

"THE IMPACT OF THE 4H STRATEGY ON THE PHYSICAL SURVEY AMONG SECOND INTERMEDIATE GRADE FEMALE STUDENTS IN PHYSICS"

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Summary:

The current research aims to identify the impact of the 4H strategy on the physical survey among female students in the second intermediate grade in physics. This is investigated through the following hypothesis: There is no significant statistical difference at the significance level of 0.05 between the average scores of the experimental group students, who will study according to the 4H strategy, and the average scores of the control group, who will study the same subject in the conventional method in the physical survey. The study was limited to second intermediate grade female students at Al-Shams Intermediate School for Girls, affiliated with the Directorate General for Education in Baghdad / Al-Karkh Second, for the academic year 2023-2024, and to the curriculum including the first three chapters of the physics textbook for the second intermediate grade. Two classes were randomly selected out of six to represent the experimental group, which was taught according to the 4H strategy, and the control group, which was taught according to the conventional method. The total number of research sample members was 64 students, distributed as 32 students in the experimental group and 32 in the control group. Equivalence between the two groups was verified in terms of the following variables: chronological age, intelligence, prior knowledge, and the physical survey scale. Necessary preparations for the research included formulating behavioral objectives for the specified subject, preparing teaching plans for both the experimental group according to the 4H strategy and the control group according to the conventional teaching method, and also a physical survey scale consisting of 35 items, whose validity and reliability were verified and found within the acceptable range. After completing the teaching of the scientific material, which lasted twelve weeks at two sessions per group, data were statistically processed using the SPSS program. The results showed the superiority of the experimental group over the control group in the physical survey. In light of these findings, the researchers presented a number of recommendations and suggestions.

Keywords: 4H Strategy, Physical Survey

Introduction

First: Research Problem

The knowledge explosion and rapid developments in the context of modern educational perspectives, which focus on the learner as the pivot of the educational process, present significant challenges in teaching science in general and physics in particular. Knowledge alone is no longer sufficient for success in a world characterized by continuous development. Learners need

opportunities to develop their skills and personal capabilities. Consequently, there is an urgent need to use modern teaching strategies and methods that are in harmony with scientific development and make the student more effective in the classroom as the foundation of a nation's progress.

Physics is crucial for countries striving for development as it encourages students to correctly engage with scientific ideas, enhances their imaginative capabilities, and increases their motivation towards science and learning. The researchers, through their teaching experience and discussions with physics teachers and supervisors, found that many female students struggle with physics due to its abstract and difficult-to-understand concepts, leading to poor academic performance. A survey among teachers revealed that:

1. 90% of physics teachers use traditional teaching methods, which rely on rote learning and memorization.
2. 95% of teachers are not familiar with the 4H strategy.
3. 94% of teachers lack information about the physical survey.

This situation highlighted the need for modern teaching methods to organize the educational environment in a scientific manner, particularly for facilitating understanding among general students and specifically second intermediate grade female students, thus improving their performance in physical surveys. This led the researchers to use the 4H strategy, which involves procedures and steps that make students more active and central to the educational process. The research problem was defined by addressing the following question:

Does using the 4H strategy have an effect on the physical survey among second intermediate grade female students in physics?

Second: Significance of the Research

In light of the rapid developments and changes in various fields of life resulting from technological advancement, where most countries strive to prepare individuals with skills that are competitive and future-oriented, it has become essential to focus on modern teaching methods and styles that keep pace with these developments, especially in physics. This subject includes numerous concepts, laws, and scientific principles and is an educational tool centered around the natural phenomena of matter, energy, life, and the universe.

Education bears a significant responsibility in keeping up with this development by preparing students capable of adapting to rapid societal changes, developing their talents, and stimulating their motivation. The goal of education is to comprehensively and integrally prepare individuals in all cognitive, social, and psychological aspects, making them useful to their society and themselves. Education is the means by which society faces local and global developments as it transfers knowledge from one generation to another, inducing desired changes and thus achieving societal progress.

Teachers play a vital role in this by helping students connect new knowledge with their existing experiences. They plan and use various methods and strategies in modern teaching methods. Physics, as a subject, is challenging yet engaging, requiring thinking, interpretation,

analysis, organization, and logical reasoning, which contribute to intellectual development and mindset building. It also possesses many unique and attractive qualities that draw interest in its study.

Therefore, when choosing a strategy, it is imperative for the teacher to be aware of the curriculum content, objectives, and have an idea of various traditional and modern teaching methods to select the most suitable and effective one. This ensures that students are able to absorb knowledge, acquire skills, and internalize the values inherent in the curriculum, thereby achieving the curriculum's objectives. This necessitates keeping up with developments in the field of education due to their importance in improving the teaching process.

Among these strategies are active learning strategies, which aim to stimulate students' motivation towards learning in general and contribute to active engagement with all components and elements of the educational environment in the learning context, including knowledge, skills, values, and the acquisition of experience through the simplest possible ways (Mar'i & Al-Hilah, 2005: 21). These strategies also enable them to be independent in learning, capable of facing life's problems, making appropriate decisions and solutions, and taking responsibility for them. Through the diverse activities used in the active learning environment, students are encouraged to listen, see, ask, discuss, search, and all these factors are present in the active learning environment (Khairy, 2018: 20).

The 4H strategy is one of the active learning strategies that provide students with real experiences contributing to effective learning and improving the educational process through knowledge construction and linking learning between school and real-life. It also develops communication skills, encourages students to be citizens with leadership skills, volunteer work, and community service (Davis, 2003: 17-19). This strategy is known for stirring enthusiasm, breaking routine, and activating the student's role (Embou Saidi & Al-Husainiya, 2016: 140), as well as developing their intellectual methodology, helping them build their knowledge, personality development, and creating an encouraging and comfortable educational environment. It focuses on developing creative vision, making smart decisions in problem-solving, and promoting positive behavior and instilling values based on love and respect among students (Heck, K. et al., 2010: 7-9). This type of learning allows learners to express their ideas and thinking processes in problem-solving, evaluate others' solutions, and benefit from them (Ahmed & Aziz, 2018: 500).

Thus, engaging learners in educational activities and encouraging them to use their mental processes through observation, discussion, questioning, and summarization helps them link new information with prior knowledge. They do not absorb information like a sponge; instead, they organize and construct it within a new framework different from the previous one (Druzeh, 2004: 79).

On the other hand, science teaching aims to develop the affective aspect, including scientific inquiry and positive attitudes towards the subject matter, to achieve the desired goal. Curiosity and scientific inquisitiveness help students acquire scientific attitudes, increase perception, and closely link scientific inquiry with thinking skills. Its development depends on approaches, methods, entrances, and the students' specific characteristics and desires to acquire

and reinforce behavior (Mar'i & Al-Hilah, 2005, 229). Curiosity is an individual's drive and desire for knowledge and understanding to develop their capabilities and is largely linked to learning about the subject (Al-Azzawi, 2020: 216). Students show their desire for knowledge and understanding when they face new situations that are difficult to interpret based on their prior knowledge, which encourages them to inquire about things that attract their attention. Students are inclined to research and read, and science teachers should encourage their desire to know and understand phenomena and events around us (Bakhsh, 1994: 94). Student motivation is stimulated through thought-provoking questions, presenting ambiguous situations that require them to seek and think to demystify, or directing their attention to contradictions and flaws in some information, making them feel the need for additional information to explain these contradictions. All these situations require active student participation in lesson activities and teacher encouragement to engage in such activities throughout the lesson (Al-Tantawi, 2013: 150).

Therefore, teachers across all grades and subjects should consider the general levels of students, their preparedness, help them develop their inquiry, follow up on topics that interest them, develop teaching plans for cognitive access, set goals for scientific activities and their drivers, and evaluate progress in light of these goals (Jaber, 2006: 173).

Thus, the importance of the 4H strategy as an active learning strategy that makes students the center of the educational process has emerged. It is suitable for all educational curricula as it is based on the constructivist theory, and the importance of physical curiosity is considered fundamental in learning as it facilitates cognitive mental processes.

The importance of the research is evident in the following aspects:

1. To the researcher's knowledge, there is no existing study that has addressed the 4H strategy in the physical survey among second intermediate grade female students in physics.
2. The significance of active learning, which makes the students more active and interactive during the lesson using the fundamental elements of the strategy: heart, hand, head, and heat.
3. Directing the attention of teachers to the physical survey among female students, arousing their interest in discovering and understanding new knowledge, and developing themselves.

Third: Research Objectives and Hypotheses

The current research aims to understand the impact of the 4H strategy on the physical survey among second intermediate grade female students in physics. This is examined through the following hypothesis:

1. There is no statistically significant difference at the 0.05 significance level between the average scores of the experimental group students who will study according to the 4H strategy and the average scores of the control group who will study the same subject in the conventional method in the physical survey scale.

Fourth: Scope of the Research

1. Geographical scope: Second intermediate grade female students in schools under the Directorate General for Education of Baghdad Al-Karkh Second.
2. Subject matter scope: The first three chapters of the fifth edition of the physics textbook for the second intermediate grade for the academic year 2023-2024, namely (Motion, Laws of Motion, Work, Power, and Energy).
3. Temporal scope: The first semester of the academic year (2023-2024).

Fifth: Definition of Terms

Firstly: 4H Strategy

Defined by Heck, K., et al. (2010) as:

A strategy that promotes positive behavior and instills values based on love and respect among students, and communication with others by building an effective relationship between students and the local community, using time wisely to achieve a balance in life or work during leisure times, and acquiring positive attitudes towards self and self-worth (Heck, K., et al., 2010: 7-9).

Defined by Embou Saidi and Al-Husainiya (2016) as:

"One of the active learning strategies that breaks routine, stimulates enthusiasm, serves as a quick review of learned material, and consists of four steps: heart, head, heat, and hand to enhance students' achievement" (Embou Saidi and Al-Husainiya, 2016: 140).

The researchers adopt the definition of Embou Saidi and Al-Husainiya (2016) for the 4H strategy as a theoretical definition.

Operational definition of the 4H strategy:

A set of planned and organized steps followed by the researcher in the educational context with the experimental group of second intermediate grade female students to clarify concepts, facts, and solve problems to achieve the desired objectives.

Secondly: Inquiry

Defined by Al-Shalawi (2009) as:

"The emotional state exhibited by a student in terms of desire and questioning about scientific topics and phenomena within their level of thinking and interests" (Al-Shalawi, 2009: 20).

Defined by Kashdan (2018) as:

"The recognition, pursuit, and desire to explore new, uncertain, complex, and ambiguous events, an effort by the learner to identify and take an interest in those events and phenomena" (Kashdan, 2018: 130).

Operational definition of inquiry:

A psychological readiness that expresses the emotional state of a second intermediate grade female student when stimulated by a physical situation that incites her to research, investigate, and

increase knowledge about it, as evidenced by her response to the items of the specially prepared inquiry scale.

Theoretical Background and Previous Studies:

Theoretical Background consisting of two main axes:

First Axis: Active Learning

Active learning is both a learning and teaching method where students actively participate in activities, exercises, and projects within a rich and diverse educational environment. This approach allows for positive listening, constructive dialogue, rich discussion, conscious thinking, and sound analysis. It involves deep contemplation of everything read, written, or presented in terms of study material, issues, or opinions, under the precise supervision of a teacher who encourages them to take responsibility for their own learning and pushes them to achieve the ambitious goals of the school curriculum. This focuses on building the complete and creative personality of today's student and tomorrow's woman (Saadah et al., 2011: 33).

Active learning is a practical application of the constructivist theory, emphasizing the active role of the learner in acquiring and building knowledge based on their culture and the society's role in the quality of that construction. This means that each learner has their unique cognitive build, and the teacher must pay attention to each one and provide opportunities for them to apply what they have learned (Daaj, 2020: 68).

It is a student-centered learning style that transforms them from passive recipients of knowledge to active participants in its creation. It involves forming their own cognitive structure by linking past experiences with acquired knowledge and applying what they learn to similar life situations. It emphasizes their active role, providing opportunities for expressing opinions, participating in building their experiences, interacting positively and cooperatively with peers, taking responsibility, and relying on themselves to seek knowledge, acquire skills, and solve problems under the guidance of the teacher (Khairy, 2018: 23).

Elements of Active Learning:

Some educators have identified four key elements as the fundamental pillars of active learning strategies:

1. Listening and attention.
2. Writing.
3. Reading.
4. Reflection and practices.

These elements require different cognitive activities and are essential skills to be developed in students as they play a significant role in the success of the learning process (Khairy, 2018: 76).

Second Axis: 4H Strategy

Several methods, styles, models, and patterns exist in active learning, varying in names and terminologies in research literature, but most agree in structure, foundation, and steps. Among these modern strategies is the 4H strategy, which develops students' self-knowledge through expressing their thoughts and feelings. This strategy aims to break the routine in classrooms and

stimulate enthusiasm in students, serving as a quick review of what has been learned in the class (Embou Saidi and Al-Husainiya, 2016: 140).

It views the student not just as a passive recipient of information but as actively interacting with the presented material, linking experiences with the knowledge presented. The teacher organizes tasks and develops student skills around the subject, rooted in their ideas, feelings, and the academic environment, linking them to the general atmosphere (Ali, 2019: 11).

In this strategy, students in a classroom are divided into small groups, working together with everyone bearing the responsibility for learning within the group, achieving the desired goals under the teacher's supervision and guidance.

Hendricks from the University of Iowa, USA, designed the 4H strategy, originating in the early 20th century to address the disinterest of rural youth in learning. The strategy was based on the idea of practical learning as a key point, linking university education to life (Lee, 1995:170).

The 4H strategy activates the student's role in learning and emphasizes active participation between the teacher and students and among the students themselves. Its concept is based on the abbreviation of the four 'H' words (Heart, Head, Heat, Hand), representing heart, head, interaction (heat), and hand, where the student performs activities related to each word (Al-Atbi, 2022: 31). The availability of appropriate educational activities and experiences, along with a suitable climate for academic content and teaching methods, contributes to raising the student's level (Hassan, 2017: 70).

Stages of the 4H Strategy:

- 1. First Stage: Heart - Representing the affective aspect:** In this stage, students express their feelings towards the lesson topic.
- 2. Second Stage: Head - Representing mental processes:** Here, students are given the opportunity to express their thoughts and what is on their minds regarding the lesson topic, encouraging and discussing those ideas freely.
- 3. Third Stage: Heat- Representing classroom interaction:** At this stage, students discuss how to find solutions, cooperate with each other, and describe the general atmosphere in the classroom.
- 4. Fourth Stage: Hand - Representing acquired skills:** In this stage, students write down what they have learned about the lesson topic and generalize the results.

Timing for Implementing the Strategy:

The implementation time is after achieving a specific goal to understand the extent of students' comprehension of the explained topic. It can also be used at the end of the lesson (Embou Saidi and Al-Husainiya, 2016: 140).

Objectives of the 4H Strategy:

1. Creating an encouraging and comfortable educational environment to make learning more enjoyable while developing related skills and practices (Phelps, 2005: 5).
2. Developing creative vision and smart decisions for problem-solving.
3. Enhancing positive behavior and instilling noble values based on love and respect among learners, and communicating with others by building an effective relationship between learners and the local community (Phelps, 2005: 7).

4. Teaching and using acceptable practices for mental, physical, emotional, and social health.
 5. Using time wisely to achieve a balance in life or work and leisure times, i.e., helping to develop positive attitudes towards managing leisure time.
 6. Equipping learners with various skills such as leadership, citizenship, self-confidence, personal discipline, critical thinking, and community involvement (Shank & et al, 2010: 7).
 7. Acquiring positive attitudes towards self and a sense of self-worth (Heck, K. et al, 2010: 7-9).
- The ability to acquire skills, concepts, and information increases the learner's level of perception, contributing to improved performance (Ali, 2022: 69). Many studies have pointed out the failure of many high-qualification institutions due to the low academic level of their employees (Al-Fatlawi & Al-Rubaiey, 2020: 2208).

Second Axis: Inquiry

Curiosity is an important aspect of the academic and educational development of learners. One factor that increases educational motivation is the availability of a safe and freedom-filled educational environment in the classroom and school, through accepting and nurturing students' ideas (Tawq & Abdul Rahman, 1984: 151).

Teachers may need to ensure the presence of physical and mental maturity that allows students to process information and knowledge. Each developmental stage has its characteristics, with certain amounts of knowledge and levels of abstraction required for actual learning to occur. In all cases, science should develop curiosity and the thirst for knowledge, perseverance, and effort in learners. These values achieve cognitive balance, increase motivation levels, and encourage them to learn through research and investigation (Carin & Sand, 1988:93).

Koujak and others (2008) suggest that motivation ensures learning occurs. If a teacher successfully stimulates students' curiosity and makes them feel the importance of the subjects presented, linking them to their current and future lives, it creates a strong desire to learn. Students become ready to participate, research, make efforts, and rely on themselves for knowledge. In this case, the teacher is not the only source of learning; students turn to various sources. The teacher needs to diversify teaching methods to create an educational climate where students are eager to learn more than what is presented and seek further knowledge from other sources. This realization leads to active and positive learning (Koujak et al., 2008: 81).

Al-Tantawi (2008) believes that stimulating students' motivation can be achieved by arousing their curiosity through thought-provoking questions or presenting ambiguous situations that require students to think and seek to resolve. Drawing students' attention to contradictions and gaps in some information makes them feel the need for additional information to resolve these contradictions and interpret them, requiring active participation in lesson activities (Al-Tantawi, 2008: 150).

Mandel (2007) notes that curiosity has positive effects on individuals, including encouraging the pursuit of new experiences, contributing to the feeling of continuous adaptation to environmental challenges, generating positive feelings and a sense of control and competence, and enhancing exploratory tendencies (Mandel, 2007: 118).

Kashdan (2018) states that most research on scientific inquiry and its characteristics confirms that it is a general, unified trait linked to the motive of exploration and learning, and the readiness to accept the complex and unexpected nature of phenomena. Individuals often seek information to resolve uncertainty and tension when facing a specific phenomenon (Kashdan, 2018: 131).

Types of Curiosity:

There are three types of curiosity:

- 1. Perceptual Curiosity:** This leads to continuous perception of stimuli. When a stimulus affects one of the human senses, it elicits a response due to an internal stimulus driving curiosity. With the continuation of the stimulus, perceptual curiosity decreases due to habituation.
- 2. Cognitive Curiosity:** This represents the individual's desire for knowledge. Satisfying this desire reduces tension in the individual caused by the need for knowledge (Al-Dosouki, 2006: 327).
- 3. Sensory Curiosity:** It manifests in the individual's desire to search and participate in various activities, whether social, sports, or adventures such as mountain climbing and deep-sea diving (Eid, 2009: 22).

Importance of Scientific Inquiry:

The importance of inquiry is represented in:

1. It plays a large part in developing innovative thinking.
2. It encourages students to be active, persevering, confident in their abilities, and allows a degree of freedom to explore the surrounding world.
3. Including the basic principles of inquiry in curricula and teaching methods helps attract students' attention and progress to new learning situations without boredom.
4. Inquiry is a key component in many research studies, as John Dewey showed that curiosity is the foundation for developing a scientific attitude.
5. Curiosity behavior and its nature are more closely related to science learning and the development of its curricula.
6. It is one of the basic processes for understanding in learning situations.
7. It is an important factor for students, leading to higher achievement levels and expanding their perceptions of attention, questioning, and resolving conceptual conflicts (Bani Jaber, 2002: 170).

Several studies highlight the necessity of curiosity and its impact on learning, innovation, and psychological health, as it:

1. Enables students to respond positively to new, strange, and ambiguous elements.
2. Allows students to express a desire to know more about themselves and their environment.
3. Enables students to persevere in research and exploration.

All these aspects are important and necessary for improving students' academic abilities (Al-Ayaseera, 2011: 326).

Researcher	Year	Study Title	Objective	Sample	Research Tools	Statistical Methods	Results
Adi	2021	The Impact of the 4H Strategy on Achievement and Geographic Inquiry among Fourth Grade Literary Students in Geography	To identify the impact of the 4H strategy on achievement and geographic inquiry among fourth grade literary students in geography.	52 fourth grade literary students/geography subject	1. Achievement test 2. Geographic inquiry scale	T-test for two independent samples	The experimental group outperformed the control group in both the achievement test and geographic inquiry.
Al-Bayati	2023	The Impact of the 4H Strategy on the Achievement of Fifth Grade Science Students in Chemistry	To explore the impact of the 4H strategy on the achievement of fifth grade science students in chemistry.	50 fifth grade science students/chemistry subject	Achievement test	T-test for two independent samples	The experimental group outperformed the control group in the achievement test.

Table (2) Second: Studies Addressing Physical Inquiry as a Dependent Variable:

Researcher	Year	Study Title	Objective	Sample	Research Tools	Statistical Methods	Results
Abush (2013)	2013	The Impact of Two Active Learning Strategies on the Achievement of Second Intermediate Grade Students in Physics and the Development of Their Physical Inquiry	To identify the impact of two active learning strategies on the achievement of second intermediate grade students in physics and the development of their physical inquiry.	96 second intermediate grade students/physics subject	1. Achievement test 2. Physical inquiry scale	T-test for two independent samples	The experimental group outperformed the control group in developing physical inquiry.
Abdullah & Abdul Razzaq (2020)	2020	Effectiveness of the Cognitive Acceleration (CASE) Model on the Problem-Solving Ability of Second Intermediate Grade Students	To explore the effectiveness of the Cognitive Acceleration (CASE) model in the problem-solving ability of second	78 second intermediate grade students/physics subject	1. Physics problem-solving test 2. Physical inquiry scale	T-test for two independent samples	The experimental group outperformed the control group in developing physical inquiry.

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Researchers' Insights from Previous Studies:

In light of the studies presented by the researcher, the insights gained can be summarized as follows:

1. Reviewing available sources and previous studies and how they can be employed in the current research.
2. Utilizing statistical methods to analyze data, interpret it, and compare these results with her future research findings.
3. Understanding the methodologies of these studies and the types of experimental designs used in them.
4. Preparing research tools, including the physical inquiry scale.

Research Methodology and Procedures:

First: Choosing the Experimental Design

The experimental design is a plan and work program representing how the experiment is conducted, meaning planning for the conditions and factors surrounding the phenomenon being studied in a certain way and then observing what happens (Al-Asadi & Sundus, 2015: 151).

Second: Identifying the Research Population and Sample

The research population represents second intermediate grade female students in the Directorate General for Education of Baghdad/Al-Karkh Second for the academic year (2023-2024). The sample chosen intentionally from Al-Shams Intermediate School for Girls consisted of 232 students, distributed randomly across six sections. Following a random lottery, Section B was designated as the experimental group and Section A as the control group, with 32 students in each group.

Third: Control Procedures

Efforts were made to ensure statistical equivalence between the experimental and control groups in variables that could affect the experiment's integrity, including chronological age in months, prior knowledge in physics, and intelligence, assessed using Raven's Standard Progressive Matrices.

Physical Inquiry Scale:

After preparing the physical inquiry scale and ensuring its psychometric properties, it was applied to the research groups. To verify the equivalence between the experimental and control groups in physical inquiry, a t-test for two independent samples was used, showing no significant difference, indicating equivalence in the physical inquiry variable.

Variable	Group	N	Mean	Standard Deviation	T-Value Calculated Table	
Chronological Age in Months	Experimental	32	159,81	3,105	0,377	2.000 Significance Level 0.05 Degrees of Freedom 62
	Control	32	159,50	3,510		
Previous Knowledge	Experimental	32	10,06	2,036	0,109	
	Control	32	10	2,502		
Intelligence (Raven)	Experimental	32	32,91	7,973	0,812	
	Control	32	31,31	7,731		
Physical Inquiry	Experimental	32	71,41	15,844	0,342	
	Control	32	70,16	13,274		

Controlling Extraneous Variables:

The researchers conducted both internal and external validations to control these variables with the aim of obtaining precise results that would provide objectivity to the research and allow for the generalization of its findings to the broader community. There were no incidents or unexpected circumstances during the execution of the experiment. Attendance was consistent, and no student was transferred from the school during this period. The researchers randomly selected the research groups to avoid individual differences between the students. The duration of the experiment was equal for both groups, lasting twelve weeks, and focused on the same curriculum represented by the first three chapters of the physics textbook for the second intermediate grade.

Research Requirements:

To achieve the research objective and test its hypothesis, several specific requirements needed to be prepared and made ready for the research:

1. Determining the Scientific Material: The first three chapters of the prescribed physics textbook for the second intermediate grade, which are studied during the first semester of the academic year (2023-2024).
2. Formulating Behavioral Objectives: Behavioral objectives refer to the mental and physical responses and behaviors of the students in both the experimental and control groups, which are fundamental tasks in constructing the educational process. Teachers are expected to undertake this task (Al-Samarrai & Raed, 2014: 13). The researcher formulated behavioral objectives in light of the general goals of teaching physics to the second intermediate grade and the content of the material to be taught in the experiment. A total of 102 behavioral objectives were formulated according to Bloom's Taxonomy of the four cognitive levels (Remembering, Understanding,

Applying, Analyzing), which are supposed to be achieved through daily teaching plans, as shown in Table (4) below.

Table (4) Behavioral Objectives According to Bloom's Taxonomy for the Designated Teaching Material from the Prescribed Physics Textbook:

Chapter	Content	Cognitive Domain					Skill Domain	Affective Domain
		Remember	Understand	Apply	Analyze	Total		
First	Motion and Force	21	11	11	6	49	3	3
Second	Laws of Motion	14	6	5	2	27	2	3
Third	Work, Power, and Energy	13	6	5	2	26	2	3
Total		48	23	21	10	102	7	9

3. Developing Teaching Plans: Teaching planning aids teachers in organizing the educational process through selecting educational objectives, teaching methods, instructional materials, content, and appropriate assessment techniques. This prevents improvisation and helps teachers confidently address educational situations, avoiding embarrassment and understanding the extent to which educational objectives are achieved (Al-Afnan & Fatima, 2011: 237). A total of 32 teaching plans were prepared, with 16 plans each for the experimental and control groups, based on the prepared behavioral objectives and the content of the study material.

Fifth: Research Tools

This research required the preparation of a tool to measure the dependent variable (physical survey), which was prepared as follows:

1. Preparation of the Physical Survey Scale:

- The scale was prepared by following these steps:

1. Defining the purpose of the scale: The scale aims to measure the exploration of physical situations and phenomena among second-year middle school students for the academic year 2023-2024.

2. Determining the scale domains: The scale prepared by the researcher included various areas in physics such as magnetism, electricity, mechanics, sound, light, and astronomy, with a total of 7 domains.

3. Preparing the scale items: The researchers modified the seven groups of questions to contain different questions in physics, chemistry, biology, and astronomy into general physical situations present in our lives to make the scale specific to physical exploration. A total of 35 items were prepared, distributed across 7 domains, each presenting a physical situation followed by two interrogative questions, with each situation comprising 5 items.

Scale Validity:

- Two types of validity were adopted:

- Face validity: To verify face validity, it was presented to a group of judges with expertise in teaching methods, measurement, and evaluation to determine the suitability, clarity, and precision of the physical survey items. Their observations and suggestions were aimed at improving the items. Based on an agreement rate of 80%, several questions and items were rephrased while maintaining the total number of items at 35.

- Construct validity: Pearson correlation coefficient was used to find the correlation between item scores and the scores of the domain to which they belonged. The correlation coefficients ranged between 0.313 and 0.743, indicating that all were statistically significant as they were greater than the table value of 0.196 at a significance level of 0.05. Furthermore, the correlation between the domain scores and the total scale score was calculated using Pearson's correlation coefficient, ranging between 0.589 and 0.889, also indicating statistical significance.

Discriminatory Power of the Scale Items: The t-test for two independent equal samples was used, and the calculated t-values served as indicators for distinguishing each item by comparing them with the table t-value of 2.000 at a significance level of 0.05 with 52 degrees of freedom. All calculated t-values were greater than the table value.

Scale Reliability: Reliability was established using two methods:

1. Cronbach's alpha method: The reliability value by this method was 0.88.
2. Test-retest method: The reliability value by this method was 0.87.

Statistical Means

The SPSS statistical package was used for the statistical processing required by the research.

Presentation and Interpretation of Results:

Firstly: Presentation of Results

- The results related to the null hypothesis, which stated that there is no statistically significant difference at the significance level of 0.05 between the average scores of the experimental group students, who studied the prescribed material using the 4H strategy, and the average scores of the control group students, who studied according to the conventional method, in the physical survey scale. To verify the validity of the first null hypothesis, the researchers organized the scores obtained from applying the physical survey scale in a table for both the experimental and control groups, then calculated the mean and standard deviation for the students' scores in both groups. The statistical results showed that the mean score for the experimental group students was 77.56 with a standard deviation of 10.242, while the mean score for the control group students was 66.66 with a standard deviation of 13.163. To determine the significance of the difference, the t-test for two independent equal samples was used, and the calculated t-value was 3.699, which is greater than the table value of 2 at a significance level of 0.05 and 62 degrees of freedom. This means that there is a statistically significant difference between the average scores of the two groups in the achievement test in favor of the experimental group students. Thus, the null hypothesis is rejected, and the alternative hypothesis, which states that there is a statistically significant difference at the significance level of 0.05 in favor of the experimental group, is accepted. This indicates that the

use of the 4H strategy had a positive effect on the physical survey scale. To ensure that these differences were

a result of the independent variable's (4H strategy) effect on the dependent variable (physical survey) and not due to chance, eta squared (η^2) was calculated to determine the effect of the independent variable on the dependent, which was 0.181, indicating a significant effect according to the standards set by Kiees (1989: 445). The effect size (D) was also calculated to determine the degree of impact, which was 0.93, a significant degree according to the standards classified by Cohen, as mentioned by Julie Pallant (2007: 246) in the table below.

Table (5) Effect Size Values

	Small	Medium	Large
η^2	0.01	0.06	0.14
D	0.20	0.50	0.80

Interpretation of the Null Hypothesis Results:

The research results in the Physical Survey Scale indicate the superiority of the experimental group, which studied using the 4H strategy, over the control group, which studied using conventional methods in the Physical Survey Scale. This study aligns with the studies of Abboush (2013) and Abdullah & Abdul Razzaq (2020). The reasons for the experimental group's superiority, from the researcher's perspective, include: 1. The 4H strategy aligns with the principle of focusing on the learner, who is central to the educational process. This contributed to increasing the effectiveness of the experimental group students in independently, earnestly, and persistently seeking information within a competitive classroom environment, thereby enhancing their curiosity in physics. 2. The 4H strategy allowed students to exchange views and ideas about physics topics among themselves, which increased their desire to learn more about physics topics and, consequently, their curiosity.

Conclusions:

Based on the research findings, the researcher concludes the following: 1. Teaching physics using the 4H strategy had a positive and acceptable impact on the achievement of second-year middle school students compared to the conventional method of teaching physics. 2. The 4H strategy satisfied the curiosity in the Physical Survey among the students who were taught using it. 3. The 4H strategy created a broad space for classroom interaction between the physics teacher and her students.

Recommendations:

In light of the research findings, the researcher recommends the following: 1. Train middle school physics teachers on how to use modern learning strategies, including the 4H strategy. 2. Emphasize to physics teachers the importance of employing an encouraging educational environment for their students to help them develop a love for scientific curiosity. 3. Urge physics teachers not to adhere strictly to traditional methods and to follow modern teaching methods and strategies that develop students' cognitive and skill abilities.

Suggestions for Further Research:

To build upon this study, the researcher suggests conducting the following studies: 1. Conducting a similar study using the 4H strategy in achievement in other educational stages and subjects. 2. The effectiveness of the 4H strategy in acquiring physical concepts and logical intelligence among fourth-year preparatory students.

Reverence

1. .Ali, Ismaeel Ibrahim, (2022): Logical inferences according to the Cognitive Development model among Preparatory school students , International Journal of Health Sciences, 6(S9), 59-72 .
2. Abboush, Hussein Zain Al-Abidin Abdullah Al-Sheikh (2013): The Impact of Two Active Learning Strategies on the Achievement of Second Intermediate Grade Students in Physics and the Development of Their Physical Inquiry, Master's Thesis, College of Education, University of Mosul, Iraq, Unpublished.
3. Abd al-Razzaq Yasin Abd Allah, Ahmad Salem Qasim Al-Azzawi (2020): The Effectiveness of the Cognitive Acceleration Model (CASE) in Enhancing the Problem-Solving Ability and Scientific Inquiry of Second Intermediate Grade Students, Published Research, College of Education Journal, Wasit University.
4. Abu Al-Haj, Suha Ahmad and Hassan Khalil (2016): Active Learning Strategies, 1st Edition, De Bono Center for Teaching Thinking, Amman.
5. Adi, Omar Abdullah Ahmad (2021): The Impact of the 4H Strategy on Achievement and Geographical Inquiry among Fourth Literary Grade Students in Geography, Master's Thesis, College of Education for Human Sciences, University of Mosul, Unpublished.
6. Ahmed, Susan Duraid & Aziz, Majed Saleem ,(2018) : The Effect of Cognitive Modeling Strategy in chemistry achievement for students , Opcion , Ano34, Especial No.17 (498-520).
7. AL- Afoun, Nadia Hussain Younis, (2022) : The Effect of Instructional Design According to Experiential Learning Strategies for the First Intermediate Grade Students in Preparing Information for Science Subject , SPECLALUSIS UGDYMIS/ SPECIAL EDYCATION , Volume(1) ,Issue (43).

8. Al-Afoun, Nadia Hussein and Fatima Abdul Amir Al-Futlawi (2011): Methods and Strategies for Teaching Sciences, 1st Edition, Basic Education Library, Baghdad.
9. Al-Afoun, Nadia Hussein Younis (2012): Modern Trends in Teaching and Developing Thinking, Al-Safa Publishing and Distribution, Amman, Jordan.
10. Al-Afoun, Nadia Hussein, and Al-Razaki, Wesen Mohan Mohsen (2017): Content Analysis of the Second Grade Science Book According to the Dimensions of Sustainable Development, Educational and Psychological Research Journal, Issue (52), University of Baghdad, College of Education for Pure Sciences / Ibn Al-Haytham.
11. Al-Asadi, Said Jassim and Sundus Aziz Faris (2015): Research Methodologies in Educational and Psychological Sciences, Dijlah Library, 1st Edition, Amman, Jordan.
12. Al-Atbi, Khalifa Mohammed Ali Khalifa (2022): The Impact of the 4H Strategy on Science Achievement and Creative Thinking among Second Intermediate Grade Students, Master's Thesis, Basic Education College, Diyala University, Unpublished.
13. Al-Ayasrah, Walid Tawfiq (2011): Teaching and Learning in Educational Psychology, 1st Edition, Osama Publishing, Distribution, and Printing House, Amman, Jordan.
14. Al-Azzawi, Ahmed Qassem, Abdul Razzaq Yasin Abdullah (2020): The Level of Physical Inquiry among Third Intermediate Grade Students and Its Relationship with Some Variables (Achievement, School Type, Gender), Journal of the College of Basic Education for Educational and Human Sciences, Issue 48, Special Issue for the First International Virtual Scientific Conference.
15. Al-Bayati, Adnan Hikmat (2023): The Impact of the 4H Strategy on the Achievement of Fifth Scientific Grade Female Students in Chemistry, Published Research, Cultural Papers, Journal of Arts and Humanities.
16. Al-Fatlawi, Fatimah Abdulameer & Al-Rubaiey, Yusra Qasim (2020) "Effects of Merging the Dimensions of prevention Education in Biology on the Health Values amongst Fourth Grade (Scientific Section) Female Students", Journal of Xi'an University of Architecture & Technology, Volume(12), Issue (4)
17. Al-Harashsheh, Kawthar Aboud (2012): The Impact of the Analogy Strategy in Teaching Science on the Acquisition of Scientific Concepts and the Level of Performance of Basic Scientific Operations, Damascus University Journal, Vol. (28), No. (2).
18. Al-Harbi, Mohammed bin Sunt and Amna bint Said (2020): The Effectiveness of the Educational Scaffolding Strategy in Developing Academic Achievement and Critical Thinking among Second Secondary Grade Female Students in Mathematics, Journal of the College of Education for Girls, University of Baghdad, Volume (31).
19. Al-Hilah, Mohammed Mahmoud (2002): Classroom Teaching Skills, 1st Edition, Al-Masirah Publishing House, Amman.
20. Ali, Sadiq Mazhar (2019): The Impact of the 4H Strategy on the Expressive Performance of Fifth Literary Grade Students, Master's Thesis, College of Education for Human Sciences, Tikrit University, Unpublished.

21. Al-Khafaji, Raed Idris Mahmoud, Abdul Sattar Saleh Assi, Sarah Kareem Mohammed (2021): Modern Technology and Teaching Strategies: Therapeutic Approaches and Social Communication, 1st Edition, Noor Al-Hassan Office for Printing, Baghdad, Iraq.
22. Al-Kubaisi, Abdul Wahid Hameed (2008): Measurement and Evaluation: Renewals and Discussions, 1st Edition, Jarir Publishing and Distribution, Amman, Jordan.
23. Al-Samarrai, Qusay Mahmoud and Raed Idris (2014): Modern Trends in Teaching Methods, Dar Dijlah Publishers and Distributors, Amman, Jordan.
24. Awad Youssef Diab, and Magdy Ali Zamel (2010): Active Learning Towards an Effective Educational Philosophical Philosophy, Curriculum Publishing and Distribution House, Amman.
25. Bakhsh, Hala Taha (1994): Effective Teaching of Natural Sciences for Secondary Stage in Light of Educational Competencies, Al-Shorouk Printing Press, Cairo.
26. Bani Jaber, Joudat, et al. (2002): Introduction to Psychology, 1st Edition, Dar Al-Thaqafa for Publishing and Distribution, and The International Scientific House, Amman, Jordan.
27. Carin, A. & R. B. Sand (1988) Teaching Modern Science, Columbus, OH: Merrill Publishing Company, Ohio.
28. Da'aj, Wadah Talib (2020): Modern Teaching Strategies and Their Applications, Ghaida'a Publishing and Distribution.
29. Darwaza, Afnan Nazir (2004): Fundamentals in Educational Psychology, 1st Edition, Dar Al-Shorouk Publishing and Distribution, Amman, Jordan.
30. Davis, shields, (2003). The California 4-H Youth Development Program-Directions for the Decade Ahead, The 4-H Mission and Direction Committee, The University of California, USA., Retrieved 2011-06-07. <http://www.ca4h.org/files/1982.pdf>
31. Desouky, Wafaa Salah El-Din (2006): The Interaction Between Instructional Control Styles and Levels of Curiosity and Its Impact on Developing Internet Skills, Quality Education Conference and Its Role in Human Development in the Era of Globalization, Mansoura University, April 21-31, Egypt.
32. Eid, Anwar Attia (2009): The Effectiveness of a Program to Develop Curiosity among Culturally Deprived Children and Its Impact on Developing Innovative Thinking, Doctoral Dissertation, Institute of Educational Studies, Cairo University, Unpublished.
33. El-Tantawy, Efat Mustafa (2008): Effective Teaching (Its Planning, Skills, Strategies, Evaluation), Al-Masirah Publishing and Distribution, Amman, Jordan.
34. El-Tantawy, Efat Mustafa (2013): Effective Teaching: Its Planning, Skills, Strategies, and Evaluation, 1st Edition, Al-Masirah Publishing and Distribution, Amman, Jordan.
35. Embu Saidi, Abdullah bin Khamis and Al-Housaniya (2016): Active Learning Strategies, 2nd Edition, Al-Masirah Publishing and Distribution, Amman, Jordan.
36. Hassan, Ahmed Obeid (2017): The Inclusion of Biology Textbooks Content for Intermediate Stage on Multiple Intelligences, University of Baghdad, Educational and Psychological Research Journal, Issue (55), College of Education for Pure Sciences / Ibn Al-Haytham.

37. Heck, K., & Subramaniam, A., & Carlos, R., (2010). The Step-It- Up-2-Thrive Theory of Change, 4-H Center for Youth Development, University of California, Davis
38. Jaber, Jaber Abdel Hamid (2006): The Differentiated and Constructivist Classroom, 1st Edition, World of Books for Publishing, Distribution, and Printing, Cairo, Egypt.
39. Kashdan, T. B., Stikma, M. C., Disabato, D. J., McKnight, P. E., Bekier, J., Ka. J., & Lazarus, R. (2018) The five-dimensional curiosity scale: Capturing the bandwidth of curiosity and identifying four unique subgroups of curious people. *Journal of Research in Personality*, (73) P.
40. Khairy, Lamia Mohammed Ayman (2018): Active Learning, 1st Edition, Yastron for Printing and Distribution, Giza, Egypt.
41. Kiess. H. O (1989), statically concepts for the Behavioral Science, Canada Sydney Toronto Allyn an.
42. Kojok, Kawthar Hassan, et al. (2008): Diversifying Teaching in the Classroom: A Teacher's Guide to Improving Teaching and Learning Methods in Arab Schools, UNESCO Regional Office for Education in the Arab States, Beirut, Lebanon.
43. Lee, John B (1995). Head, Heart, Hands, Health: A History of 4- H in Ontario, Ontario 4- H Council.
44. Mandl, M. C. (2007). the Relationship Between Adolescent Parental Attachment, Curiosity, and Coping with Stress. Doctoral dissertation, Department OF Psychology, Wayne State University.
45. Mar'i, Tawfiq Ahmad and Al-Hilah, Mohammed Mahmoud (2005): General Teaching Methods, 1st Edition, Al-Masirah Publishing House, Amman, Jordan.
46. Phelps, Connie S., (2005). The Relationship Between Participation In Community Service Elearning Projects And Personal And Leadership Life Skills Development In Louisiana Highschool 4-H Leadership Activities, Doctor of Philosophy in The School of Human Resource Education and Workforce Development, Louisiana State University.
47. Sa'adeh, Judeh Ahmad, Fawaz Aqel, Magdy Zamel, Jameel Eshtayeh, Huda Abu Arqoub (2011): Active Learning Between Theory and Practice, 1st Edition, Dar Al-Shorouk, Amman Jordan.
48. Shalawi, Taha Mahmoud Hussein (2009): Comparing Three Styles of Exploratory Demonstration Experiments in the Achievement of Second Intermediate Grade Students in Chemistry and the Development of Their Scientific Inquiry, Master's Thesis, University of Mosul - College of Education, Unpublished.
49. Shank, Stephanie & Pater, Susan& Astroth, Kirk (2010). Arizona 4-H Volunteer Handbook, Head, Heart, Hands, Health Cooperative Extension, College of Agriculture and Life Sciences, University of Arizona (Tucson, AZ), Cooperative Extension, AZ4- H V olunteerHandbook Revised2011 pdf.
50. Shbib, Adel Kamel (2017): The Difficulties of Applying Modern Trends in Teaching Physics in Baghdad Secondary Schools from the Perspective of Physics Teachers,

Educational and Psychological Research Journal, College of Education for Pure Sciences
/ Ibn Al-Haytham, Issue (52).

51. Tuq, Muhyi al-Din and Ads, Abdul Rahman (1984): Fundamentals of Educational Psychology, 1st Edition, John Wiley & Sons, New York, United States.