The Effect of the Duit Model on Inductive Thinking among Second-Grade Students in Physics

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ABSTRACT:
The research aims to identify the impact of the (Duit) model on the inductive thinking of students at the second intermediate level of physics. Randomly, the researcher chose the average of the daytime government girls in the Al-Saddah sub-district in Babil Governorate, as the school contains four divisions (A- B -C - D). In the drawing method, Division (A) was chosen to represent the control group that will study in the usual way, and Division (B) represents the experimental group that will study according to the (Duit) model in physics. The total number of female students after exclusion reached (74) students (38) for the experimental group and(36) for the control group. The researcher conducted a parity between the students of the two research groups for the following variables (chronological age calculated in months, previous information, Daniels intelligence test, inductive thinking test). The research was limited to the students of the second intermediate grade for the academic year (2023-2024) for the second semester and the specific scientific subject (fourth semester, fifth semester, sixth semester) of the physics textbook. After conducting the equivalencies between the two groups, the researcher prepared the application requirements for the two groups. After completing the experiment, the researcher applied her research tools to both groups as she obtained data and was processed by the t-test and the results showed the superiority of the experimental group in the control group according to the Duit model in inductive thinking.

First: Research Problem

The educational process faces many problems, especially in light of the rapid scientific developments and the many challenges and issues that require quick solutions. These solutions must be characterized by their honesty, and realism and based on scientific research. The teaching of physics is not isolated from these problems or challenges, as its teaching faces many difficulties and issues that make it a study subject that gives it a kind of boredom and inertia in presenting the lesson because the most expensive teaching methods prevailing in its teaching are traditional methods and thus provide learners with information without taking into account the scientific aspect and how to apply this information on the ground.

Many local studies have tried to address this problem, including the Sharif study (2000) and the study (Al-Ghurairi, 2003), and that the problem experienced by educational systems in general in the aspect of teaching and its methods is to move away from the world of learners' educational materials are sometimes presented in dry ways without taking into account the environment of learners, their needs and their way of thinking, as well as the lack of interest in different mental abilities and the use of various methods and methods of teaching to address each group by its suitability and method of learning, where anxiety is increasing day by day as a result of the phenomenon of poor academic achievement in our schools and is still one of the outstanding problems in the educational field, which is a major obstacle to achieving the goals of the educational system.

The researcher conducted field visits to several schools according to the book of the Directorate of Education in Babylon and conducted questionnaires about the reasons for the poor achievement of students and the teaching methods used and whether they have knowledge of inductive thinking skills. The answer was that (90%) of the teachers were not aware of inductive thinking skills and low achievement. This was due to the use of traditional methods and strategies in teaching, which prompted

the researcher to choose one of the models of constructivist theory, which is a teaching model (Duit) that helps raise the level of achievement and the level of inductive thinking. The research problem was identified by answering the following question **What is the impact of the Duit model on the achievement of second-grade students in physics and inductive thinking?**

Research Significance:

The most important characteristic of our current era is scientific progress and cognitive renaissance. We see a great race between the countries of the world and nations in various fields of knowledge and different sciences. There are many new facts and discoveries, and this requires communicating them to the learner at various academic stages for the learner to keep pace with the wheel of development and an effective axis in it and not in isolation from what surrounds it. This development does not take place on its own, so there must be an effective way to spread quickly in the educational fields in its various aspects. Therefore, education is considered a means for society to improve it(Hassan, 2004: 24).

Educational institutions have a great responsibility tocontinuously prepare generations and help them to develop their thinking and arm themselves with the weapon of science so that they can face the challenges of the future with mental powers and intellectual production,as a result of the rapid development and progress in various fields of science. This progress has been accompanied by an abnormally accelerated cognitive achievement and the individual needs to work hard to adapt to it, participate in life positively, and become able to adapt to the requirements of the times (Attia, 2010: 22).

Education is the most important component of educational institutions. It transfers science from one generation to another through the acquisition of knowledge and experiences by individuals. Without education, science would not have disappeared and would not have reached all generations (Al-Khazaleh, 2010: 25).

The principles of modern education rely on attention to continuous learning and keeping pace with modern scientific research, culture, and general, theoretical, and professional preparation, and it has become concerned with the various school and family environments of man, so it has taken care of a man in all stages of his life, to help him to develop himself in an integrated manner in the light of his preparations, abilities, ability, and talents, and it also depends on all philosophical, literary, scientific, professional and sports activities, and the educational work is not limited to defining one form within which everyone is limited(Zaour, 2006: 8)

Scientific education is concerned with preparing a scientifically educated citizen who possesses a degree of knowledge and awareness of general scientific matters related to various areas and aspects of life to be able to make sound and appropriate decisions about the situations and problems he faces in his life in an ever-changing society in all aspects of life (Ali, 2009: 21).

Education plays an active role in improving and developing the learning environment to reach educational outcomes that keep pace with the requirements of the times and achieve the aspirations of educators. This entails understanding the components of the educational process to develop appropriate strategies in an accelerated era of different fields, especially cognitive and technical (Al-Hashemi and Al-Dulaimi, 2008: 29).

Education is an important part of education as one of its important means of achieving its goals, as it plays an important role in achieving learning. The need to organize the education process is one of the obligatory things imposed by the progress of humanity. The development that hit the developed world came only from the methods of taking care of education and curricula, and education as a social and human activity that must be contributed by both the teacher and the learner within the educational process (Al-Fatlawi, 2003: 31).

Education is seen as the mechanism that has been presented, and some assume that in the case of providing new information and knowledge, this curve must be adopted in the transfer of experiences and knowledge because learners lack information as they come to school and they are blank pages, so the behavior of education must be conducted to achieve the goal for which they came, which is to develop

their thinking and provide them with the information and experiences necessary for life(Katami, 2008: 19).

The school is an educational and social institution established by the community to serve its purposes and achieve its goals. It also has an important and effective role in providing the various conditions and possibilities necessary to prepare and raise generations, including providing an appropriate environment for learning in a way that facilitates the learning process facilitates the teacher to play his role, and increases the student's pride in his school(Amer and Rabie, 2008: 96).

The school contains several integrated functions related to all aspects of life, because it helps the learner to intellectual growth and solve his psychological and social problems, in addition to refining his personality, and working to take into account individual differences and qualify him to work life to be a real element in his environment and society (Zaour, 2010: 46).

For the school to achieve its goals in the best way, the curricula that contain integrated experiences must be available. Physics curricula are one of the important curricula in any educational system at the global level and follow their importance because they contribute significantly to the progress and development of nations, as they are relied upon to provide learners with scientific concepts that enable them to understand the various phenomena surrounding them and deal with them efficiently, and to provide them with the accuracy of observation and the behavior of the scientific method that links the results, causes and theories that depend on extrapolation, understanding, and conclusion. They also provide learners with physical concepts and principles to develop their thinking and contribute to building a civilized society with a scientific-educational structure. They train learners on the scientific method in solving problems and promoting understanding and original trends, which includes consolidating faith in God Almighty, conviction in causality, and moving away from myths (Al-Khazraji, 2015: 6).

The teacher or teacher is one of the basic elements of the educational process. Without an academically qualified and professionally trained teacher, no educational system can achieve its desired goals. With the huge explosion of knowledge and the entry of the world into the era of globalization, communication, and high technology, there is an urgent need for a teacher who constantly develops in line with the spirit of the age, a teacher who meets the needs of the learner and society(Daamas, 16:2011).

The teacher is also an important axis of the educational process because he seeks to achieve the objectives of the curriculum, and he is considered the main responsible for achieving the objectives of the curriculum and his active role in developing the various skills of learners and plays a major role in them because these skills are very important in preparing learners for working life, and these skills consist of mental, academic and social skills, and are acquired by learners to enhance their abilities in thinking and feel human and enhancing their self-confidence (Al-Azmi et al., 2007: 164-165) (paragraph on the learner).

The methods and techniques used by teachers or educators are one of the most important aspects of the educational process, as teaching methods are important and effective tools in the educational process. They take an active and important role in organizing the procedures and aspects of the directed activity practiced by teachers or teachers to help learners achieve the desired goals and change their behavior and then prepare them to acquire the desired trends, values, information, and knowledge. A good teaching method enables learners to understand the facts and helps them to acquire positive trends and develop their abilities and skills (Al-Hasnawi, 2019: 41).

Modern teaching strategies aim to develop the skills of teachers and teachers inside and outside the classroom and contribute to changing the role of learners from recipients of information and knowledge to active, vital, and positive roles, information seekers, and producers (Daamas, 2008: 60).

Interest in improving and developing the teaching methods of science is increasing day by day through the use of teaching strategies and models that raise the learner's desire to learn, which may help develop their thinking (Qatami, 2008:18).

Diversity in teaching methods would break the boring pattern imposed by regular teaching methods that focus on the role of the teacher and reduce the role of the learner (Al-Yamani and Alaa, 27:2010).

The Duit model or the analog education model is one of the models that develop motivation and excitement among learners in new learning by researching their previous experiences to discover the relationships between them and the new experience. This seems clear when we deal with a phenomenon to compare it with another familiar phenomenon. It brings the familiar and new concepts closer to becoming aware of the learners through the link that he found between them. A similar process is by linking two concepts with the same level of difficulty and clarifying the common elements between them, provided that the first concept is familiar and the second is unfamiliar (Darwazah, 2000: 283), and the (Duit) model of analog education includes six steps, which are (presenting the target concept,mentioning the basic concept of the learner's cognitive inventory,identifying similar features in the basic and target concepts,interviewing similar and different features between the two areas of the interview, and referring to shortcomings in the similarity).

The significance of the research also comes from the importance of academic achievement because academic achievement is one of the most important educational outcomes, and one of the objectives of teaching due to its importance in the life of the learner. In the educational field, achievement is the important criterion according to which learners progress in study and transfer from one educational class to another, as well as their distribution in different education disciplines or their acceptance in their collegesor universities of higher education. Achievement of most educational decisions (methodological and administrative) in education contributes to increasing the ability to retain information because it makes the study more effective (Razouki and Dhamia, 2017: 105).

One of the things that may help learners to increase achievement is the interest in their thinking process. Thinking is a mental activity that helps them to perceive relationships. Inductive thinking is one of the important types of thinking, as inductive thinking is inherently directed to exploring laws and rules, as it is an important way to find new solutions to old problems, solve new problems, or develop new hypotheses. Inductive thinking has a great deal of space in our time. If we cannot go beyond the limits of the information available to us and generalize, we will not be able to understand or discover the details of nature (Jarwan, 2015: 73).

The significance of the current research comes from the importance of education at this stage of the school stages, which is the intermediate stage that comes after the primary stage and is followed by secondary education (preparatory). The intermediate stage is an important stage of education because it is a stage with a transition in the lives of learners. It is a stage in which the development of basic skills and knowledge achieved by the primary stage is stabilized and expanded, as well as the stage of learners' knowledge of their roles in serving the school and society (Al-Sunbul, 1412: 20).

Second:Therefore, research significance is highlighted

1- The independent variable (Duit) model helps to develop the students' thinking and their ability to solve the problems they face in the future.
2- Achievement in physics, which is a large collection of information possessed by students, which can be used at other stages.
3- The importance of the variable that follows inductive thinking because it works to increase the ability of learners to understand information in a sense and awareness in a way that increases their skills in the field of thinking.
4- Intermediate stage:It is considered a transitional stage between the primary stage and the preparatory stage, which is a stage between childhood and adolescence.
5- The current research is a qualitative addition to the educational library,as it can be used by researchers to develop their skills.

Third:Research Objective

The research aims to find out the impact of the Duit model on the inductive thinking of middle second-grade students.

Fourth: Research hypotheses

To verify the two research objectives, the following two null hypotheses were formulated:

1- (There is no statistically significant difference at the level of significance (0.05) between the average scores of the female students of the experimental group who will study according to the (Duit) model and the average scores of the female students of the control group who will study in the usual way in the achievement test prepared for this study).
2- (There is no statistically significant difference at the level of significance (0.05) between the average scores of the experimental group that will be studied according to the (Duit) model and the average scores of the control group that will be studied in the usual way in the inductive thinking test).

Fifth: Limitation of The Research

The research is limited to:

1- **Human Limit**:Female students of the second intermediate grade in the government morning middle and secondary schools for girls affiliated with the Directorate of Education in Babylon.
2- **Time limit**: The second semester of the academic year (2023-2024).
3- **Spatial Limit**: Governmental Day Intermediate and Secondary Schools of the Directorate of Education in Babylon /Al-Musayyib District.
4- **Cognitive Limit**: The last chapters (fourth, fifth, and sixth chapters) of the physics textbook to be taught for the second intermediate grade from the Ministry of Education, Fifth Edition (2023) for the year (2023-2024).

Sixth: Definition of The Terms

First: The effect is known by

1. **(Al-Qaisi, 2001) that "**the amount of change brought about by the teaching method is represented in the learning outcomes of knowledge among students, and their knowledge is measured by the increase or decrease in their average grades " (Al-Qaisi, 2001: 17).
2. **(Ibrahim, 2009) that "**the ability of the worker under study to achieve a positive result, but if this result is not achieved, the factor may be one of the direct reasons for the occurrence of negative repercussions (Ibrahim, 2009: 3).
3. **(Al-Ezzi, 2013) as** "the outcome of a desirable change that occurs in the learner as a result of the intended educationprocess" (Al-Ezzi, 2013: 7).
   i. The researcher adopted the theoretical definition (Al-Ozza, 2013) because it is the closest to the research topic.

Operational Definition:

The amount of change that teaching physics using the Duit model causes in achievement and the development of inductive thinking skills among second-grade students is average, and their answers are measured by the scores they obtain in the achievement and inductive thinking tests prepared by the researcher for research purposes.

Second: (Duit) model

Duit(1991) defined it as a model of analog education developed based on theoretical perceptions through experimental results on analog education, and analytical studies conducted on the use of analogs (Duit, 1991: 672).

The researcher adopted the theoretical definition of (Duit) for its proximity to the research.

Procedural definition of the Duit model:

A model followed by the researcher to teach the students of the experimental group in physics and know its impact on their achievement by identifying similar features and differences.

Third: Achievement

Known by:

A-Allam (2000)

" The degree of acquisition achieved by the student or the level of success he achieves or reaches in a specific subject, educational or training field" (Allam, 2000: 305).The researcher has adopted the definition of (Allam, 2000) a theoretical definition because it is the closest to the research steps.

Operational Definition: -

Defined as the score obtained by the students through their answers to the achievement test paragraphs prepared by the researcher for the current research.

Fourth: Inductive Thinking: Define It

A- Sultan Al-Harthy(2010): "It is the cognitive mental performance in which the thinking moves from partial judgments or special individual cases on a general basis that ratifies all similar cases.

Procedural definition:

It is a mental process in which learners rise from the private to the public, from the part to the whole, and from the molecules to the generalities, where we reach generalization, which is the ability to collect a large number of special questions and reach the general rule through which several questions are presented to him to deduce a fact, concept or rule according to inductive thinking skills.

2. Chapter Two: Theoretical framework

Theme 1: Theoretical Background

Constructivist Theory:

Its inception

The ancient historicalroots of the emergence of the constructivist theory **extend** to the era of Socrates, but they crystallized in its current form in the light of the theories and ideas of many theorists such as Özbel, Piaget, and others (Sabri, 1421: 68).

Most constructivist theorists consider Piaget as the first builder of constructivism. He is the one who believes that the process of knowledge lies in building or reconstructing the subject of knowledge.Then came a group of constructivist theorists who reformulated and modified their ideas, as Ernst von Glaser-Svlade is considered the most prominent theorist of contemporary constructivism (Zeitoun, 1993: 33).

Therefore, it was necessary to adopt an advanced educational system to help future generations to progress in all areas of life. Therefore, in the last century, interest in the educational system and education has increased, because they represent two important factors related to each other and represent a complex phenomenon that has an impact and influence on the educational process. Education is not a one-dimensional behavior, but an activity that includes many variables that affect the behavior of the student, and thus this is reflected in the life of human societies. The system in education has taken the path towards constructive education, and we are in an era of global progress, unprecedented human and material mobility, and technology that has invaded the minds of our children and opened horizons for communication and communication. It is necessary to work to find what is best to educate the children of the current generation in line with scientific, current, and future developments.

Educators have been interested in meaningful learning, which is concerned with the previous knowledge of the learner, his motivation to learn, his patterns of thinking, how to develop them, methods of acquiring scientific concepts, analyzing his abilities to pay attention, his ability to remember, measureforgetfulness, and address the dispersion of information. As a result, many theories of learning have emerged that are concerned with explaining the mechanism of learning and the cognitive construction of students. Perhaps the most important of these theories is the constructivist theory, which has its roots in the depths of history, as it is linked to Socrates' ideas about education and knowledge building, but it crystallized in its current form after several thinkersand scientists reformulated and coordinated in a new way, such as Fico, John Dewey and Piaget (Zeitoun and Zeitoun, 1995: 17).

The constructivist view is seen in two ways: philosophical and psychological. Philosophically, it is a theory of knowledge that has its principles and assumptions. One of its most prominent theorists is (Glasersfield), who is considered the creator of the first basic building blocks of constructivist theory as a cognitive theory. (Glasersfield) explains constructivism as follows:

1. Knowledge is adopted because of the learner's activity and is not received from the external environment.
2- Learning is based on the process of comparing the new experience with the knowledge made up of previous experiences.
3-The role of the teacher is to find relationships between concepts that help learners to dissolve useful meanings of their own.
4-It requires leading children and young pupils in activities to reach conclusions about what is going on in the educational author (Zeitoun, 2007: 27).
Constructivism has assumed the existence of cognitive structures in the individual learner that are developed within developmental stages by the learner himself, and Piaget has divided them into four stages:
1-The sensorimotor stage
2- Pre-operative stage.
3-Formal operational stage
4-The stage of physical operations.
For learning to occur, the mental equilibrium of the learner must be punctured so that he feels that what he has in the construction of knowledge does not explain a phenomenon, so he performs the processes of representation and adaptation. Representation is a mental process that includes receiving information from the environment and placing it in cognitive structures. As for adaptation, it is a mental process that includes modifying cognitive structures to be able to interpret the new experience (Nasif, 2003: 284)

Second: Duit Model:

Human society is distinguished by itsability to call names to dysfunctional objects and assets and classify them in special lists and concepts that facilitate dealing with dysfunctional social situations. Thus, a lot of comparisons are made and there are similarities and differences among them,to be clearer and easier to use. Crowell believes that (analogical learning is one of the new methods of teaching, to help it move from sensory knowledge to formal knowledge, from the perceived to the abstract, and from the familiar to the unfamiliar, which leads to the expansion of horizons)(Crowell, 1987: 60-83).
Duit (1991) cited the (TwA model), which was developed based on theoretical considerations, experimental results on analog education, and analytical studies conducted on the use of analogs in physics books, and includes a set of mental processes. The TwA model provides both the learner and the teacher with a general structure of the steps to be followed when adopting this educational model and how these steps are taken and realized in the basic phenomenon. The model actively develops learners' cognitive schemes if analog education is used realistically, and the model enables learners to understand the analogy presented to them as it is in the mind of their teacher. The TwA model also enables the teacher to ensure that the learners' vision of real analogs is as he sees it(Flaquier, 1991).
The researcher believes that the teacher must pay attention to the concept that he is looking for similar to the new concept to find similarities and differences and highlight the shortcomings in it to give clear conclusions later. (Qatami) indicates that the student in analog learning searches his stored experiences and new experiences for similarities and thus saves the time and effort necessary to learn together. (Qatami and Qatami, 2000: 335).
It is clear from the above that the analog model (Duit) in which the teacher replaces the familiar ideas of students with unfamiliar ones. It is an effective method in education because it provides sensory perception of abstract information and at the same time builds new information and is easy to absorb.
The researcher believes that the Duit model can provide the appropriate educational environment for learning through the integration of learners in research and experience and their direct interaction with the teacher and encourage them to build their symmetry while thinking about possessing new knowledge and solving problems that connect their new experiences and compare them, which generates strong knowledge and helps to keep it and retain it(Breeman, 1988: 163).

Thus, breaking the routine of the traditional educational process that depends on the teacher as a carrier of information and the focus of the educational process and making the student a recipient only and neglecting his role as well as not having the ability to form his personality and develop his mental, skill and emotional abilities as well as make the classroom environment a boring environment that does not contain excitement and suspense, which is one of the important things that attract the attention of learners and increase their demand for learning, as well as increase the attention factors of the learner and thus make him an effective and active element to increase his ability to form new ideas and make him a focus of the educational process and form social relations between learners and know how to adapt to the environment in which he lives.

Duit Steps:

1- Introducing the target concept: The school briefly explains how to conduct symmetry between the topics,to present the concept to be presented.
2- Remembering the basic concept of the student's cognitive stock: retrieving some information from the learner's memory by conducting some scientific discussions to indicate the similarity between new and previous knowledge.
3- Identifying similar features in the basic and target concepts.
4- Interviewing similar and different features between similar fields: Comparing the reason between the two concepts and then highlighting the differences between them.
5-Referring to similar deficiencies: The teacher discusses with his students to ensure that they do not have misconceptions or unacceptable perceptions about the target concept, and if any, seeks to correct it.
6- The status of conclusions: The teacher concludes with his students what has been learned about the new concept compared to the old concept(Deut, 1991: 273).

Inductive Logical Reasoning

Thinking is a mental process in which an individual does something meaningful and knows, understands, and accepts many things. Thinking has many patterns, including "inductive thinking", which indicates the tracking of molecules to obtain a total judgment or a general rule. This means tracking molecules of a specific type, to know the total judgment that applies to them to compose a general rule. Extrapolation in the Arabic language means tracking and examination by examining examples and partial materials and searching for similarities and differences to reach general provisions in concepts and rules of comparison, deduction, and measurement (Hadi et al., 2010).

Inductive thinking is a guide to discovering rules and laws, and an important way to solve new problems, find new solutions to old problems, or develop new hypotheses. Inductive thinking focuses on the participation of students in reaching rules, standards, criteria, foundations, or general judgments. Inductive thinking is a type of multiple thinking patterns, as scientists often call it the upper part of the bottom of human thinking, because the final things or conclusions are usually derived from special cases, including building each case on top of the other to reach the desired conclusion. Inductive thinking is concerned with the participation of students in reaching standards, criteria, or basic rules (Saada, 2014).

Inductive thinking is based on induction, which is a philosophical basis to the effect that: the mind behaves in gradually tracking the knowledge from part to the whole. The goal of this thinking is to reveal general provisions, rules, generalizations, and facts using investigation to track them and reach them. The mind uses observation and observation to reach the total issues that are called in science the scientific or natural laws, and it also reaches the total mathematical issues,and the laws of economic and social sciences (Al-Dulaimi and Al-Waeli, 2009).

Thinking Characteristics

1. May use observation and experimentation.
2- He may use assignments of all kinds and levels.
3- Investigation and application (sensory experience to achieve results) may be used.
4-The search for reasons may or may not be used.
5. Philosophical mathematical deduction may be used in conjunction with experience.

6- He may accept or reject induction as a way for him to research(Mahmoud, 2006:152).

The second axis: Previous studies

- **Studies related to the Duit model**

1. Al-Qatrawi Study (2010) (The Impact of the Strategy of Similarities in the Science Processes of Eighth Grade Basic Students in the Subject of Science Reflective Thinking Skills)
2. Al-Azzawi study (2012) (The impact of the strategy of similarities in achievement and visual thinking in the principles of biology among students of the first intermediate grade)

- **Studies related to inductive thinking**

1. The impact of inductive thinking and free-thinking strategies on the development of critical thinking, metacognition, and achievement among students of the basic stage in biology)
2. Al-Bahadli study (2012) (The impact of the adoption of science teachers of both the self-questioning strategy and direct teaching by integrating the skills of inductive and deductive thinking in the achievement of the components of the cognitive construction of science and the development of reflective thinking skills among students)

3-Chapter Three

First: Research Methodology:

The researcher adopted the quasi-experimental research approach to achieve the goal of her research. This is one of the most successful approaches to test the validity of hypotheses and determine the relationships between variables. It expresses judgments resulting from actions and steps that achieved their objectives, which resulted in an experiment that can be repeated to ensure the validity of its hypotheses (Ibrahim, 2000: 127).

Second: Experimental Design

The current research includes one independent variable (Duit model) and two dependent variables (achievement and inductive thinking). After reviewing the experimental designs, the researcher found that the appropriate experimental design for her research is the experimental design with partial adjustment and post-testing as in Table (1).

Table 1:

Group	Equifinality	The independent variable	Dependent variable	Exam
Experimental group	1. Chronological age in months 2-Physics grades for half the year 3- Daniels Intelligence Test	Model (Duit)	Inductive Logical Reasoning Collection	-Achievement test -Inductive thinking test
Control group		The usual method		

Third: Research Community

The research community refers to the set of vocabulary, phenomena, and elements that the researcher aims to study to achieve the results of his study (Abu Samra and Muhammad, 2020: 45). The researcher resorted to the Statistics Division of the General Directorate of Babylon Education/Musayyib Education under a mission facilitation book issued by the College of Basic Education/University of Babylon as in Appendix (12). The morning middle and secondary schools in Musayyib, affiliated with the Directorate of Babylon Education, were identified to represent the research sample for the academic year (2023-2024). Thus, the research community includes second-grade students in the morning middle and secondary schools of the Directorate of Babylon Education/Musayyib (2023-2024)

Fourth: The research sample

The research sample means part of the Indigenous community concerned with the study, which represents the indigenous community in the best representation so that it bears the characteristics of the indigenous community so that it can circulate the results to the community (Al-Obaidi and Alaa, 2010: 44).
Accordingly, (Al-Sadda Intermediate School for Girls) was selected in a simple random manner from the schools affiliated with the Directorate of Education in Babylon for the academic year (2023-2024) affiliated with the General Directorate of Education in Babylon, Al-Musayyib District, Al-Sadda District (2023-2024), as shown in the table below.

Table (2): Search students before and after exclusion

Section	Group	Number of female students before exclusion	Number of female students who failed	Number of students after exclusion
A	Experimental group	42	4	38
B	Control group	40	4	36
Total		82	8	74

Fifth: Equivalence of the two research groups

The researcher conducted an equivalence between the two research groups in some variables that may affect the integrity of the experiment and the accuracy of the results. Although the students of the research sample are in a very similar social and economic environment, and they study in one school of one gender, these variables are

1- Chronological age in months.
2- Prior information
3- Mid-year exam scores for the year (2023-2024)
4- intelligence test
5- Inductive Thinking Test.

Sixth: Research Requirements

To achieve the objectives of the research and its hypotheses, the research requirements had to be prepared as follows:

Scientific material:

Before the application of the experiment, the scientific subject taught in the second semester of the academic year (2023/2024), the fifth edition of the physics textbook for the second intermediate grade (2023) was determined.

Seventh: The research tool

It is how the researcher collects his data to be able to control and solve the problem and verify his hypothesis (Al-Shayeb, 2009: 69). To identify the extent to which the objectives of the research were achieved, the researcher built the tool of the dependent variable.

- **Build a test for inductive thinking skills.**

A structured method for measuring the attribute to be measured, and providing quantitative data on the degree or value of the attribute rank measured by the respondent. The test is provided in the form of specific triggers, which may be oral or written questions or practical performance (Al-Zughbi et al., 2001: 88).

1-Determine the purpose of the test :

The current test aims to find out the extent of mental abilities possessed by individuals and to measure the level of possession of students in the second intermediate grade of inductive thinking skills.

2-Identify inductive thinking skills:

After reviewing many of the literature and studies, the researcher defined the procedural definition of the concept of inductive thinking, and in light of the definition and the theoretical framework of the current

research, she set out to determine the inductive thinking skills that suit the research sample and achieve its objectives. Inductive thinking consists of five skills (determining the causal relationship, determining the relevant information, analyzing open problems, representative reasoning, and reaching conclusions).

3-**Drafting the test paragraphs:**

The researcher drafted the test paragraphs initially by drafting five paragraphs for each skill and thus the test includes (25) paragraphs of the multiple-choice type as in Appendix (12).

4- Formulating and correcting test instructions:

- **Answer instructions: The** researcher formulated the test instructions and how to answer them, so that they are easy and clear for the students, and included the instructions for the test and how to answer it and the time to answer the test with a clear example of how as in Appendix (13).
- **Correction instructions:** The researcher prepared a typical answer for all paragraphs, where I gave one score for the paragraph whose answer is correct, and zero for the paragraph whose answer is wrong and treated the coefficient of the abandoned paragraph that carries more than one answer as the wrong paragraph, so the final score of the test is (25) and the lowest score is (0) as in Appendix (13).

5-Psychometric properties of the test

It means the necessary characteristics related to validity, stability, and standards that are calculated after testing the test on a representative sample of the community (Murad and Amin, 2005:350) to ensure that the test measures what it is set for and that the difference between the performance of individuals in the test is due to the real performance of individuals and not because of random measurement errors.

- **Statistical analysis of test items.**

1- **Construction sincerity**

It means analyzing the meaning of test scores in the light of psychological concepts (psychologically interpreting the scores on this test, the most important of which is finding the differences between students through the two extremist groups and based on the total score, and extracting the difference between the answers of students of these two groups in each of its statements and deleting the phrase that shows a clear distinction between these two groups, as well as extracting the relationship between the scores of subtests and the total score of the test (Majeed, 114:2014). To verify this validity, the researcher calculated:

A– Paragraph discrimination coefficient for the test: This means that the paragraph can distinguish between the answers of the students in the upper group and the answers of the students in the lower group (Al-Yacoubi, 2013: 105).After calculating the coefficient of discrimination coefficient for each of the test paragraphs, the researcher found that the coefficient of discrimination of the paragraphs ranged between (0.33-0.52). This indicates that the test paragraphs are acceptable in terms of their discriminating ability and are valid to apply Appendix (13), if the discriminating power of the paragraphs is (20%) or more, they are valid and acceptable and the discrimination in it is real (Allam, 2006: 116).

B-Paragraph Difficulty Coefficient: Finding the percentage of students who answered correctly from the students who answered incorrectly from the upper group and the lower group, and means that the difficult paragraph that failed to answer a large percentage of the total upper and lower, and since the paragraph itself is either difficult or easy and therefore the paragraph is characterized between the factors of ease and difficulty (Al-Yacoubi, 2006: 105).

After calculating the difficulty coefficient for each of the test paragraphs, the percentage ranged between (0.39-0.69) as in Appendix (13). This explains that all news paragraphs are acceptable and valid to apply, and the test paragraphs are good and valid to apply if their level of difficulty ranges between (0.20-0.80)(Abdul Hamid, 2014: 65)

C-The effectiveness of the wrong alternatives: The effectiveness of the alternatives is evaluated by comparing the number of respondents to an alternative of the members of the two groups (upper and

lower),and the dispersant attracts the largest number of members of the lower group, and the ineffective dispersant is the one that no one chooses (Murad and Amin, 2005: 220)
The researcher calculated the effectiveness of the wrong alternatives and found that they ranged between (-0,26-0,07-)
This shows that the wrong alternatives have been attracted to it by a larger number of students of the lower group than the number of students of the upper group, and thus it was decided to keep the wrong alternatives as they are without change, as in Appendix (13).
D-Internal consistency: It means the extent to which the test paragraphs are related to each other within the test and the extent to which each paragraph is related to the test paragraphs in general. The most important thing in internal consistency is the consistency of the paragraphs with the content of the material(Al-Murdani, 2022: 111)

- **Relationship of the paragraph score to the overall score of the test:**

This method is one of the methods used to calculate internal consistency using the correlation coefficient, as it is interested in knowing that each of the test paragraphs must be consistent with the other paragraphs in achieving the goal of the test and that its inconsistency in achieving this purpose means deleting it and replacing it with another more consistent with the test paragraphs if the value of the correlation coefficient ranges between (0-0,1) (Abdul Rahman, 2008: 231).
The values of the correlation coefficients were calculated for the relationship of the paragraph to the total score of the test, using the Pearson correlation coefficient, and the results of the statistical analysis showed that the values of the correlation coefficient ranged between (0.24-0.61), and when compared with the tabular one, it reached (2) and the degree of freedom (70) at the level Significance (0.05) is statistically significant, and the following table shows this.
Test stability:
One of the characteristics of a good test is that it is stable, which is to give the same results almost every time it is applied to a sample of learners with the same conditions (Abu Al-Taman, 2007: 252), meaning that the results shown by the tools are stable in the sense of indicating things, or the same results or re-applied to the same sample in the same conditions after an appropriate period. When the results do not change by reapplying the tool and the response of the examiners does not differ, this means that the tool is stable (Attia, 2009: 111).
The researcher relied on the equation (Keoder Richardson 20) in calculating the stability coefficient, as the stability coefficient reached (0.84), which is an acceptable percentage, and thus the test is ready for application in its final form consisting of (25) test paragraphs.
CHAPTER FOUR:
First: Results
The current research aims to (identify the impact of the (Duit) model on the inductive thinking of the students of the second grade in physics) and for this purpose, the results reached by the researcher are presented according to the variable of this research and its null hypothesis as follows:
It states **that (There is no statistically significant difference at the level of significance (0.05) between the average scores of the female students of the experimental group studied according to the (Duit) model and the average scores of the female students of the control group studied according to the usual method in the test after calculating the** arithmetic mean, standard deviation and variation of the scores of the female students of the two research groups in the post-test for inductive thinking skills. To show the difference between the average scores of the two groups, the T-test was adopted for two independent samples as shown in Table (3).

Table (3): Results of (t-test) to find out the significance of the difference between the mean scores of the experimental and control groups in the inductive reasoning test

Variable	Group	Number	mean	Standard deviation	Degree of	T-test	Significant

				(Maths.)	Freedom	Calculated	tabular	
Post-test	Experimental group	38	16.21	3,79	72	3,825		statistically non-functional
	Control group	36	12:47	4,59				

The results showed a statistically significant difference between the averages of the inductive reasoning test scores between the experimental and control group students and in favor of the experimental group. The average scores of the experimental group students reached (16.21) with a standard deviation of (3.79), while the average scores of the control group students reached (12.47) with a standard deviation of (4.59). Using t-test for two independent samples, it was found that the statistically significant difference was at the level of significance (0.05), as the calculated T-value was (3,825), which is greater than the table of (2) with a degree of freedom (72), thus rejecting the zero hypothesis and accepting the alternative hypothesis, which means that the experimental group students who studied according to the (Duit) model outperformed the control group students who studied in the usual way in the induction thinking test

The researcher adopted the equation of the size of the impact. The size of the impact was (0.90), which is an appropriate value to explain the size of the impact and a large amount of the independent variable model (Duit) in the inductive thinking test and favor of the experimental group

Its value is (0.90), which is large. The researcher has adopted Kuhn's classification in explaining the magnitude of the impact. The table shows this

Grade	Small	Medium	Major
Value	0,20-0.50	0.50-0.80	0.80 +

(El Dardier, 2008: 79).

Findings:

In light of the results of the research, the researcher reached the following conclusion: (The use of the Duit model in teaching has had an impact on increasing the achievement of second-grade students in physics compared to the usual way)

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