

How to Cite:

Al-Husseini, O. A. H., & Daoud, D. S. (2022). Scientific inquiry skills and their relationship to achievement in chemistry for third-intermediate students. *International Journal of Health Sciences*, 6(S5), 9748–9764. <https://doi.org/10.53730/ijhs.v6nS5.12073>

Scientific inquiry skills and their relationship to achievement in chemistry for third-intermediate students

Olfat Alaa Hashem Al-Husseini

University of Baghdad-College of Education for Pure Sciences Ibn Al Haytham

Email: alhusinyolfat@gmail.com

Prof. Dr. Dhamia Salem Daoud

University of Baghdad-College of Education for Pure Sciences Ibn Al Haytham

Email: Sdamiaa@yahoo.com

Abstract---The current research aimed to identify the skills of scientific investigation and achievement in chemistry among third-grade intermediate students, as well as to identify the strength and direction of the relationship between the research variables, and the descriptive correlative approach was adopted. The average in schools affiliated to the Directorate of Education / Karkh third in Baghdad by (2%) of the research community of (22,148) male and female students for the academic year (2021-2022). Measurement, classification, conclusion, extrapolation, prediction, communication, use of space and time relationships, procedural definition, controlling variables, imposing hypotheses, experimental design, and data interpretation) by 50 items (multiple choice). (40) paragraphs, including (35) objective paragraphs of a multiple-choice type with four alternatives and (5) essay paragraphs. Psychometrics of the two tools using the Statistical Package for Social Sciences (SPSS+22) The statistical results showed the following: 1) The third intermediate grade students have a good achievement in chemistry as a result of their perseverance and scientific efforts; 2) The third intermediate grade students have sufficient scientific inquiry skills; 3) There is a correlation between scientific inquiry skills and achievement.

Keywords---skills, relationship, intermediate students.

Chapter one

First: the research problem

Through the researcher's fifteen-year experience in teaching chemistry and what she has seen of students' results in school and ministerial exams (from the

records of grades of ministerial exams for the intermediate level in a number of schools for the previous years: (2020-2021), (2019-2020)) (2018) -2019) In addition to conducting a survey for the opinion of a sample of chemistry teachers (20) male and female chemistry teachers. Therefore, the low achievement of students in chemistry is one of the important problems facing teachers. The researcher was not satisfied, but rather diagnosed the problem through an exploratory questionnaire directed to female teachers and teachers of chemistry for the third intermediate grade, and discussed the opinions of a group of female teachers and teachers in chemistry about the reasons for the poor level of students' achievement and the level of their practice of scientific inquiry skills. After quantifying the answers, the researcher reached the following results:

- ❖ 75% of them confirmed that the reasons for poor achievement are due to the adoption of traditional teaching methods that make the teacher the focus of the educational process, while students are only responsible for listening, memorizing and recalling.
- ❖ 71% of them agreed that they did not know the skills of scientific investigation.
- ❖ 73% of them agreed that the students' abilities to practice scientific inquiry skills are weak.

Hence the problem of this research, which lies in answering the following question:

((What is the relationship between scientific inquiry skills and achievement in chemistry for third-intermediate students?))

Second:

The importance of research:

We live now in the information age and the huge information technology revolution. A great development has been achieved in the field of technology due to the great acceleration in scientific and technical development and the rapid leaps that occurred in this field, and this development was reflected on educational institutions. This is because education is one of the aspects affected by technology, and the communications and information revolution that the world has witnessed in the past two decades has led to cultural changes whose pace and impact are increasing daily on all societies of the world, and it still represents one of the most important transformations and changes that have affected and will affect the formation of the society of the present century. The science of chemistry is one of the important study subjects because it has a direct relationship with man and society because it explains many natural and life phenomena and also includes many concepts, laws and general principles, and this requires the adoption of teaching methods and methods in teaching chemistry that help build knowledge in a meaningful way, especially that its teaching methods and methods Which teachers follow is still traditional and ineffective. Since the science of chemistry is one of the sciences that depend on creativity, insight, experimentation, and mental skills that require patience and continuous knowledge of everything new (Hegazy, 78:2009). It is worth noting that the teaching of chemistry in our schools in Iraq begins at the intermediate stage, specifically the first intermediate grade, which gives it importance in developing the skills of scientific inquiry among students in an advanced stage of education

(the third intermediate). The importance of the research can be summarized as follows:

1. The research acquires its importance by targeting the skills of scientific inquiry and the educational attainment of students as two of the main objectives of teaching science, as the relationship between them will be discovered in the research.
2. The importance of the research comes in terms of the researcher's preparation of a test of scientific investigation skills and an achievement test in chemistry for the intermediate stage.

Third: Research Objectives:

The current research aims to identify:

- 1) Scientific inquiry skills for third intermediate grade students.
- 2) Achievement in chemistry for the third intermediate grade students.
- 3) The statistically significant differences in the skills of scientific investigation according to the gender variable (males, females).
- 4) Statistically significant differences in the achievement of chemistry according to the gender variable (males, females).
- 5) The correlation between investigation skills and achievement in chemistry among third-grade intermediate students.
- 6) There are statistically significant differences in the correlation between scientific investigation skills and achievement in chemistry according to the gender variable (males, females).

Fourth: the limits of research

- 1) Human limits: third-grade intermediate students (of both sexes)
- 2) Spatial boundaries: the General Directorate of Karkh Education / the third in the center of Baghdad governorate.
- 3) Time limits: the academic year 2021-2022 AD
- 4) Cognitive Boundaries: Chemistry Book for the Third Intermediate Class 10th Edition 2019-2020 Chapters:
 - Chapter one: the atomic structure of matter.
 - Chapter Two: The first and second groups.
 - Chapter Three: The third group.
 - Chapter Four: Solutions and Expression of Concentration

Fifth: Define terms

❖ Scientific investigation skills / known by:

(Zeitoun 2004): It is a set of special mental abilities and processes necessary to apply the methods of science and scientific thinking correctly. - Using numbers - using spatial and temporal relationships - communication) and integrative skills and it includes five skills (interpretation of data - procedural definition - controlling variables - imposing hypotheses - experimenting).

(Zaitoun , 2004: 101-106)

The researcher adopted a definition (Zaytoun, 2004) of scientific exclusion skills as a theoretical definition.

The researcher defines them procedurally as: the skills that students must practice in the third intermediate stage while performing practical activities in chemistry, which are determined in eight main basic skills so that the main skills are determined in (observation, classification, measurement, conclusion,

induction, inference, prediction, The use of spatio-temporal relationships), and the integrative skills that are determined by five skills: (the skill of interpreting data, procedural definition, controlling variables, imposing hypotheses, and experimenting).

❖ **Achievement :is defined by:**

(Al-Najjar and Shehata 2003): It is the amount of information, knowledge or skills that the student obtains, expressed in grades in the prepared test, with which the specified levels can be measured. (Al-Najjar and Shehata, 89, 2003)

The researcher adopted the definition of (Al-Najjar and Shehata, 2003) a theoretical definition of the collection.

The researcher defines it procedurally as the final outcome that the students succeeded in achieving in terms of knowledge, experience, trends, and skills in chemistry during a certain period of time, and by measuring it, an honest picture of the learner's performance level is given.

Chapter Two

First: Scientific investigation skills

The skills of scientific inquiry are at the heart of what is known as the scientific culture that many educational societies have advocated in teaching science today. Scientific inquiry skills are also tools for building that culture inside and outside the school, and it is the mechanism by which problems can be identified and then explored and solved. Scientific inquiry skills play a major role in teaching science because, as is known, science searches for answers to human questions, and these questions are based on human observations of the world around him. Thus, he uses observation, interpretation and inference to reach the answers to these questions. And do not forget that scientists use investigative skills in carrying out their scientific experiments to reach certain discoveries and conclusions. (Ambo Said and Al Balushi, 2009: pp. 61-62). Scientific inquiry skills are defined as mental operations carried out by an individual in order to clarify or explain a mental event related to natural phenomena and events (Al-Sharif 2009: 141). Scientific inquiry skills are general behavioral skills, they are not affected by time, do not depend on memory to some extent, and are not linked to a specific situation or specific information. Or instinct and training, its application becomes easier, faster and more accurate (Alyan 2010: 64). The interest in scientific inquiry skills is based on two references. The first is what Brunner mentioned in his book "The Process of Education" in 1961 AD, in which he stressed the need to focus on manual scientific inquiry skills, such as observation, classification, arrangement, measurement, and others, and he said that these skills should be the goal. itself in learning. The second: what Piaget viewed and asked for, that children, regardless of their culture, advance in their cognitive development through four stages:

1. The sensory-motor stage
2. Pre-operational stage
3. Concrete operational stage
4. Formal-operational stage

Brunner considered: scientific inquiry skills as learning habits, while Gagnier viewed them as: learned abilities and mental skills, as the ability to use scientific inquiry skills requires the educated individual to represent information, process

it, and take mental steps behind the given basic information (Zayton , 1999: 101). The views of educators differed in defining the investigation skills and their names. Sometimes they are called scientific research skills, scientific thinking skills, science operations skills, or scientific experimentation skills.

Classification of scientific investigation skills:

Robert Gagner rating:

Robert Jannet put the skills of scientific investigation in a hierarchical arrangement that corresponds to the stages of cognitive maturity, as follows: observation, classification, use of temporal or spatial relationships, communication, prediction, inference, procedural definition, formation of hypotheses, interpretation of data, control of variables, and experimentation. . (Al-Muqram, 2001: 140)

It is defined by (Nashwan 2001,) in eleven skills: observation, comparison, definition, classification, measurement, interpretation, prediction, ascertainment, formulation of hypotheses, isolation of variables, experimentation. (Nashwan 2001: 208)

(Zaytoun, 2010) divided science processes into two types, namely:

- ❖ **First: Basic Science Processes:** They are relatively simple processes that come at the base of the learning processes pyramid, and they include ten scientific processes, namely: observation, measurement, classification, deduction, induction, inference, prediction, use of numbers, and use of spatio-temporal relationships. Communication (communication).
- ❖ **Second: Integrated Science Processes:** which are (five) advanced processes and the highest level of basic science processes in the pyramid of learning the skills of scientific processes, sometimes called experimental science processes, which are: procedural definition, imposing hypotheses, controlling variables, experimental design, Interpretation of the data. (Zaytoun, 2010:101)

The researcher takes into account the classifications of skills (abilities) included in scientific investigation when constructing a test for scientific investigation skills, and sees that despite the differences in these skills, they have many similar commonalities, so she will address the skills that fit with the scientific subject on the one hand, and with the age group. For university students, on the other hand, the closest classification for the researcher is the classification (Zaytoun 2010).

1) Observation:

Observation is defined as: an individual's mental ability that enables him to use one or more of his senses to examine something or an event, then describe it and record the results directly, accurately and objectively. To start the investigative activities that often lead him to new inferences or suggest appropriate hypotheses for the investigative activity. (Atallah, 219, 2001).

2) Measuring:

The measurement process is intended to be the use of different tools and means of measuring accurately. He also defined it as: the student's ability to use standardized measurement tools, to make his observations quantitative, as well as the ability to make calculations for the tools. He added that it is a process of determining the legal characteristics using different tools and means of measurement. (Zaytoun, 1999: 102-103)

3) Classification:

It means that it organizes observations (information) in ways that carry a special meaning. Organizing groups are built based on the extent of similarity and variance according to a certain characteristic (criterion).

It includes the students' classification of the collected information and data into specific categories or groups based on the characteristics (criteria) common to them, and includes other skills such as the skill of discrimination and the skill of comparison. It is the process of collecting things in groups on the basis of the characteristics that distinguish them and deals with the similarities and differences, as well as The overlap between adjectives and then ends with the division of things into groups. (Zaytoun, 2002: 114)

4) Inferring Conclusion:

Inference means that it is a mental process in which a transition takes place from the general to the particular, and from the universals to the particulars (Zaytoun, 1996 AD, p. 103).

5) Induction:

Induction is defined as a mental process in which one moves from the particular to the general, and from the particulars (examples) to the generalities, as if the student arrives from his observations of certain facts (examples) or separate individual cases (Zaytoon, 103: 2004).

6) Predicting:

A mental process that includes the student's ability to use his previous information to predict the occurrence of a phenomenon or an accident in the future (Zaytoun, 1994: 104).

7) Using Space & Time Relationship:

It is a mental process complementary to the use of numbers, it requires mathematical relationships and scientific laws and rules that express spatial or temporal relationships between related scientific concepts (Zaytoon, 1996: 104)

8) Communication:

It includes helping the student to transfer his ideas, information, or results to others, by translating them either orally or in writing into tables, graphs, scientific boards, or research reports. (Zaytoun, 1996: (104)

9) Operational Defining:

It is the definition of scientific concepts or terms in a non-lexical way, but a procedural definition: either by defining (the concept or the term) with a series of operational procedures, or showing how to measure it. (Zaytoon, 1996: (10)

10) Formulation Hypothesis

It is the student's ability to propose a temporary solution (interpretation) of a possible relationship between two variables or a (possible answer) to the question(s) of the study or the problem in question.

11) Controlling Variables:

Determine the different variables, or factors that may affect the results of the experiment, and isolate the variables (other than the experimental variable) whose effect on the dependent variable is to be determined. (Ibrahim, 1999: 87)

12) Experimenting:

It is the design of specific artificial conditions that facilitate the study of the response of a system to constraints imposed in an arbitrary manner. (Zaytoun, 2002: 100)

13) Interpreting Data:

(Sulaiman, 2004) defines it as: a complex process in which students use data to make communication, prediction, inference, hypothesis, equation formation, and designs that support the results of experiments. (Solomon, 2004: 49).

Second: Achievement

Attainment is defined as the attainment of a certain level of gathering information and performing the required skills, as measured by standardized tests or teacher reports. (Ahmed, 2010: 47) Academic achievement is a common measure that indicates the extent to which the individual has achieved intelligence and cognitive abilities. Therefore, those in charge of educational institutions pay great attention to the decisive educational decisions that result from it. The indicators that achievement gives to those in charge of education are: The extent to which educational goals have been achieved, and this, in turn, is reflected in the society's aspirations for progress, development and development (Al-Jawhuriya, 2010: 34) Academic achievement is of great importance, as academic achievement in its general concept refers to the amount of information that students obtain during their studies and it does not bear fruit unless if it was the result of a study of the abilities and readiness of students by those responsible for the process of guiding students, and academic achievement is the main entrance through which to identify the problems of student failure in schools (Al-Khalidi, 2008:89).

Chapter Three Research Procedures

This chapter includes the research methodology and procedures in terms of defining the research community and the sample, verifying the psychometric properties of the tests approved in the research (the test of scientific investigation skills), and (the achievement test in chemistry), and determining the statistical methods used in the current research.

First: Research Methodology:

In order to achieve the objectives of the research, the researcher relied (the descriptive correlative approach) to identify the correlation between the skills of scientific investigation and the achievement of chemistry among the third intermediate grade students.

Second: Research community:

The current research community consists of students of the third intermediate grade in the General Directorate of Karkh Education / the third in the center of Baghdad governorate of both sexes, numbering (22,148) male and female students, at a rate of (11329) males, (51%), and (10819) females, and a percentage of (49%), according to the statistics of the Karkh Directorate of Education / Third Division for the academic year (2021-2022).

Third: The research sample:

In order for the sample to be representative of the original community, the researcher took a sample of (400) male and female students from the third intermediate grade in the General Directorate of Karkh / Third Education in the

center of Baghdad governorate, using a simple random method, at a rate of (2%) from the research community, and according to gender by (205) male and 195 female students, as the school sample was first chosen randomly, and then a group of male or female students from the school was randomly selected.

Fourth: search tools

The researcher adopted two tools to measure the two variables among the students of the basic research sample, as she prepared a test for achievement in chemistry and the last skills of scientific investigation, and the following illustrates this:

1- Achievement test in chemistry:

One of the research requirements is to build an achievement test in chemistry. The researcher followed the following steps:

A. Determining the scientific subject: The scientific subject has been defined in the four chapters of chemistry for the third intermediate grade, which are prescribed for the first semester of the academic year 2021-2022 AD, which are:

- Chapter one: (the atomic structure of matter).
- The second chapter: (the first and second groups).
- The third chapter: (The third group).
- Chapter Four: (Solutions and Expression of Concentration).

B. Preparing the specification table (test map):

The researcher determined the weights of the behavioral objectives by calculating the percentage of each of the six levels (remembering, understanding, application, analysis, synthesis, evaluation). Content and goals.

C. Formulation of achievement test paragraphs: The test paragraphs were formulated according to the specification table and in the form of objective and essay paragraphs because they together provide an acceptable degree of honesty. The correct number was (35) paragraphs, and the other paragraphs of the test were articles that numbered (5) paragraphs, because they stimulate high levels of thinking such as analysis and conclusion.

D. Correction of the test: Criteria have been set for correcting the answers for the (35) objective achievement test items, as follows (one score for the correct answer for each of the test items, and zero for the wrong or left out answer, or if there is an answer for more than one alternative). The number of (5) paragraphs, the degree was given from (0-3) according to the steps of the correct solution and according to the degree of importance for the total answer that was adopted, and thus the total score of the test ranged from (0-50) degrees.

E. Correction of the test: Criteria have been set for correcting the answers for the (35) objective achievement test items, as follows (one score for the correct answer for each of the test items, and zero for the wrong or left out answer, or if there is an answer for more than one alternative). The number of (5) paragraphs, the degree was given from (0-3) according to the steps of the

correct solution and according to the degree of importance for the total answer that was adopted, and thus the total score of the test ranged from (0-50) degrees.

Apparent honesty:

The apparent honesty was reached by presenting the items of the achievement test to a group of arbitrators specialized in the field of chemistry and methods of teaching chemistry and educational psychology. An agreement percentage (80%) or more, as this percentage was considered a criterion for accepting the paragraph with amendments to some paragraphs.

Content validity:

This type of validity is achieved by analyzing the content of the study material into its elements, determining the behavioral objectives, setting a specification table, and constructing an achievement test appropriate to the specification table and consistent with the specific behavioral objectives.

The first exploratory: application of the test:

For the purpose of determining the time that students need to answer the test, and to ensure the clarity of its instructions and paragraphs, the test was applied to a simple random exploratory sample chosen from the research community, consisting of (30) male and female students from the third intermediate grade in one of the schools affiliated to the Baghdad Education Directorate / Karkh 3 , by (15) students from (Sumer High School for Boys), and (15) female students from (Al-Hadara High School for Girls). The students were informed a week before the test date, and while the researcher was supervising the application, she noticed that the answer instructions and the test paragraphs were clear through the lack of student inquiries about how to answer, which indicates the clarity of the test paragraphs and instructions. The time taken to answer was calculated, and the average time was To answer the scale (30) minutes.

Difficulty coefficient:

The difficulty coefficient of each paragraph of the achievement test was calculated by applying the equation of the difficulty coefficient, and the goal of calculating the difficulty coefficient of the test paragraphs was to delete the paragraphs whose difficulty coefficient is less than 20% and those paragraphs whose difficulty coefficient is more than 80%, an equation was applied The difficulty of the objective questions was found to range between (0.43-0.59) degrees, and the difficulty coefficient of the article paragraphs reached (0.43-0.56) degrees, as the acceptable range of the difficulty coefficient ranged between (0.20-0.80). (Al-Dulaimi and Adnan, 2005: 86), thus all the test items are good and their difficulty factor is appropriate.

Discrimination coefficient of test items:

The discrimination coefficient of the paragraphs was calculated using the discrimination coefficient equation for the multiple-choice questions, and it was found that it ranges between (0.40- 0.62) degrees, and the discrimination coefficient of the article items reached (0.53- 0.69) degrees, and this is a good indicator for the acceptance of the paragraphs, as the paragraph is considered acceptable discrimination if it is Its discrimination coefficient (0.20) or more (Al-

Zahir et al.), 1999: 130, and this indicates that all test items have an acceptable discrimination coefficient.

Effectiveness of false alternatives for objective items: The effectiveness of false alternatives for (35) objective items was extracted from the achievement test items by using the equation for the effectiveness of false alternatives, and the values of the effectiveness of false alternatives ranged (0.08--0.28), and with this procedure, it was decided to keep the alternatives as she.

The stability of the achievement test:

The stability coefficient of the achievement test was calculated by adopting the Alpha-Cronbach equation because the test contains both objective and article items at the same time. A good stability coefficient, as the test is characterized by stability if its value is (0.67) or more (Al Nabhan, 2004: 240)

The achievement test in its final form:

After the researcher conducted the statistical analysis of the achievement test paragraphs and analyzed the psychometric properties represented by stability, and thus the achievement test in the final form was ready to be applied to the basic research sample, and thus the number of paragraphs of the achievement test was (40) paragraphs, of which (35) were objective taken Upon correction, one mark for the correct answer for each of the test paragraphs, and zero for the wrong or left over answer, or if there is an answer for more than one alternative), and (5) essay paragraphs are given on correction (0-3) degrees, according to the steps of the correct solution and according to the degree of The importance of the total answer that was adopted, and thus the total score of the achievement test ranged (0-50) degrees.

Scientific investigation skills test:

The following steps were followed:

Determining the skills of the test:

In light of the procedural definition of the skills of scientific investigation (the skills that students must practice in the third intermediate stage while performing practical activities in chemistry, which are determined in eight main skills so that the main skills are determined in the skill of observation, classification, measurement, deduction, induction, inference, prediction , the use of spatio-temporal relationships and integrative skills that are determined by five skills, namely: the skill of data interpretation, procedural definition, controlling variables, imposing hypotheses, and experimenting), so the test included (13) skills.

Formulating scientific investigation skills test paragraphs: (50) paragraphs were formulated to test scientific investigation skills in its initial form, as each paragraph consists of an introduction that includes a specific situation or idea, followed by four alternatives, one of which represents the correct answer.

Correction of the test:

The test consists of (50) items, the items are formulated in a multiple-choice method, where the respondent is asked to choose the correct alternative from

among the answer alternatives, and the student gets one point when choosing the correct alternative and gets (1) and (zero) when choosing the wrong alternative or The left paragraph or if there is an answer to more than one alternative, so the highest score for the test is (50) degrees, and the lowest score for the test is (0) degrees.

The apparent honesty of the test:

to ensure the apparent sincerity of the paragraphs of the scientific investigation test, it was presented to a group of arbitrators and specialists in chemistry sciences, chemistry teaching methods and educational psychology

The proposed amendments were made according to the arbitrators' opinions and observations, and the researcher relied on the criterion of judging the validity of the deserts if she obtained an agreement percentage (80%) or more than the arbitrators' opinions, and with this procedure she won (50) paragraphs on the criterion of agreement percentage or more. Thus, the apparent validity of the scale was achieved.

The first survey application:

To ensure the clarity of the test paragraphs and the clarity of the instructions and the identification of the difficulties encountered in its application to avoid them, and the time it takes to answer its paragraphs, the scientific inquiry test was applied to a simple random sample drawn from the research community consisting of (30) male and female students of the third intermediate grade in one of the schools affiliated to the Directorate of Education in Baghdad / Karkh 3, with (15) students from (Sumer High School for Boys), and (15) female students from (Al-Hadara High School for Girls). The test was applied from Sunday (2/23/2022). From this procedure, the instructions for answering and the test paragraphs were clear through the lack of student inquiries about how to answer, which indicates the clarity of the test paragraphs and instructions. The time taken to answer the test was calculated, and the average time to answer the test was (40) minutes.

Difficulty coefficient:

The difficulty coefficient of each paragraph of the scientific investigation test was calculated by applying the difficulty coefficient equation, and it was found that it ranges between (0.46-0.55) degrees.

Discrimination coefficient of test items:

The item discrimination coefficient was calculated using the discrimination coefficient equation for the multiple choice items, and it was found that it ranges between (0.42- 0.70) degrees, and this indicates that all the test items have an acceptable discrimination coefficient.

The effectiveness of the wrong alternatives:

to ensure the effectiveness of the wrong alternatives for the alternatives of the paragraphs of the scientific investigation skills test, the equation for the effectiveness of the wrong alternatives was used, and the values of the effectiveness of the wrong alternatives ranged (0.08 - -0.31).

Indicators of construction validity:

1. The method of the paragraph degree in the total degree to test the skills of scientific investigation.

The "Point Baseball" correlation coefficient was used to extract the correlation coefficient between the score of each paragraph and the total score of the sample members of the statistical analysis, and it was found that all correlation coefficients are statistically significant when compared with the tabular value (0.098) at the level of significance (0.05) and the degree of freedom (398).

2. The method of the relationship of the degree of the paragraph with the degree of skill to which it belongs:

In order to calculate the correlation coefficient between the degree of the paragraph and the degree of the skill to which it belongs, the correlation coefficient was used: Point Baseirl. It was found from this procedure that all correlation coefficients are statistically significant when compared with the tabular value (0.098) at the level of significance (0.05) and the degree of freedom (298).

3. The internal correlations between the degree of each skill with other skills and with the total degree of the skills of the scientific investigation test:

The matrix of internal correlations was extracted between the degrees of each skill and the other skills of scientific investigation skills, and it was found that all the correlation coefficients are statistically significant. (398), and Table (13) illustrates this.

Test Reliability:

The researcher used two methods to calculate the reliability:

- 1) **Test-retest method.** In order to achieve stability in this way, the researcher applied the test of scientific inquiry skills to the stability sample, then the same test was re-applied after a period of time of (15) days. Pearson's correlation coefficient was (0.77).
- 2) **Half-split method:** The researcher relied on this in extracting the stability of the scientific investigation skills test on the stability sample after dividing the test items (50) into two halves, and thus each part contains (25) items. (0.72), which represents half of the correlation, and after correcting it with the Spearman-Brown formula: it reached (0.84), which is a good stability coefficient.

Statistical indicators to test scientific investigation skills:

The following statistical indicators were verified to test scientific investigation skills.

Scientific investigation skills test in its final form:

After extracting the statistical and psychometric characteristics to test the skills of scientific investigation, the final form consists of (50) multiple-choice objective paragraphs, and each paragraph contains four alternatives, one of which is correct, and grades were given (1) for the correct answer and (zero) for the wrong answer. The highest score for the test is (50), and the lowest score is (zero), with a theoretical average of (25) score.

Chapter Four

Presentation and interpretation of the results

First: Presentation, interpretation and discussion of the results.

This chapter includes a presentation of the research results that have been reached, their interpretation and analysis, and then a statement of the conclusions, recommendations and suggestions as follows:

The first objective:

the scientific investigation skills of the third intermediate grade students

After applying the scientific investigation skills test on the research sample of (400) students of the third intermediate grade, the results indicated that the arithmetic mean of the scores of the sample members reached (24,491), with a standard deviation of (2.679), and when comparing the arithmetic mean with the hypothetical mean of the test Scientific investigation skills whose value is (25) degrees, and by using the t-test for one sample, it appeared that the calculated t-value is (-3,793) degrees, and this value is located on the left end of the equilibrium distribution, and it is less than the tabular t-value ((1.960), and it is not significant Statistically at the level (0.05) and the degree of freedom (399), and Table (1) illustrates this.

Table (1) The results of the t-test for one sample for the difference between the arithmetic mean of the sample and the hypothetical arithmetic mean of the scientific investigation skills test

The meaning of the difference	Indication level	T value		The hypothetical mean of the scale	Standard deviation	The arithmetic mean of the sample	Sample	Variable
		Tabular	Calculated					
Function	0.05	1.960	38.130	25	4.792	34.137	400	Scientific investigation skills

The table shows that there are statistically significant differences between the arithmetic mean of the sample and the hypothetical mean of the scientific investigation skills test, where the calculated value of the T-test was greater than the tabular value, meaning that the students have scientific investigation skills in general.

And that all scientific investigation skills were achieved by students of the intermediate stage, where the calculated T-values were greater than the tabular T-value (1.960), at the level of significance (0.05), and at the degree of freedom (399).

The second goal: achievement in chemistry among third-grade intermediate students

After applying the achievement test in chemistry for third-grade intermediate students on the research sample of (400) male and female students, the

researcher extracted the arithmetic mean of the academic achievement degrees, which amounted to (31.167), with a standard deviation of (7.245), and when comparing the arithmetic mean with the hypothetical average of the achievement test Which has a value of (25) degrees, and using the t-test for one sample, it appeared that the calculated T-value (17.025) degrees, and this value is greater than the tabular T-value ((1.960), statistically significant at the level (0.05) and the degree of freedom (399).

Table (2) The results of the one-sample t-test for the difference between the arithmetic mean of the sample and the hypothetical arithmetic mean of the achievement test scores

The meaning of the difference	Indication level	T value		The hypothetical mean of the scale	standard deviation	The arithmetic mean of the sample	Sample	Variable
		Tabular	Calculated					
Function	0.05	1.960	17.025	25	7.245	31.167	400	achievement test in chemistry

Table (2) shows that there are statistically significant differences between the arithmetic mean of the sample and the hypothetical mean of the achievement test in chemistry, where the calculated value of the T-test was greater than the tabular value, meaning that middle school students have a high achievement in chemistry.

The third objective:

statistically significant differences in scientific investigation skills according to the gender variable (males, females)

After applying the scientific investigation skills test on the research sample of (400) male and female students and analyzing the data, the results were that there were no statistically significant differences between males and females in the degrees of scientific investigation skills, where the calculated t-value was (1,564) less than the tabular t-value (1.906) at the level of significance (0.05) and the degree of freedom (398).

That is, there are no statistically significant differences according to each of the scientific investigation skills according to the gender variable, as all the calculated T-values for all scientific investigation skills were less than the tabular T-value at the significance level (0.05) and the degree of freedom (399). This result reflects the nature of curricula, teaching and the unified system for both sexes, so the differences between them did not appear.

The Fourth objective

statistically significant differences in the achievement of chemistry according to the gender variable (males, females)

After applying the achievement test in chemistry to the research sample of (400) students and analyzing the data, the results were that there were no statistically significant differences between males and females in the degrees of academic achievement in chemistry, where the calculated T-value (0.037) was less than the value T-tabular (1.906) at the level of significance (0.05) and the degree of freedom (398). This result reflects the nature of curricula, teaching, and the unified system for both sexes, so the differences between them did not appear.

The Fifth objective:

The correlation between scientific investigation skills and achievement in chemistry among third-grade intermediate students

In order to achieve this goal, the Pearson correlation coefficient was used to find the relationship between the two variables between scientific investigation skills and academic achievement in chemistry, and its value reached (0.879) degrees. The researcher is based on Lehman's table (Lehman, 2005), which explains the correlation coefficient. And judging the level of the correlation between the two variables is a very strong relationship between the skills of scientific investigation and the degrees of academic achievement in chemistry. This may be due to the fact that the scientific investigation skills were achieved in the research sample, and when the correlation coefficient was squared to identify the proportion of the common variance between the two variables, it amounted to (0.772) between the degrees of academic achievement and the scientific investigation skills percentage (77%), which is a strong percentage for predicting academic achievement through investigative skills. Scientific.

The Sixth Objective:

The statistically significant differences in the correlation between scientific investigation skills and achievement in chemistry according to the gender variable (males, females)

To identify the differences in the correlation between scientific investigation skills and academic achievement in chemistry according to the gender variable, the Pearson correlation coefficient was calculated and its values were converted to standard Fisher values and the z value was extracted. The results were: There are no statistically significant differences in the relationship between scientific investigation skills and achievement. The standardized value was (0.055), which is less than the table value (1.960) at the level of significance (0.05) and the degree of freedom (398).

Second: Conclusions:

In light of the research results, the researcher concluded the following:

- 1) The third intermediate grade students have a good achievement in chemistry as a result of their perseverance and scientific efforts.
- 2) The third intermediate grade students have sufficient scientific inquiry skills.

- 3) There is no statistically significant difference between males and females in achievement in chemistry.
- 4) There is no statistical difference between males and females in the level of their enjoyment of scientific investigation skills
- 5) There is a correlation between scientific inquiry skills and achievement.

Third: Recommendations:

In light of the results of the current study, and in light of the study's limitations and methodology, the researcher presents a set of recommendations that can contribute to bringing the results of the study to practical application. The following is a presentation of these recommendations:

- 1) Encouraging and urging male and female teachers of chemistry at all academic levels to use the skills of scientific inquiry in teaching chemistry.
- 2) Including chemistry books in the intermediate stage for scientific investigation skills.
- 3) The necessity of activating a program to develop students in their use of scientific inquiry skills.
- 4) Opening courses and workshops for teachers to use the skills of scientific inquiry and how to develop them among students.

Fourth: Suggestions:

The researcher suggests conducting a study similar to the current study on other educational stages such as secondary, preparatory and university.

References

1. Ahmed, Ali (2010): Academic achievement and its relationship to Islamic values. Beirut: Hassan Modern Library.
2. Al-Dulaimi, Ihsan Aliwi and Adnan Mahmoud Al-Mahdawi (2005): Measurement and evaluation in the educational process, 8th edition, Ahmed Al-Dabbagh Office for Printing and Publishing, Baghdad.
3. Al-Jahouriya, Siham (2010): The importance of academic achievement. Journal of Educational Development - Sultanate of Oman, 69, (54) 8.
4. Al-Khalidi, Nariman Ali, (2008): The effect of teaching with concept maps on acquiring scientific concepts and basic science operations skills among fourth-grade students, unpublished master's thesis, College of Education, Yarmouk University, Amman, Jordan.
5. Al-Muqram, Saad, (2001): Methods of Teaching Science, Principles and Objectives, Dar Al-Shorouk, Jordan.
6. Al-Nabhan, Musa, (2004): Basics of Measurement in Behavioral Sciences, 1st Edition, Dar Al-Shorouk, for publication and distribution, Amman, Jordan.
7. Al-Sharif, Kawthar Abdel Rahim (2009): Scientific Education, Teaching Science, The Egyptian Renaissance Library, Cairo.
8. Alyan, Ribhi and Ghoneim, Othman (2010 AD): Scientific Research Methods, Theoretical Foundations and Scientific Application, 2nd Edition. Amman: Dar Safaa for Publishing and Distribution.
9. Al-Zahir, Zakaria Muhammad and others (1999): Principles of Measurement and Evaluation in Education, Edition 1, Dar Al Thaqafa, Amman.

10. Ambo Saidi, Abdullah Al Balushi Suleiman, (2009): *Methods of Teaching Science, Concepts and Practical Applications*, Dar Al Masirah, Amman.
11. Atallah, Michel Kamel (2010): *Methods and Methods of Teaching Science*, 3rd Edition, Dar Al Masirah, Amman.
12. Hijazi, Farid Abdel Rahman (2009): *Building a Scale of Attitudes Towards Chemistry for Eleventh and Twelfth Grade Students*, *Journal of Technical Educational Sciences*, Volume Nine, Issue 1, page 39, Amman, Jordan.
13. Ibrahim, Shaaban, (1999): *The impact of the science teacher's understanding of science processes on the development of curiosity among his students and their attitudes towards science*, *The Egyptian Society for Scientific Education, The Third Scientific Conference: Science Curricula for the Twenty-first Century A Forward Vision*, Volume Two, July 25-28, Cairo Egypt.
14. Nashwan, Yaqoub Hussein, (2001): *The New in Science Education*, Dar Al-Furqan, Jordan.
15. Sari, R. I., Syarif, S., Arsyad, M. A., Usman, A. N., & Ramadany, S. (2021). Android-based application of women's reproductive health to parent knowledge as a learning media. *International Journal of Health & Medical Sciences*, 4(2), 196-201. <https://doi.org/10.31295/ijhms.v4n2.1691>
16. Shehata and Zainab Al-Najjar (2003): *A Dictionary of Educational and Psychological Terms*, 5th edition, The Egyptian Lebanese House, Cairo.
17. Soliman, Nahid Mohamed, (2004): *The effect of using advanced science laboratories on developing some science processes skills and scientific trends among primary school students*, unpublished master's thesis, Girls' College, Ain Shams University, Cairo, Egypt.
18. Suryasa, I. W., Rodríguez-Gómez, M., & Koldoris, T. (2022). Post-pandemic health and its sustainability: Educational situation. *International Journal of Health Sciences*, 6(1), i-v. <https://doi.org/10.53730/ijhs.v6n1.5949>
19. Zaitoun, Ayesh, (1999): *Methods of Teaching Science*, 1st Edition, Dar Al-Shorouk, Amman, Jordan.
20. Zaytoun, Ayesh Mahmoud, (2010): *Contemporary Global Trends in Science Curricula and Teaching*, 1st Edition, Dar Al-Shorouk, Amman, Jordan.
21. Zaytoun, Ayesh, (1996): *Methods of Teaching Science*, 2nd Edition, Dar Al-Shorouk, Jordan.
22. Zeitoun, Ayesh, (2004): *Methods of Teaching Science*, 1st Edition, Dar Al-Shorouk, Jordan.
23. Zeitoun, Kamal, (2002): *Teaching Science to Understanding a Constructive Future Vision*, 1st Edition, World of Books, Cairo, Egypt.