014) conducted a study aimed at explore the effectiveness of using the Six Thinking Hats in teaching physics subject in acquisition the physics concepts and developing Meta-cognitive skills for the second-grade students of secondary. The research sample consists of (62) student which divided into two groups: the control group, consists of (30) student, studied by the traditional method; and the experimental group, consists of (32) student, studied by the Six Thinking Hats. The research tools: the test of Physics concepts that related to the unit, measures of Meta-cognitive skills. The research founded effectiveness of using the Six Thinking Hats in acquisition the Physics concepts and developing the skills Meta-cognitive skills, as well as there are a positive correlation between students' scores in post application of physics concepts test and Meta-cognitive skills measure.

Al-Otaibi,(2013) conducted a study aimed at investigating the effect of teaching with the Six Thinking Hats strategy on academic achievement and inclinations towards biology in Makkah Al-Mukarramah; The study sample consisted of 62 female students from the first year of secondary school, they were divided equally into two groups: experimental and control. There are statistically significant differences between the mean scores of the two study groups in the achievement test and the propensity scale in favor of the experimental group students

Study of Toraman and Altun (2013) aimed to reveal the effectiveness of applying an educational design based on the six hats strategies in developing the attitude towards the environment and life. From the seventh grade science book. The study sample included (20) male students (10 female and 10 male) in Beykoz of Istanbul, and the study tool consisted of observation card, open questions and documents as a main source of data, and one of the most important findings of the study: There is an improvement in students' understanding and skills towards The environment, and a negative view of life and the environment in the future was revealed by the majority of the sample.

Gunes & Demir (2013) conducted a study aimed at investigating the effectiveness of the Six Thinking Hats on the achievement of second-year university students in teaching the endocrine system. The researchers used the quantitative and qualitative method in data collection and evaluation. The study sample consisted of (60) students. Ondekouz Mais University in Turkey, it was divided into two equal groups, experimental and control, and the test results showed that the experimental group outperformed the control group in the test of achievement of scientific concepts related to the endocrine system. And develop creative thinking by dealing with various aspects of the subject.

Radwan (2012) conducted a study aimed to reveal the effect of using the Thinking Hats strategy on developing scientific concepts and decision-making skills in science for eighth grade female students at the International Relief Schools in Gaza. The study was applied to a sample of (80) female students divided into two groups, an experimental group studied using the hats strategy. Thinking and a control group studied in the usual way, and the measurement tools

were prepared, which included a test of scientific concepts and a measure of decision-making skills.

The study concluded the following results: There are no statistically significant differences at the level ($a \leq 0.05$) in the average scores of the scientific concepts test as a whole, and there is a statistically significant difference in the scores of higher-order thinking skills after the decision-making skills scale in favor of the experimental group.

The problem of the study and its hypotheses

The process of acquiring scientific and physical concepts among students is one of the main objectives of the educational process and science teaching, and accordingly, educators believe that it has become necessary to pay attention to education based on the use of modern educational methods, and to search for new strategies that meet the needs of the student, and are in line with scientific progress and human development that goes beyond mere memorization of the student information to and use it in new situations.Since the stage of basic education is one of the important stages in which scientific concepts are built for students, the teaching of concepts for this stage still does not receive the desired attention, as traditional teaching methods suffer from shortcomings in providing students with correct physical concepts; This requires the introduction of the Six Thinking Hats strategy, which the researchers expect to help students acquire physical concepts, and the acquisition of concepts may be modified by achievement motivation (high, low) among students of the basic stage, which was included in this study because of its prominent importance in sequential educational theories; And the idea of the study also came from the educational literature, which calls for a move away from traditional teaching methods and the adoption of constructivist methods in teaching. According to the researchers' knowledge, the effectiveness of the Six Thinking Hats strategy in acquiring physical concepts has not been studied, So this study was conducted to determine the appropriateness of the Six Thinking Hats in acquiring The physical concepts of the tenth grade students in the light of their achievement motivation, so this study comes to answer the follows main question:

What is the effectiveness of using the Six Thinking Hats in acquiring physical concepts for tenth grade students in the light of their achievement motivation?

To answer the study question, the following hypotheses were formulated:

1. There is no statistically significant difference ($\alpha = 0.05$) between the average acquisition of physical concepts for tenth graders who studied using the Six Thinking Hats strategy and the average of their peers who studied using the traditional method.

2.: There is no statistically significant difference ($\alpha = 0.05$) between the average acquisition of physical concepts among tenth grade students due to their achievement motivation level.

Third: There is no statistically significant interaction ($\alpha = 0.05$) between the Six Thinking Hats strategy and achievement motivation level in acquiring physical concepts for tenth grade students.

The importance of study

From the theoretical side: this study comes from being one of the first studies that applied the Six Thinking Hats strategy in teaching physics according to the researchers' knowledge, and It also helps to enrich scientific research and teaching methods in science curricula. From the practical side, by providing lessons using Six Thinking Hats strategy to help students acquire physical concepts; and also provides a test for acquiring physical concepts, which students of scientific research may benefit from when preparing their tools. In addition This study may open the way for educational researchers to conduct other studies related to this strategy.

Study limits and limitations

- The study was limited to an intentional sample of tenth grade students in Madaba Governorate.
- The results of the study are determined by the credibility, validity and reliability of the study tool.

Study terms and procedural definitions

- The Six Thinking Hats Strategy: It is one of the modern thinking teaching strategies developed by Edward de Bono, where "De Bono" divided human thinking into six patterns, and considered each pattern as an imaginary hat that a person wears or takes off according to his way of thinking at that moment, so that the individual moves Thinking from one particular style to another according to the situation he is exposed to, De Bono gave a distinctive color to each hat so that it could be distinguished and memorized easily.
- Acquisition of physical concepts: the students' ability to represent and comprehend physical concepts and use them in describing, explaining, predicting natural phenomena and applying them in new life situations. The acquisition of physical concepts was measured by the score obtained on the post-test of physical concepts.
- Achievement Motivation: It is the tendency to obtain success and excellence, and it is considered an educated thing; This means that the individual constantly strives hard and actively to achieve success and perseverance; To complete a variety of class tasks, including very difficult, medium and easy, and procedurally defined by the mark obtained by the student through a questionnaire specially prepared for that; So that the student who got the mark from (1-7) was considered a low achiever, and the student who got the mark from (8-14) was considered a high achiever.

Methodology

The current study follows the experimental approach based on the quasi-experimental design pattern, as it was applied to a study sample from a school chosen intentionally.

The research design of this study includes the following variables:

A- Independent variables:

1- Teaching strategy and it has two levels: the Six Thinking Hats strategy, and the traditional strategy.

2- Achievement motivation (as a categorical variable), it has two levels: high and low

B- Dependent variable: Acquisition of physical concepts

The sample of the study

The study sample consisted of (55) female students of the tenth grade in Madaba Governorate, for the academic year 2020/2021. They were randomly divided into two groups, one of them was an experimental group consisting of (28) students who were taught using the Six Thinking Hats, and the other was a control group consisting of (27) students, taught using the usual method. The female students in both groups were classified according to the academic self-concept into two levels: high and low, as shown in Table (1).

Table (1): **Distribution of the study sample according to teaching method and achievement motivation level**

achievement motivation	Experimental group,	control group	total
High	**15**	**14**	**29**
Low	**13**	**13**	**26**
Total	**28**	**27**	**55**

Study tools:

The study tools consisted of:

1. The Physical Concepts Acquisition Test:

A multiple-choice test was prepared and its validity was verified by presenting it to a group of arbitrators specialized in curricula and science teaching. out of (30) paragraphs. And its stability was verified using Cronbach's alpha equation to calculate the degree of internal consistency between the test items, and the alpha value reached (92.0), and the indicators of the difficulty and discrimination coefficients were calculated for the test items of Acquisition of Physical Concepts. The indicators of the difficulty coefficients for the test items ranged between (0.3). – 0.77) and indices of discrimination coefficients between (0.33-0.69) were considered suitable for the purposes of the study.

2-The achievement motivation scale

referred to in Qatami (1993) is the quest to reach a level of excellence and distinction. Qatami (1993) Arabized the achievement motivation scale, the paragraphs of which were formulated in a way that one half is positive and the other negative, and some of its paragraphs were deleted to suit the Jordanian environment. The paragraphs were reformulated to be more suitable for the study, and then they became fourteen paragraphs, half of them are positive and the other half are negative, which included the answer with yes or no, and the total of (1-7) was considered a low achievement motivation and (8-14) a high achievement motivation. The stability coefficient was found through application and re-application after five weeks, and it was found to be (0.89) and considered appropriate for the study.

3-educational material

Teaching notes were prepared in the(Energy Unit) in line with the Thinking Hats strategy, where they numbered (12) teaching notes. And to verify the validity of the evidence, it was presented to arbitrators specialized in curricula and methods of teaching science, and their observations were taken.

Statistical processing

ANCOVA was applied to discover the effect of independent variables (strategy, achievement motivation) on the dependent variable. The study adopted the level of statistical significance (α = 05.0) to test the null hypotheses of the study. In order to find out the effect size)),, Eta square²(η) and the explained variance (prediction) ratio were used.

The results and their discussion

Results related to the study hypotheses

first: There is no statistically significant difference (α = 0.05) between the average acquisition of physical concepts for tenth graders who studied using the Six Thinking Hats strategy and the average of their peers who studied using the traditional method.

Second: There is no statistically significant difference (α = 0.05) between the average acquisition of physical concepts among tenth grade students due to their achievement motivation level.

Third: There is no statistically significant interaction (α = 0.05) between the Six Thinking Hats strategy and achievement motivation level in acquiring physical concepts for tenth grade students.

The arithmetic means and standard deviations of the scores of the female students in the study sample were calculated on the pre and post tests of acquiring physical concepts. As shown in Table (2).

Table (2): Mean and standard deviations of the students' scores on the Physical Concepts Acquisition Test

strategy	achievement motivation	Pre test			Post test		
		mean	standard deviation	numbers	mean	standard deviation	numbers
experimental group	High	10.75	6.50	15	21.75	4.55	15
	Low	10.65	5.75	13	16.70	5.80	13
	total	10.70	6.13	28	19.22	5.65	28
control group	High	11.24	3.45	14	15.61	4.75	14
	Low	11.91	2.90	13	13.65	2.45	13
	total	11.53	3.15	27	14.63	3.41	27
Total	High	11.00	4.85	29	18.68	5.45	29
	Low	11.28	4.37	26	15.18	4.71	26
	total	11.14	4.58	55	16.93	5.45	55

The Table (2), shows that there is a difference between the mean scores of the female students in the post-test of acquiring physical concepts According to the variables of strategy and achievement motivation level, where the arithmetic

mean of the scores of the experimental group students was (19.22), and the standard deviation was (5.65); While the arithmetic mean of the scores of the control group students was (14.63), and the standard deviation was (3.41).

The arithmetic mean of the scores of the students with high achievement motivation level was (18.68**)**, and the standard deviation was (5.45); While the arithmetic mean of the scores of the students with low achievement motivation was (15.18), and the standard deviation was (4.71). And based on the difference in descriptive statistics (apparently) for the scores of the students of the study members related to the post-test acquisition of physical concepts, it was decided to test the effect of the teaching strategy, achievement motivation, and the interaction between them, in the acquisition of post-physical concepts using the analysis of variance, considering the students' marks on the pre-test physical concepts acquisition co-variant as shown in Table (3).

Table (3): scores of participants on the post-test of physical concepts acquisitions according to strategy and achievement variables and the interaction between them

Source of variation	Square total	Independences scores	Squares means	F value	Significant Level	Eta square
Covariance pre	136.187	1	136.187	8.21	.0.11	0. 171
Teaching strategy	327.765	1	327.765	18.468	0.000	0.251
achievement motivation	199.688	1	199.668	11.185	0.02	0.170
strategy * achievement motivation	30.646	1	30.646	1.651	0.212	0.04
error	1005.229	50	18.612			
total	1656.132	54				

Table (3) shows that there are statistically significant differences (α = 05.0) for the value of "F" (18.468) related to the effect of the teaching strategy on the variation of female students' scores in the post-test of acquisition of physical concepts. In Table (4), this difference was in favor of the students of the study group who studied using the Six Thinking Hats strategy, where the adjusted average for them reached (19.26) marks, while the adjusted average for the students of the study group who were used the traditional method reached (14.51) marks.

In order to find the effect of the teaching strategy and its effectiveness in acquiring physical concepts, the effect size was found using the Eta square $^{2}(\eta)$ given in Table (3), where it was found that it is equal to (0.251); This means that the Six Thinking Hats strategy explains about (25.1%) of the variance in the acquisition of physical concepts among the students of the research individuals, while the rest (74.90%) is not explained and is due to other factors that may not be controlled.

It is noted from Table (3) that there are statistically significant differences (α = 05.0) for the value of "F" (11.185) related to the effect of achievement motivation on the variation in the scores of female students in the post-test physical concepts acquisition, and it is clear from the adjusted averages in Table (4) that this The difference was in favor of the female students with high achievement motivation, as the average for them reached (18.74) marks, while the average for the female students with the low achievement motivation reached (15.03) marks.

In order to find the effect of achievement motivation (high, low) and its effectiveness, the effect size was found using the Eta square $^{2}(\eta)$ given in Table (3), where it was found that it is equal to (0.170); This means that the locus of control explains about (17.0%) of the variance in the acquisition of physical concepts among the students of the research individuals, while the rest (83. %) is not explained and is due to other uncontrolled factors.

It is also noted from Table (3) that there are no statistically significant differences (α = 05.0) for the value of "F" (1.651) related to the effect of the interaction between teaching strategy and achievement motivation in acquiring dimensional physical concepts

Table (4): The modified mean and standard error for the acquisition of physical concepts test

	Group		achievement motivation	
	experimental	control	High	low
mean	19.26	14.51	18.74	15.03
standard error	0.80	0.796	0.764	0.831

Based on the foregoing and based on the previous findings of the study, the following conclusions can be reached:

- The superiority of the Six Thinking Hats strategy over the traditional method in acquiring physical concepts for tenth grade female students.

The superiority of female students with high achievement motivation over female students with low achievement motivation in acquiring physical concepts

- There is no effect of the interaction between teaching strategy and achievement motivation in acquiring physical concepts.

Discussion the results

The results of the first hypothesis that states: There is no statistically significant difference ($\alpha = 0.05$) between the average acquisition of physical concepts for tenth graders who studied using the Six Thinking Hats strategy and the average of their peers who studied using the traditional method

The results showed that the superiority of the Six Thinking Hats strategy over the traditional method in acquiring physical concepts for tenth grade female students. This result is consistent with the results of some similar studies, in terms of what they revealed of the effect of using the Six Thinking Hats strategy in teaching science, as in the study of (Radwan, 2012),

This result can be explained as follows:

Due to the multiplicity of hats, the differentiation of their colors, and the uniqueness of each hat with a specific type of thinking, it facilitated the organization of learning, and then focus on organizing ideas and finding relationships between them, which was positively reflected on the level of students' acquisition of physical concepts.

using of the Six Thinking Hats strategy enhanced the participation of students in generating and discussing ideas, which opened the way for them to acquire and retain concepts, which reduces the process of forgetting, and thus increases the students' understanding and acquisition of physical concepts.

The presence of enrichment activities accompanying the Six Thinking Hats strategy requires students to carry out continuous investigations to obtain information, which led to an increase in students' motivation to learn. In addition the Six Thinking Hats strategy has helped achieve students' interaction with the situations and activities that have been implemented, which may have an impact in contributing to providing an active learning environment that helped students achieve a better understanding than the traditional method.

The results of the second hypothesis that states: There is no statistically significant difference ($\alpha = 0.05$) between the average acquisition of physical concepts among tenth grade students due to their achievement motivation level.

The results showed that the superiority of the students with high achievement motivation level over the students with low achievement motivation level in acquiring physical concepts for tenth grade female students. This result can be explained as follows:

The female students with high achievement motivation were observed to have a greater sense of responsibility required by the educational situation and more daring to search for information and benefit from it in a good way, persevere in performing tasks, and take initiatives to challenge difficult situations and problems, thus immersing themselves in the process of solving them, and giving new ideas and solutions It is an incentive for the students to persevere and insist, to reach the desired understanding of the physical concepts.

The results of the third hypothesis that states: There is no statistically significant interaction ($\alpha = 0.05$) between the Six

Thinking Hats strategy and achievement motivation level in acquiring physical concepts for tenth grade students.The results showed that there was no statistical significance (α = 05.0) for achievement motivation and the interaction between teaching strategy, and achievement motivation in acquiring physical concepts for tenth grade students. This result can be explained on the basis that the effect of the teaching strategy was equal on female students with high achievement motivation and female students with low achievement motivation in acquiring physical concepts alike.

Recommendations:

In light of the results and conclusions reached by the two researchers, recommend the following:-

1. Conducting studies similar to the current study on other subjects and addressing other variables.

2. Adopting the teaching plans prepared according to the six hats strategy in teaching tenth grade students because of its impact on acquiring physical concepts.

3.Training teachers at the basic and secondary levels to use the six hats strategy in teaching.

4. Providing curriculum developers with sufficient and clear information on the importance of the six hats strategy to take this into account in designing and planning school curricula.

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