

The Effectiveness of Suchman's Model in Formal Thinking among Fifth Grade Scientific Level Students

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Abstract

The aim of the current research is to identify the effectiveness of the **Suchman's model** in the **formal thinking** of the **fifth grade scientific level students**, and to verify the goal of the research, the following null hypothesis was formulated e:

- There is no statistically significant difference at the level of (0.05) between the average scores of the experimental group students who studied according to the Sukhman model and the average scores of the control group students who studied according to the normal method in the formal thinking test.

The current research community was represented by the fifth grade scientific level students in the secondary and preparatory schools for government girls affiliated with the Directorate of Karbala Education for the academic year 2021-2022 AD. By random selection, Al-Farouk Prep for girls was chosen from among the schools of the current research community, as it included three divisions (A , B , C). The two divisions (A) and (C) were chosen by simple randomization to represent (C) the experimental group of (35) students, which was studied according to the steps of the Sukhman model, and similarly, from Division (A) to represent the control group, which was studied according to the usual method. The experimental design was adopted with two groups (experimental and control), which partially control one of the other two. Of those with a post-test in formal thinking, the experiment was applied in the first semester of the academic year 2021-2022 AD , and it lasted (11) weeks. The researcher herself studied the two research groups, chemistry for the fifth scientific level grade, and it was four sessions a week. The two research groups (experimental and control) were rewarded in a number of variables, including (formal thinking test, previous information test, intelligence). The content of the current research was determined by three chapters of the book of chemistry according to the omissions of the Iraqi Ministry of Education, if it was analyzed to behavioral purposes, which reached (148) behavioral purposes in light of Bloom's classification of the cognitive field of the first six levels (remember , understand, apply, analyze, compose, evaluate). (44) daily study plans were prepared for the control group according to the usual method. To achieve the goal of the research, the researcher prepared an objective tool represented by the test of formal thinking of the type of multiple choice, and the discriminatory power of each paragraph of the test was calculated by applying its equation, as it was found to range between (0.31 – 0.63), as well as extracting the psychometric properties, the results references to the superiority of the experimental group students who studied according to the steps of the Sukhman model over the students of the control group who studied using the usual method in the test of formal thinking and with a large impact.

Keywords : Effectiveness, Sukhman Model, Formal Thinking.

educational institutions to keep pace with the characteristics of this era and its requirements and help individuals to absorb the huge amount of knowledge and use it in their lives (Hamah, 2019: 19). Where it has been proven that the educational systems in their traditional stages are insufficient to

Article One

First: Problem of research: The world is witnessing continuous development and a comprehensive scientific renaissance in various fields of life, it is the era of rapid changes and developments, so it is a great responsibility on the

highest stage of development in humans, in the stage of formal processes the individual reaches the peak of development in cognitive structures and is able to solve hypothetical problems, and verbal problems, and to conclude the possible possibilities in solving the problem, following the deductive approach in thinking (Al-Zubaidi et al., 2021: 68), and through the above, the importance of current research can be summarized in the following:

- Activating the role of education is a necessity for the development of societies and the advancement of the ethical educational reality in them.
- The use of modern educational models as it is one of the educational methods that help to address the shortcomings in the employment of direct scientific expertise.
- The use of modern educational models such as the Sukhman model is one of the sophisticated models in which the student is the center of educational effectiveness and process.
- The importance of formal thinking is one of the most important types of thinking in humans.

Third: The goal of the research and its hypothesis: The research aims to identify (the effectiveness of Sukhman's model in formal thinking among fifth-grade scientific level students) and to achieve the goal, the following zero hypothesis was formulated:

- There is no statistically significant difference at the level of (0.05) between the average scores of the experimental group students who study according to the Sukhman model and the average scores of the control group students who study according to the normal method in the formal thinking test.

Fourth: The limits of research: The current research is limited to

- Students of the fifth-grade scientific level /biological in Al-Farouq Preparatory School for Girls belonging to the General Directorate of Education in the Holy Governorate of Karbala.
- The first semester of 2021-2022 AD, morning study.
- The subjects of study included (for the first, second and fourth semesters) of the book of chemistry scheduled for the fifth year of biology, 7th edition, for the year 2018, Ministry of Education, Republic of Iraq.
- Use of the Sukhman model in teaching biological fifth graders (research sample).

Fifth : Definition of terms

Suchman's model is defined by (Ghabawia and Abu Sha'ira) as: It is one of the educational models that adopt the investigational approach to teaching, and it is

reach the goals followed by societies, especially the developing ones, in addition, many educators concerned with science have found that there is another basic problem faced by educational institutions represented in the weak ability of female preparatory students to practice formal thinking inside and outside the classroom (Al-Garawi, 2016 :661), and accordingly, the research problem was formulated with the following question:

- What is the effectiveness of Sukhman's model in testing formal thinking among fifth-grade scientific level students?

Second :Importance of Research:Importance of Research

That the comprehensive and integrated growth of the human being is the topic and purpose of education, and that this important role comes from its role in building the human in all aspects of mental, physical and moral so that this human being is a useful member of the society in which he lives. Education prepares the individual for the future and his evolving needs and makes him ready to accept change and scientific and technical transformation as well as social and economic change (Al-Hasnawi, 2019 : 15). Our current era is characterized by rapid scientific and technical progress in all aspects of life, which made development a necessary approach, and change is imperative for educational systems, institutions and sectors. Therefore, it has become necessary to educate as the effective tool in making the changes required in preparing the human for life in all its dimensions to keep pace with scientific progress and the explosion of knowledge, and to become an effective force in the process of change and renewal, in order to prepare human minds with a high degree of efficiency, qualified to face the challenges of the times (Al-Munir, 2015 : 9), and through thinking, it is possible to reach a new knowledge based on his previous experience, with the decision making, or to prove the result of a judgment. Thinking enables the learner to reach a logical result acceptable to the mind, and depends on assumptions made by the learner to provide explanations for the results (Tiger, 2021: 46), Formal thinking is one of the most important types of thinking for educationalists and psychologists, as the educational scientist Jean Piaget considered it the

data and reaches the results (Al-Ayasra, 2012: 391)

– **Sukhman Survey Model**

The survey education model falls under the cognitive education models, and deals with the training of students in systematic research using the survey by forming theories about an unexpected event that surprises them, although they are familiar with it. Richard Sukhman developed such a model of investigative education to teach students the processes of research into phenomena and practice procedures somewhat similar to the procedures used by scientists in obtaining and organizing knowledge and generating principles and theories, and since this pattern depends mainly on the idea of scientific research, it tries to provide students with the skills and terminology of scientific investigation. In developing the pattern, Sukhman carefully analyzed the methods and procedures used by innovative researchers, especially in the field of science, and after identifying them, he formed an educational pattern that he called training or investigative education (Marei, 2005 : 153).

– **Features of the Sukhman survey model:** **The Sukhman survey model has a set of features:**

1. The Sukhman survey model is a cognitive education model.
2. Focuses on the training of students through the scientific processes involved in scientific methodology in research and thinking.
- 3 - The Sukhman model requires the student to use his senses, mind, and intuition in integration and harmony to solve the problem faced; according to this scenario, the Sukhman model of investigation is based on hearing, sight, conscience, works of mind, and thinking processes (Karmin, 2021: 175).

– **The disadvantages of the Sukhman survey model:** **The Sukhman survey model has several disadvantages, including: -**

- 1- It requires teachers with a high degree of educational preparation, and therefore it is difficult to use it by teachers who lack the necessary competencies to use it.
- 2- It takes a long time in the preparation phase, and the implementation phase, and hence the gain that this model brings in learning certain topics may be at the expense of other topics.
- 3- Some students do not have the ability to do the investigation (Al-Hasnawi, 2019: 62).

the entrance in which the student is the focus of the educational process by placing him in an educational position that requires him to think and organize ideas and present them logically and soundly to access knowledge (Ghabawi, 2010: 27).

– The procedural definition of the Sukhman model: A set of interrelated and interconnected educational procedures and steps adopted by the school within the classroom that help students (the study sample) to investigate according to the stages and steps described by Sukhman to reach the desired goals of increasing the formal thinking of students in the chemistry prescribed for the fifth grade scientific level (biological).

Third: Formal thinking is defined by him (Razzouki, 2018) as: the mental ability that aims to draw conclusions and extract abstract meanings of things and relationships by virtual thinking through symbols and the ability to make assumptions and verify their validity (Razzouki and Latif, 2018 :349).

- Procedural definition: It is the degree that students (the research sample) will receive in the formal thinking test prepared for the purposes of the experiment after being exposed to the experimental procedures.

Chapter Two:

Theoretical background and previous studies

This chapter includes a brief presentation of two themes included in the current study:

The first topic : Theoretical background:

Second: Survey

The concept of investigation: The concept of investigation in its essence indicates that it is a process, and that each process (process) includes the meaning of development and change, it is an organized mental process that includes activities to solve a problem that challenges the thinking of the learner, and it is a pattern or type of education in which the learner uses skills and trends to generate, organize and evaluate information. The learner examines and tests a situation, in search of honest information and facts. Therefore, it is part of the solution of the problem, and it is included in solving the problem, and it does not solve the problem without investigating and the investigation comes in the light of the problem, so the investigation aims to develop the thinking of the learner, and the learner has a positive role in it, as he is the one who collects, classifies and tests the

2. The student must be able to deal with problem-solving methods of various kinds that develop her intelligent abilities.

3. Participation of female students in interaction with educational institutions so that each of them can develop their thinking, which depends directly on reality and 2- social interaction and its relations with different circles. (Afana and Army, 2008: 201).

Third: Formal thinking: (Piaget) believes that formal thinking is characterized by practical thinking, which is a homogeneous internal mental process. This concept develops through interaction with different things and topics (Kamash and Hassan, 2018 : 254) , which puts the adolescent before new and growing mental potential, so he can be free with this thinking from the limits of physical reality to the world of mental perceptions, principles and theories (Badir, 2008 : 114).

Characteristics of Formal Thinking

1. Formal thinking is essentially a kind of deductive hypothesis.
- 2- Formal thinking consists of second-degree processes.
- 3- Formal thinking is based on synthetic logic (Zayat, 2006: 201).

Features of Formal Thinking

- 1- It is based on the imposition of various hypotheses and possibilities and tested in a scientific way. It depends on the growth of concepts and principles, whether in a tangible or an abstract scope.
- 2- The learner relies through formal thinking on methods of abstract thinking in solving his problems. (Abu Asaad and Al-Khatina, 2011: 50).
- 3- The learner can imagine the possible relationships between things and address them and start thinking about the limits of the logical premises that can be taken from other experiences (Ahmed, 2014: 52) .

Steps of Sukhman Survey Education Model

Sukhman describes some of the conditions that must be taken into account in investigative learning:

Choosing an incident or phenomenon that excites students' interests and prompts them to question and seek explanation or explanation.

The phenomenon targeted by education or training must be of such importance and ambiguity that it surprises or surprises students in a way that prevents the emergence of indifference.

Students' questions should be of the type that the teacher can answer with "yes" or "no"

The educational dialogue must be conducted in a way that enables students to determine the facts of the phenomenon, the subject of the research, and the conditions for its occurrence or change. The logical

organization of these facts facilitates the processes of interpretation, control and forecasting (Meri, 2005 : 156-157) .

The role of the school in the Sochman model

- 1- Participant in asking questions directed to the problem or event in order to draw the attention of the learner to the information and facts of the occurrence of the phenomenon.
- 2- It is directed to the learners' questions by answering them with yes or no, and therefore it does not provide any explanation or clarification of the phenomenon's subject of research and study.
- 3- A classroom environment officer who manages the dialogue and supervises the testing and testing processes.
- 4 - Following closely the patterns of thinking and information related to the incident or problem while trying to modify or evaluate the behavior of the learners during the investigation and discovery attempts.

Student Role in Sukhman Model

- 1- The students should be able to participate with others in making

Researcher, Country and Year of Completion	Study Title	Objective of the study	Study sample	a Method of study	Statistical means	Study Findings
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The second topic : Previous studies

First: Studies related to the Sukhman model

gdecision that concern them and direct their intelligence abilities themselves by focusing on the topics that they refine and develop

	Study of Abdullah , Abdul Razzaq Yassin and Ahmed Salem Qasim Al-Azzawi 2019 Iraq	The effectiveness of the Adi and Shire model in the development of disintegration in the form of fourth grade scientific level students	You know the effectiveness of the Adi and Shire model in the development of formal care among fourth grade scientific students	148 male and female students	Formal reasoning test	Factor Binary Variance Analysis	There are statistically significant differences in favor of the experimental group
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the researcher introduces changes and notes the results, and this is done through his study of opposing positions and depends on careful observation of the phenomenon to be studied (Wolfolk, 2015 : 87).

- Experimental Design:

It means the work plan followed by the researcher in his experiments to start safely his method of choosing the experimental units in and distributing them through a specific system and ending in a standard way for the outputs (Bin Jajdal, 2019 : 66) Chart (1) shows that .

Scheme No. (1) The experimental design of the members of the two groups (experimental and control)

Second: Studies dealing with formal thinking section the third

Research Methodology and Procedures

1. Residential Methodology

In her research on the experimental approach, the researcher followed the natural suitability of her research because it is the most accurate research that can affect the natural relationship between the independent variable and the dependent variable in the experiment. Instead of abbreviating to describe what is present,

	Researcher , Country and Year of Completion	Study Title	Objective of the study	Study sample	a Method of study	Statistical means	Study Findings
1	Nada Yousef Abdulrahman Habib 2017 JORDAN	The impact of the use of the Sukhman model on the academic achievement of the subject of science, thinking and scientific level trends for the students of the seventh grade	Learn the impact of the use of the Sukhman model on the academic achievement of the subject of science and thinking and scientific trends for the students of the seventh grade	A sample of (96) students divided into two groups (Experimental - Officer)	Achievement test and a tool to measure scientific level trends	Test T_test, K-box, and Pearson correlation coefficient	A The results showed that there are statistical differences in favor of the experimental group in testing the learning processes

The two groups.	Equivalence	The independent variable	Dependent variable
Experimental group	- Previous Collection	Sukhman Model	- Choice of

Control group	- Testing previous information Yes, brains.	The usual way.	formality.
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School for Girls) was chosen intentionally from one of these secondary and preparatory schools affiliated with the General Directorate of Education of the Holy Governorate of Karbala for the academic year (2021-2022), if the research sample was chosen by random appointment by the (lottery) of Division (A) and (C) was chosen to represent the experimental research that will be studied according to the model of Sukhmanby (3) female students and Division (A) represents the control group that will be studied according to the usual method by (3) female students.

Third: Equivalence of the Research Groups

Before the start of the experiment, the researcher applied the experiment equally between the students of the two research groups in some of the variables that may affect the results of the research, which are (formal thinking in chemistry for the fourth scientific level grade, pre-chemistry information for the fourth scientific level grade, and Raven's intelligence test, Table (1) shows this:

Table (1) Values for the arithmetic mean, standard deviation, and the calculated and tabular T value for the three variables

Variables	Experimental(35)		control(35)		T value(0.05)	
	Arithmetic mean	StDev	Arithmetic mean	StDev	tabular	Calculated
Formal thinking	12	2.326	11.314	2.152	2	1.280
Prior information	11.114	1.890	10.857	2.088		994
intelligence test	245, 39	7.558	37.771	7.352		540

and control is one of the important elements in the researcher's control of her work and the success of her experiment, and the researcher gains high confidence by studying it, and therefore leads to results of scientific value, so the researcher should identify the variables and factors (in the independent variable) that affect the dependent variable and work to stabilize them except for the

Second: Research Community & Sample

A – Research Community: It is all the vocabulary of the phenomenon that the researcher wishes to study, especially all the individuals, things or people who are the subject of the research problem (Al-Jabri, 2011 : 245). The current research community represents all the fifth grade scientific level /biological students who study in all government day time preparatory and secondary schools affiliated to the General Directorate of Education of the Holy Governorate of Karbala for the academic year (2021-2022). The number of female students * (2099) female students distributed over (15) preparatory and secondary schools for girls.

B – Research Sample: It is defined as "a model that includes an aspect or part of the units of the original community concerned with the research that is representative of it so that it carries its common characteristics. This model or part enriches the researcher to study all the units and vocabulary of the original community (Qandalji; 2019: 186), as the current research sample (Al-Farouk Preparatory

Table (1) showed the equivalence of the two groups with the extraneous variables, as the calculated value of any of them did not reach the tabular value of (2) at the level of significance (0.05) at the level of freedom (68), and thus equalized this.

IV. Controlling for Extraneous Variables

It is precisely intended to stabilize all factors except for the factor whose impact is to be known,

- 7- circumstances of the outbreak of the Coronavirus, the number of lessons became (three) per week for each group and a weekly quota in electronic form through the platform (Zoom) for each group.

Fifth: Research Supplies The Research's Requirement

In order to prepare the research requirements, where (study plans for both experimental and control groups) the researcher conducted what is necessary:

1- Determining the scientific material: Before starting and applying the research, the researcher identified the study material for research in chemistry, within the curriculum for the fifth scientific level / biological grade, the seventh edition for the year 2018 for the first semester of the academic year (2021-2022), which included the following chapters:

- Chapter One – Developing the Atomic Concept (Quantum Preparation).
- Chapter Two – Correlation forces, geometric shapes between molecules
- Chapter IV. Solutions

2- Formulation of behavioral goals: It is necessary to define behavioral goals, as it facilitates the selection of appropriate experiences and the selection of appropriate educational activities for learners, as well as helps in choosing the method of teaching and educational methods appropriate to the content of the educational material (Razouki, 2017 : 91), the behavioral goal is "a phrase formulated accurately and clearly to describe what is expected to happen in the student's behavior, which he is doing after passing new educational experiences related to the vocabulary of the lesson /the concepts contained in it, where it can be observed and measured(maximum: 2018, 84-83), as the number of behavioral goals formulated reached (148) behavioral goals distributed according to the classification of cognitive Bloom at his six levels, and the researcher has presented it from the arbitrators specialized in educational and psychological sciences and methods of teaching science; to indicate their opinion on the extent of their safety and their conformity with the conditions of formulating behavioral purposes and the suitability of their cognitive levels, and that good behavioral purpose is considered a good observable and measurable behavioral purpose (Living), (838) Table: 2) This table shows:

variable whose impact is to be measured (Rauf, 2001 : 22), and among these variables:

1- Subject: Then teaching the two groups (experimental and control) the same subject represented (in the first, second, and fourth chapters) of the chemistry book scheduled for students of the fifth grade of bioscience, 7, for the year 2018.

2- Teacher of the subject: To emphasize the objectivity, the researcher herself studied the students of the two research groups in order to avoid differences in the treatment of the two groups of female students and as a result of the differences resulting from the personal characteristics of the teachers, the method of teaching, their teaching methods and the level of teaching, especially in terms of experience, qualification and service, and this by its nature gives the experience a high degree of accuracy and objectivity.

3. Educational Environment (Place of Experience): The researcher applied the experiment in one school (Al-Farouq Preparatory School for Girls), for the purpose of conducting safety rules and applying social distancing to avoid the spread of the Corona virus among students, and they are represented in two rows that are almost similar in terms of design, space, lighting, classroom capacity, ventilation, number of seats, number of students, and the social environment that is close, which excluded the impact of this factor on the progress of the experiment.

4 -experiment Confidentiality : The researcher was keen on the confidentiality of the experiment by agreeing with the school administration and the school of the subject not to inform the students of the nature of the research and its purpose, so as not to make any change in their activity or their dealings with the experiment, which may affect the integrity of the experiment and its results.

5- trial duration : The trial lasted the same period of time for the experimental and control groups and included the first semester of the academic year (2021-2022), as it began with the application of the trial on Monday (7/11/2021) and ended with the trial on Wednesday (26/1/2022).

5- Distribution of quotas: The quotas were distributed according to the weekly distribution schedule in agreement with the school administration. The number of quotas for chemistry for the fifth scientific level / biological grade was

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No.	Levels	Cognitive feild
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		Recal l	intake	appli cation	Anal ysis	Graft	calend ar	Total
Chapte r One	Evolution of the atomic concept	6	10	6	4	3	4	33
Chapte r 2	Correlation forces and geometric shapes of molecules	10	18	15	15	5	4	67
Chapte r Four	Solutions	18	9	9	8	2	2	48
Total		34	37	30	27	10	10	148

Table 2 Distribution of behavioral objectives to academic content

school), and the goal of the test is not to leave any paragraph without an answer or choose more than one answer to the one paragraph and not to write on the test paper, but to answer the test paper attached to the test.

B- Instructions for correcting the test paragraphs: After the researcher finishes drafting the formal thinking test questions and developing the standard answers for all the paragraphs of the test, she thought to give a score of (one) for the correct answer, and (zero) for the wrong answer, or abandoned, thus the degree of testing the objective paragraphs for selection from multiple top (20) and the minimum score is (zero).

3. Test validity: "An honest test" is a test that measures what has been prepared for measurement (Assad, 2014: 183 - 184). To verify the validity of the test, the following types of validity have been found: -

A- Apparent honesty:

Means the general appearance of the test in terms of vocabulary, clarity and drafting, including the instructions of the test, accuracy, clarity and objectivity, and deals with the appropriateness of the test for the purpose for which it was designed (Al-Gharawi, 2007: 44).

b. Content validity/ content validity

The two dimension tests, the first of which includes academic subjects and the second educational objectives, and this is done through the extent to which the content of the test corresponds to the data of the subject and the analysis of its objectives (Hariri, 2008: 141).

Applying the test to the reconnaissance sample:
It was in two stages: -

- **Phase 1: The first reconnaissance sample of the test.**

3. Preparing teaching plans: Planning a design process for a preconception of what the educational situation will be includes choosing the methods and aspects of activity suitable for the learning situation and the nature of the learner, and achieves the desired objectives of the educational learning process (Alian, 2010: 213), and in light of this, the researcher prepared (22) teaching plans for the control group and (22) teaching plans for the experimental group according to the (Sukhman model).

Sixth: The research tool: In order to achieve the goal of the research and its zero hypothesis and measure the impact of the mobile variable on the dependent variable (formal thinking), this required the preparation of a test for the research sample, which is:

- **Formal thinking test:** One of the requirements of the current research is to conduct a formative thinking test on the individuals of the research sample, and after the researcher has reviewed a set of thinking tests, the researcher found it appropriate to adopt the formative thinking test that she prepared (for my disadvantages 2011) for its ease of application and correction and the clarity of its paragraphs and its suitability for the stage of study to be studied in this research, as the test includes (20) items of the type of multiple test.

Test Formulation instructions

Include...

A- Answer instructions: The researcher prepared an instruction sheet for the answer and it is attached to the test paper and it included information for students (name, class, division,

The correlation between the degree of poverty and the total score of the test was calculated using the point-Biserial Correlation Coefficient Formula for the statistical analysis sample of (200) students. It was found that all correlation coefficients are statistically significant, as the coefficients were greater than the tabular value of (0,098) at the significance level (0.05) and with a degree of freedom (198).

Seventh: Procedures for applying the experiment

The researcher conducted the application on the research sample (experimental and control) starting from Monday (7/11/2021) to Wednesday (26/1/2022) in the first semester by four sessions per week for the two groups (experimental and control).

Eighth: Statistical means/ statistical means

- 1- T-test2.
- 2- Equation of the strength of the distinction of the objective paragraphs.
- 3- Point pacerial correlation coefficient

Chapter Four

Presentation and interpretation of results

Results of the research: (There is no statistically significant difference at the level of (0.05) between the mean scores of the experimental group students who are studying according to the Sukhman model and the average scores of the control group students who are studying according to the normal method of formal thinking). The arithmetic mean and the standard deviation of the students of the experimental and control groups were calculated in the test of formal thinking, and it was found that the arithmetic mean of the members of the experimental group (16.285) with a standard deviation (2.243), and the arithmetic average of the members of the control group (12.800) with a standard deviation (2.552). To know the significance of the difference, the T-test was used for two independent samples, and it was found that the calculated T-value (6.068) is greater than the tabular T-value (2), at the level of significance (0.05) and degrees of freedom (68), which indicates the superiority of the experimental group students over the control group students in the postmental thinking test, Table (3).

Table(3) The arithmetic mean, standard deviation and T-value of the students of the experimental and control groups

In the posterior morphological reasoning test

group	Number	arithmetic mean	standard deviation	T value		Significance level	Freedom degree	Difference Significance
				Calculated	tabular			

In order to reveal the clarity of the paragraphs and to calculate the average response time to the test paragraphs, the researcher applied it to a sample of (70) students of the fifth grade scientific level (biological) in (Al-Farouq Preparatory School for Girls), and the researcher noticed through the students' questions and observation that the wording of all the test paragraphs was clear and understandable, and she recorded the response time of each student of the research sample on the answer paper, as she found that the time taken to answer ranged between (42 - 45) minutes with an arithmetic average of (44) minutes.

Phase 2: Second Reconnaissance Sample for Testing.

The purpose of conducting statistical analysis is to improve the efficiency and quality of the test by detecting weak test paragraphs and working to amend them by reformulating them or excluding the invalid ones (Abayji, 2013: 78), and in order to extract the statistical analysis of the test, it was applied to a sample of (200) students of the fifth grade scientific level (biological), where they were tested from a school (Karbala Preparatory School for Girls) that is not subject to the main experiment, and it was agreed with the school administration and the subjects' school on the date of the test, and the students were tested by the test appointment a week before it was conducted for the purpose of preparation and readiness.

The analysis of the test paragraphs includes the calculation of the following: - a) The distinctive strength of the paragraphs: The distinctive strength of each test paragraph was calculated by applying its own equation, as it was found to range between (0.31 – 0.63), which is a good indicator of the acceptance of all paragraphs, as Eble believes that the test paragraphs are good if the strength of its distinction is (0.20) and more (rain & others, 2007: 63).

b) Method of correlation of the paragraph score with the overall test score

Experimental group	35	16.285	2.243	6.068	2	0.05	68	Statistically D
Control group	35	12.800	2.552					

In order to calculate the size of the effect of the Sochman model in the formal thinking of the students of the experimental and control groups, the researcher calculated the ETA square (η^2) to know the size of the effect, and when applying the equation of the size of the effect, it was found that the value of the size of the effect is large according to the specified standard. Table(4).

Table(4) the value of (t) and (η^2) and the size of the effect in the formal thinking

Table T Value	Calculated T Value	Effect Size Value	Effect size
2	6.068	0.351	large

3- To

inform students of various ways of thinking by teaching them the steps of this model.

4- Making students participate in the activities of the lesson and focusing more on the questions raised through the lesson, discussion and inquiries to find solutions.

Recommendations: In light of the results of the current research, the researcher recommends the following:

1. It is necessary to prepare effective and interesting teaching supplies such as furniture, equipment, teaching aids and laboratories for the success of the teaching process on the Sukhman model.

2. Interest in activities that help to develop the students' formal thinking.

Suggestions: In light of the results of the current research, the researcher proposes to conduct the following studies:

1- The effectiveness of teaching using the Sukhman model in the teaching of chemistry and in other variables such as formal thinking, science processes and predictive thinking in the preparatory stage.

2- Conducting a study similar to the current study in the subject of physics, biology and mathematics and for other stages of study such as the secondary and intermediate stages.

References :

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Interpretation of results : show from consequences

search Presence differences self indication Statistic between averages grades the group Experimental Which I studied using Model Sukhman and the group the officer Which I studied the way Ordinary at thinking formality , was superiority at averages grades Favor the group Experimental attributed a reason Excellence the group Experimental at thinking formality to me Participation female students and their cooperation at Access to me the answer correct then teaching and use thinking formality Participate Larger number from senses I have female students at Receive the information, So Than Assist turn on Understanding and assimilation Subject Scientific Which Submitted their Than make keep with information or Experience Period longer at their mind , and that thinking formality Makes female students at that be they have Ability growing on thinking Consistently With others, and communication in the form of big With others and sensitivity towards their needs , the ability on justification Ideas and test Bezel validity Strategies solutions when others and listening and seek behind The opinion collective and give up on idea What from Yes the work on idea Person else, and sympathy and kindness and leadership collective and altruism.

Conclusions: In light of the results of the current research, the researcher concludes the following:

- 1- Teaching chemistry using the Sukhman model has had a greater impact on students than teaching in the usual way.
- 2- The presence of a positive effect of Sukhman's model in the teaching of chemistry and formal thinking.

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