

**How to Cite:**

Amir, A. M. A., & Mohamed, A. A. (2022). Logical reasoning skills according to Piaget's model for chemistry students in the college of education for pure sciences Ibn al-Haytham in Iraq. *International Journal of Health Sciences*, 6(S4), 7006–7019.  
<https://doi.org/10.53730/ijhs.v6nS4.10352>

## **Logical reasoning skills according to Piaget's model for chemistry students in the college of education for pure sciences Ibn al-Haytham in Iraq**

**Asmaa Mohammed Abdul Amir**

University of Baghdad / College of Education for Pure Sciences / Ibn Al-Haytham  
Corresponding author: [asmaa.mohammed1205b@ihcoedu.uobaghdad.edu.iq](mailto:asmaa.mohammed1205b@ihcoedu.uobaghdad.edu.iq)

**Assistant. Prof . Anwar Abbas Mohamed**

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

**Abstract**---The aim of the current research is to identify the level of logical reasoning skills in chemistry students at the Faculty of Education for Pure Sciences/ Ibn Al-Haytham for the academic year (2021-2022). The differences in their level of skills according to the gender variable (males and females) and the academic stages (first-second - third - fourth). The descriptive approach was adopted because it corresponds to the nature of the research objectives. The research sample consisted of (400) students selected in a relatively random stratified way. The researcher constructed a logical reasoning test, which includes (6) sub-skills, which is (proportional - probabilistic- synthetic- deductive- logic- variable adjustment). The psychometric properties of the test were also verified from face validity, discriminatory power, item difficulty index, and the relationship between the items score and the total degree of the test. Statistical methods were used in the Cronbach equation, the Spearman-Brown equation, (SPSS+22). Pearson correlation coefficient, one sample T-test, two independent samples T-test, mono-variance analysis- Chevy test). The results that were reached showed that the students of the Chemistry Department have an average level of reasoning skills (proportional- probabilistic- synthetic) more than other skills and that males are superior to females in all reasoning skills. The results also showed that fourth stage students are superior than students in other stages in all reasoning skills. In the placement of the results that have been reached, the current research recommended the need to develop the curricula in general for all stages of study and work to include various training in reasoning

skills and the need for guidance by officials and supervisors on the use of modern teaching methods and to move away from methods of memorization and indoctrination that make the student a recipient of information without interest in stimulating thinking.

**Keywords**---logical reasoning skills, piaget theory, cognitive development theory, chemistry students.

### **Research problem**

Education in Iraq has suffered from major problems for many years, as the educational process is still viewed from a narrow perspective. Teachers focus on the traditional method that relies on indoctrination and memorization of information, and teachers neglect an important aspect, which is how to develop thinking skills in general and inference skills in particular because inference and his skills develops in learners the ability to criticize, compare, analyze logically and make decisions, which helps to find a flexible mindset in them, in addition to making an effort to reach alternatives to solve the problems they face . The reasoning does not grow automatically and that a person needs reasoning at all stages of his life to manage his life , so educational institutions are responsible for his development. Because the science of chemistry is a science that needs thinking , it is necessary to pay attention to the methods of thinking of students and stand by their reasoning and skills. It has been found that there are many difficulties that the Chemistry Department suffers from in using higher thinking skills. This extreme weakness was especially noticeable in their use of logical reasoning methods and related skills. This problem has crystallized in the researcher after conducting interviews with some teachers in the Chemistry Department.

The opinions of the teachers in the Chemistry Department indicated that there is a lack of reasoning and that there is a clear weakness in their reasoning skills ,and that the students rely on the conning and retrieval of information without paying attention to the higher thinking processes and methods of development. Therefore, the need for a diagnostic process that leads to identifying the deficiencies and weaknesses in the reasoning skills according to the Piaget model resulted in the following question (What are the logical reasoning skills according to the Piaget model in Chemistry students ?)

### **Research significance**

What distinguishes the current era are the successive changes, the increasing information and the cognitive developments that have included the areas of life in addition to the information revolution as a result of the advancement of technological technologies, so the movement of educational reform has focused on developing thinking among students to be able to accommodate and confront these conflicting changes by preparing them for what the future era will be.(Al-Halafi,2020 :17 )

There is an urgent need for leaders who have the ability to develop thinking skills in this era. The current era is an era of permanent change and development in which traditional organizations must seek to adapt to the nature of the age. Educational organizations are the organizations that most need to keep pace with reality due to the nature of their goals and their role. Therefore, they are more in need than other organizations of leaders and officials who have deduction skills and have a vision for the future, because this era in which reorganization processes and the introduction of new technologies have become a need that they must be familiar with and their attitudes towards it must be positive. The era of the knowledge revolution and technology techniques requires leaders with higher thinking skills. During the last two decades, the educational field is witnessing great and major shifts in the consideration of the educational process by the researchers, and these shifts included raising the question of external factors affecting the education process such as the characteristics of the teacher (such as his personality, the clarity of his expressions, his enthusiasm, and the way he praised ) in addition to raising the question of what is happening inside the mental buildings of the learner such as (his previous knowledge, his understanding of knowledge, his ability to remember, his ability to process information, his attention, his patterns of thinking, and everything that makes learning meaningful ), and the researchers had significant and clear contributions in this field, and this was shown through their focus on how the meanings of the concepts are formed by the learner, and the role of previous information in shaping these meanings and new mental structures. (Al mughrabi ,2018 :228 )

Cognitive theory is an educational philosophy that means that the learner forms his own knowledge and stores it inside. Everyone has his own knowledge that he stores for himself and that the learner has his own knowledge either individually or in a community based on his current knowledge and previous experience, where the learner selects and converts information and form hypotheses and make decisions based on his knowledge structure that cares about that. (Aggression,David,2016: 34) Piaget is one of the most famous scientists who established the first steps of cognitive theory. He believes that cognitive learning is a process of self-regulation of an individual's cognitive structures aimed at helping him adapt. In other words, the individual seeks to learn in order to adapt to cognitive pressures that contradict his experience during his interaction with the data of the surrounding world. Piaget assumes that there are two basic processes that occur during the learning process.

They are : 1. Representation 2. Alignment . (Al mughrabi ,2018 :229)

The process of representation can be seen as a cognitive process to put new events or stimuli into existing schemes. Harmonization is the process of creating schemes, or modifying old schemes, and both processes result in change and upgrading of cognitive structures. Harmonization reflects upward mobility (qualitative change), while representation reflects growth (quantitative change), both of which reflect intellectual adaptation, and upward mobility of intellectual structures. (Al-Askari et al., 2012 :132) . Educators agree that education for thinking or learning thinking skills is an important goal of education, and schools must do everything they can to provide thinking education opportunities and skills to their learners, and that teachers must consider the task of developing the learner's ability to think as an educational goal, making it a top priority.

(Jarwan,2011 :19 ). The role of the science teacher is not merely to provide students with the knowledge structures of the academic subject, but to help learners develop positive skills, attitudes and values. The science teacher may need to apply the basic principles of science teaching and be at the beginning of the lesson by raising questions about nature and the phenomena of things in the learner's environment, to try to understand them and to explain their behavior and provide opportunities for the learner to participate in learning activities as well as to provide the learners with a historical background of scientific perspectives because this will show them how scientific knowledge grows and develops (Hama,2019: 18 ). Logical Reasoning is an important ability in the life of an individual whose level must be determined because of its important role in acquiring knowledge, solving problems and making decisions . (Saeed,1999 :1) That reasoning is one of the types of thinking, which is the ability to rationalize and deductive explanation and perceive relationships to link causes and consequences, and thus includes several processes, including abstraction and reaching generalizations and proving relationships to reach solutions to problems and evaluate opinions and draw conclusions . (Al-Haloul, Yahya,2011 :338 )

Reasoning has been described as the art that ensures orderly, accessible and error-free leadership of mind processes . ( Lee, 2015: 20) The following are a number of points that illustrate the importance of reasoning:

- Provides students with new skills to help them adapt to the world around them .
- It does not directly provide them with knowledge but rather teaches them how to process information and experiences.
- Students are given an opportunity to plan, observe, organize , conclude and evaluate to accomplish their work.
- Develops students' potential and abilities, develops their self-confidence and helps them face the requirements of life .
- Achieves the goals of education by making students think clearly and gain information accurately.
- The use of the scientific method . When students move between extrapolation and extrapolation , it seeks to impose hypotheses and is a reference test for students' knowledge of their mastery of the scientific material.
- Increases activity and effectiveness within the classroom by organizing students' learning and solving their problems. (Al-Najdi et al., 2005 :244)

### **The importance of research stems from**

- 1- The importance of the current research lies in the theoretical aspect, which is represented in the logical reasoning skills of the students of the Department of Chemistry in the Faculty of Education, Ibn Al-Haytham for Pure Sciences, as they provide it to the teaching sample and their ability to think about their students is reflected in later thinking.
- 2- Learning to use inference contributes to conveying what he learned and experimenting with in the field of his work life and solving the problems he is exposed to on a scientific basis by understanding the basic components

of each problem to be able to analyze and understand them and draw the appropriate solution.

- 3- Teaching students logical reasoning skills contributes to increasing interest and focus on processes within the classroom, i.e. the goal is to learn mental processes ,not just academic content.
- 4- It is considered a scientific addition and the quality of Iraqi and Arabic studies in the specialization of teaching methods of chemistry, as the skills of logical reasoning are known according to the theory of Piaget for an advanced age.
- 5- Contributes to helping graduate students and researchers in the field of teaching chemistry methods to benefit from the test that has been built.
- 6- It coincides with the importance of the age stage. At this stage, the student will have completed most of the changes in the cognitive structures (mental openness) and in the physical and emotional aspects.

### **Research objectives: The current research aims to identify**

- 1- The level of logical reasoning skills according to the Piaget model among the students of the Department of Chemistry in the Faculty of Education for Pure Sciences – Ibn Al-Haytham.
- 2- Identifying the statistically significant differences in the level of logical reasoning skills according to the gender variable ( males - females) among the students of the Department of Chemistry in the Faculty of Education for Pure Sciences - Ibn Al-Haytham.
- 3- Identifying the statistically significant differences in logical reasoning skills according to the study variable (first –second – third –fourth) among the students of the Department of Chemistry at the Faculty of Education for Pure Sciences –Ibn Al-Haytham .

### **Definition of terms: Logical reasoning is defined by: -**

Piaget: “The ability to solve problems using logical processes” (Wordsworth,1990,96 )

(Saeed,2008 ): A mental process aimed at eliciting results and extracting abstract meanings of things and relationships by virtual thinking through symbols, generalization and the ability to make assumptions and confirm their validity (Saeed,2008 :30)

The current research defines it procedurally (the ability of students of the Faculty of Education for Pure Sciences/Ibn Al-Haytham Department of Chemistry to exploit their higher mental abilities in the learning process and is measured by the degree obtained by the student in the logical reasoning test prepared for this purpose).

### **Theoretical Framework**

Jean Piaget : Jean Piaget was born in the Swiss city of Neuchâtel in 1896 and his father was a specialist in the study of the history of the Middle Ages. Since his childhood , Piaget had a clear passion for studying natural history and biological sciences . He was very interested in how nature performed its functions. He obtained a bachelor's degree in biology at the age of eighteen from

the University of Neuchâtel and obtained a doctorate in biology from the same university at the age of twenty-two. Piaget grew up in a scientific environment surrounded by research and cultural activities. The work that he used to do helped think and scientific research. At that time, he aspired to build a theory of knowledge. He also had a desire to understand the union between the forms of the organic world and the two structures of intelligence( Piaget ,1970:16 ). What distinguishes Piaget workers from other scientists who studied intelligence is the methodology that he used and called the methodology that he used. He applied the clinical methodology and that he relied on errors in which other children fall on the correct tests. He was very interested in the epistemology that was on his mind, and he had many questions about it.

- What is the meaning of knowledge?
- Do you acquire knowledge through the senses or the path of the mind?
- How does a child's knowledge of the world grow?
- When is a child able to use reason in their thinking?
- Is there a biological explanation for how a child acquires knowledge?

These and other questions were like the crucible in which Piaget's energies and research were melted, and his attempts to answer the question about how one acquired knowledge and how it grew were perhaps the main axis from which Piaget's epistemology emerged. (Zeitoun, Kamal, 2003:82)

### **Cognitive theory**

It is one of the theories of cognitive learning that works to stimulate interaction between learners and teachers, that is, it focuses on the activities carried out by both parties to the educational process and includes classroom, extracurricular and other activities that encourage the learner to achieve academic achievement. ( Al-Saadi et al., 2021: 513) Piaget's theory is the first theory that tracked the individual's cognitive development in an organized way and provided a deep and comprehensive explanation of human cognitive development. Piaget also believed that children are active beings that build their own knowledge, and that they do not see things as adults see them, not even as children older or slightly younger see them, and that things in children at a specific age are measured by their number and not by their size, so instead of looking at the child's perceptions as wrong, we should look at it as reflecting the logic that the child adopts for himself and how he views his world and interprets it in his own way. (Abughazal,66:2012)

Piaget's stages of cognitive development: Mental buildings change and their complexity increases as the child grows. These mental buildings differ qualitatively from one phase to another. Piaget distinguished between four stages of cognitive development (Al Askary and others 2012 135) that the transition from one phase to the next is linked to the specified years of life, but these stages develop sequentially and each stage is considered necessary for the next stage to occur. These stages are as follows :

First: Sensorimotor stage: (from birth– 2 years) : This stage begins at the moment of birth until the end of the second year . Learning and cognitive growth occur mainly at this stage through the senses. Thinking occurs in a major way through

actions. The process of motor synergy improves and the coordination of responses improves. Awareness is gradually developing and the idea of survival or stability of the material develops and the process of language acquisition begins.

Second: The Preoperational Stage: ( from 2 years – 7 years) : This stage begins at the end of the second year until the seventh year of life. Piaget is transitional and incomprehensible because it is not characterized by a constant and clear level of cognitive development, but linguistic growth increases and the child can use linguistic symbols more and the status of self-centeredness is prevalent at this stage and the child begins to form concepts and classify things. Failure to think in more than one way and visual perception precedes logical thinking.

Third: Concrete operational stage: ( from 7 years – 11 years) : This stage begins from the seventh year to the eleventh year and the child can at this stage practice the processes that indicate the occurrence of logical thinking, but they are related to tangible physical actions. One of the advantages of this stage is the transition from self-centeredness to social character and that thinking occurs during the use of tangible material objects and topics and develop the concept of survival and retention (mass, weight and size). The concept of reversibility develops and thinking processes develop in more than one dimension. The processes of concept formation, classification and compilation also develop and fail to think about future possibilities without direct experience of material topics.

Fourth +: The Formal Operational Stage: (from 12 years – and above) : At this stage, most children can develop and test hypotheses as well as be able to deal with problems and reach logical results without referring to physical things or direct experiences and thinking about future possibilities and predict them. At this stage, the processes of representation and alignment are balanced and the individual reaches a high degree of balance. The individual also has the ability to deduce and reach abstract thinking and develop the ability to imagine before presenting the possibilities for a situation. At this stage, the individual can deal with things through logical synthetic processes and he is able to fix all factors and change one of them to examine him and he is able to understand proportionality and perceive engineering matters and focuses on relationships more than content and moves from self-centeredness to thinking about mutual social relations (Al-Khali, 1996: 132).

### **Reasoning**

It is a logical mental process that contains a set of sub-skills that appear in each mental activity characterized by extrapolating the base from its parts and eliciting the part of the whole in which the individual walks from known facts or issues whose validity is recognized to know the unknown mentally. (Khalida, 2016: 261) The logical reasoning begins with natural sensory experiences, whether simple or complex, and then develops into abstract experiences, and then moves to more abstract experiences as we find in the laws of science, whether natural or human, and that the reasoning works within the scope of new problems that need to be observed, focused and invented. (Mustafa, 2002 :63 )

The most important properties of logical reasoning are as follows :

- A logical process in which logic rules are used .
- Relational thinking that includes adjusting the causes and results by remembering , analyzing and recognizing the relationships between past experiences and new experiences .
- It is used in cases of concept formation and derivation of theoretical hypotheses .
- It helps to discover the relationships and systems that link knowledge by realistically processing it.
- Upper mental processes such as comprehension, imagination and abstraction are used.
- Intelligence is closely related to inference. (Razouki, Suha, 2013 :32-33)

### **Logical Reasoning Skills**

Theories have approached the concept of inference in two directions:

First: It includes the general theories of intelligence : Addressing the concept of inference in general without emphasizing its characteristics and how it develops, and also without referring to the factors affecting it, and that the skills of inference according to the general theories of intelligence are: deductive reasoning, inductive reasoning, and deductive reasoning (Al-Saffar ,2015: 20)

second: The theory of cognitive development : Piaget's theory of cognitive growth is one of its most famous, as it deals with thinking and reasoning in a detailed and clear manner, especially in children and adolescents. Therefore, Piaget is a pioneer in studying cognitive growth, determining its stages, and analyzing the inferential processes in children and how to acquire concepts. Piaget mentioned skills that distinguish deductive thinking for the formal procedural stage. The current research has adopted these skills

- 1- Proportional Reasoning: It means the ability by which an individual infers the nature of the proportional relationship between more than one element using ratio and proportionality (Khalili ,1996: 132) or is ( the ability to infer the nature of the proportional relations between more than one element using ratio and proportionality) (Hama,2019: 30)
- 2- Probabilistic reasoning : Or it is (the ability to reach the basic list based on general information, but in addition it puts several hypotheses to solve the problem and makes the imposition of a probability of success ) (Al-Gharawi,2016 :661 ) Or it is (the ability of the individual to study the quantitative relations between the elements of the group or groups and determine the proportions of each of them and then compare the proportions and give certain possibilities ). (Hamah, 2019 :39)
- 3- Synthetic reasoning: It means (the ability to form the possibilities of correlations and relationships in an attempt to find a solution to the problem) (Nielsen, 1996:79) It is also called consensual reasoning and means the ability of the individual to deal empirically or theoretically to make as many correlations as possible between the elements of the subject of the study, provided that the correlations are organized and coordinated



and not random or repeated, such as making correlations from numbers 1,2, 3, 4, 5. (Khalili ,1996: 133)

- 4- Deductive reasoning: It is the ability of the individual to apply the general rules to individual cases to test the extent to which these special cases fall within the general case. ( Ibrahim ,2005: 331) It also means the individual's ability to make a set of assumptions and try to test their validity to reach the results of any inference about possible results . (Baron, 1992:300)
- 5- Logical analogy: It means ( the ability to draw conclusions from certain facts). (Al-Qadiri, 2002 :227 ) or (the ability to deduce relationships between things for several ideas and concepts)(Al-Gharawi,2016: 670 )

Adjusting variables: The ability to know the impact of one of the variables related to the problem and isolate and adjust other variables that are not related to the problem. (Piaget&Inhelder, 1958:46))

### Research procedures

Research Methodology: The descriptive research method was adopted, which is based on identifying the phenomenon as it is and describing the quality of the relationship between its variables, its nature, causes and other aspects

Research community: The research community consists of the students of the Department of Chemistry in the Faculty of Education for Pure Sciences - Ibn Al-Haytham for the academic year (2021-2022 ), the number of which is ( 900) male and female students. The distribution of the sample was as shown in Table (1)

Gender: TheStage	Males	Percentage	Females	Percentage	Total
The first one.	133	54%	113	46%	246
Second	116	49%	123	51%	239
Third	114	53%	101	47%	215
Fourth	109	55%	91	45%	200
Total	472	52%	428).	48%	900

Research sample: Since the current research community can be divided into layers, based on the stage of study and gender, the research sample was chosen in a relatively random class method, and the sample reached (400) male and female students, by (109) male and female students in the first stage and by (27%), (107) male and female students in the second stage and by (27%), (96) male and female students in the third stage and by (24%), and (88) male and female students in the fourth stage and by (22%)

Research tools: The current research requires building a test of logical reasoning skills as follows

Determining the goal of the test: It is to measure the level of logical reasoning skills according to the Piaget model among the students of the Department of Chemistry in the Faculty of Education for Pure Sciences/ Ibn Al-Haytham, with the aim of extracting results and extracting abstract meanings of things and

relationships by virtual thinking through symbols, generalization and the ability to make assumptions and ensure their validity.

Formulation of the test items and instructions: The test items were formulated from the type of multiple choice with four alternatives. The test items included problems and attitudes, some of which are general, and some of them require mastery of the chemistry. (60) items were formulated to measure a test of logical reasoning distributed according to the six skills by (10) items for each skill. The student gets one (1) degree when choosing the correct alternative and gets (0) when choosing the wrong alternative, so the test score is (60) degrees, and the lowest test score is (0) degrees

Test Validity: The test was presented to a group of arbitrators and specialists in chemistry, teaching methods, and educational psychology

Exploratory trial of the test: To ensure the clarity of the test items and instructions and determine the time required to answer, apply a logical reasoning test to a simple random sample selected from the research community

### **Statistical analysis sample**

The test of logical reasoning skills was applied to the sample of statistical analysis, for the purpose of analyzing the test items, and confirming its statistical and psychometric characteristics. The coefficient of characterization of the items was calculated and found to be between (0.41- 0.68). The test items are considered to be of acceptable distinction if the coefficient of distinction is between (0.39 and more) (Al-Dulaimi, Adnan, 2005: 90). The difficulty coefficient was applied as the difficulty equation for objective questions was applied and it ranges between (0.36- 0.70) as the acceptable range of the difficulty coefficient ranges between (0.20-0.80). (Al-Dulaimi and Adnan, 2005: 86), the effectiveness of each wrong alternative and each test item was calculated using the formula of the effectiveness of the alternatives. It was found that all the wrong alternatives are negative, that is, they are attractive camouflages for weak students. As for the stability of the test, two methods were adopted to calculate it, as it reached a coefficient of stability of (0.725) by applying the Cronbach equation. The other method was by adopting the half-part formula, and since the number of vertebrae is even, so the stability was extracted by calculating the Pearson correlation coefficient between the two halves of the test and correcting it by means of Spearman-Boran corrective. The stability is thus acceptable in descriptive studies, so that the test of logical reasoning skills in its final form is made up of (60) vertebrae and the total score in the test is at its highest (60) degree and its lowest (0) degree and with a hypothetical average of (30) degree, and thus the test is ready to be applied to the research sample

### **Results and Discussion**

The first goal: The level of logical reasoning skills according to the Piaget model among students of the Department of Chemistry in the Faculty of Education for Pure Sciences - Ibn Al-Haytham After applying the logical reasoning skills test to the research sample and calculating the scores obtained by the research sample

at the level of logical reasoning skills as a whole, the test was adopted. The results indicated that the arithmetic average of the scores of the sample members reached (30.945), and with a standard deviation (6.846), it was shown that the calculated T-value is (2.761) degree, which is greater than the tabular T-value) 1.960, which is statistically significant at the level of (0.05) and with a degree of freedom (399), which means that there is a statistically significant difference in favor of the arithmetic average of the sample, and Table (2) shows this.

Variable	TheSample	Sample arithmetic mean	deviation normative	Hypothetical average scale	Value		Sig	Difference Significance
					Calculated	tabular		
Logical Reasoning Skills	400	30.945	6.846	30	2.761	1.960	0.05	Function

It is clear from Table (2) that there are statistically significant differences between the arithmetic mean of the sample and the hypothetical average to test the logical reasoning skills and in favor of the arithmetic mean of the sample, that is, students have logical reasoning skills. The logical reasoning skills achieved by the students of the Department of Chemistry are (proportional, probabilistic, synthetic), while the unfulfilled logical reasoning skills of the students of the Department of Chemistry are (deductive, logical measurement, identification and control of variables) and that the reason for the decline of some skills of the research sample should not be left to blame on students only, but on the curricula first and on those who study them. Second, the information age in which we live needs a modern curriculum that challenges his abilities and skills and also needs teaching methods that depend on the foundations of logic in building mental systems that deal with daily events at higher levels of thinking, analysis, composition, evaluation and evaluation. Some of their students have access to universities and they are one way of dealing with information, which will prevent them from acquiring those skills.

**The second goal: Identifying the statistically significant differences in logical reasoning skills according to the gender variable (males -females) among the students of the Department of Chemistry in the Faculty of Education for Pure Sciences - Ibn Al-Haytham.**

There are statistically significant differences between males and females in logical reasoning skills, where the calculated T-value was (4.906) greater than the tabular T-value (1.906) at the level of significance (0.05) and in favor of males, where the arithmetic mean was (32.467), and a standard deviation (6.164), where females reached the arithmetic mean (29.193) and a standard deviation (7.181). There are also statistically significant differences according to each logical reasoning skill according to the variable of gender and in favor of males, where all arithmetic means for males were greater than the arithmetic means for females, and this is consistent with the study of (Nile Khazar 2002) and (Rana 2003), which confirms the preference of the work of each side of the brain for both sides of the genders, as the right side of the brain (males) and the left side of the brain (females). This explains the superiority of males in terms of the brain, but it is not possible to judge in some of the brain.

**The third goal: Identifying the statistically significant differences in logical reasoning skills according to the variable of the academic stage (first - second - third - fourth) among the students of the Department of Chemistry in the Faculty of Education for Pure Sciences - Ibn Al-Haytham.**

All logical reasoning skills were statistically significant, as all their values were the calculated percentile greater than the tabular logical value (2.62) at the level of significance (3-399) and with a degree of freedom (0.05). To know the significance of the differences according to the four stages of study, the researcher used a verbal test for post-comparisons. The results of the Chevé test for post-comparisons were statistically significant for the fourth stage in all logical reasoning skills. The differences that appeared in the level of reasoning skills and the variable of the stage of study for all logical reasoning skills were all in favor of the fourth stage. These results indicate the close relationship between the subjects that are studied for his application to the Department of Chemistry. As a study (Reikifen and Harry 1996 ) showed that the development of reasoning skills in students is related to the previous knowledge variable, performance abilities, mindset, age , gender, intelligence, culture, social status, and culture. The researcher believes that the stimulating classroom environment in scientific laboratories or theoretical lessons that are taught to chemistry students helped to develop the students' higher thinking skills because chemistry and its interactions require students the ability to analyze, explain, deduce , sort thought, perceive relationships, process information, and probe to reach generalizations.

### **Conclusions**

1. The results revealed the existence of an impact of the gender variable in logical reasoning skills, as males are superior to females in the use of abstract logical reasoning rules
2. Students tend to use structured and coordinated relationships, possibilities and interrelationships when solving their problems
3. The student has weakness in imposing and testing the validity of the hypotheses to reach possible results or to control the impact of one of the factors surrounding the problem
4. The educational materials and curricula have an impact on the logical reasoning of students

### **Recommendations**

1. Developing a curricula in general for all academic stages and work to include various trainings in reasoning and its skills.
2. Conducting training courses for teachers and teachers and introducing them to the importance of developing thinking skills in general and inference skills in particular on student achievement .
3. Guidance by officials and supervisors on the need to use modern teaching methods that have proven successful and to move away from methods of memorization and indoctrination that make the student a recipient of information without paying attention to stimulating thinking.

## Proposals

1. Conducting research on logical reasoning skills and their impact on the achievement of chemistry for preparatory students .
2. Conducting research to show each of the inference skills during the four different stages of development.
3. Conducting research on the impact of some thinking patterns on reasoning skills .
4. Design educational programs based on the Piaget model to develop other thinking skills upon his high school application

## References

- Abu Ghazal, Muawiya Mahmoud (2015): General Psychology, 2nd Edition, Wabel Publishing and Distribution House, Amman\_Jordan
- Aggression, Zaid Salman, Ahmed Issa Daoud (2016): The Social Constructivist Theory and Its Applications in Teaching, 1st Edition, Dibono Center for Thinking Education, Dubai, United Arab Emirates.
- Al mughrabi ,Nabil (2010): Dimensions of Learning, Publisher Deanship of Scientific Research, Al-Quds Open University, Palestine.
- Al-Halfi, Intisar Awa Musa (2020): Holistic Thinking, 1st Edition, Al-Amir Library of Printing and Cloning, Baghdad, Iraq.
- Al-Haloul, Ismail Abd, Yahya Mohammed Abu Jahjough (2011): Logical reasoning in students the Faculty of Education at Al-Aqsa University Gaza, Al-Azhar University Gaza Journal Humanities Series, Maj 13, p. 2, pp.333-362.
- Al-Kadiri, Abdul Latif Dirham (2002) : Logical thinking when applying for the preparatory stage and its relationship to their gender and specialization, (Master Thesis ), Faculty of Education Ibn Rashid University of Baghdad.
- Al-Khalili, Yousef, Abdul Latif Hassan Haider, Mohammed Jamal Al-Din Yousef (1996): Teaching Science in General Education, Dar Al-Qalam, Dubai - United Arab Emirates .
- Al-Najdi, Ahmed Mina, Abdul Hadi Saudi, Ali Rashid (2005) : Modern trends in science education in light of international standards and the development of thinking and constructive theory , 1st edition, Dar al-Fikr al-Arabi, Cairo, Egypt.
- Al-Saadi, Hassan Khayal et al. (2021): Contemporary Educational Studies, 1st Edition , Dar Al-Sadiq Cultural Foundation, Baghdad -Iraq.
- Baron, R. (1992). Psychology. Advising of simon, Schuster, Inc. (3th ed.). Boston London
- Chanana, M. (2018). Empirical study: relationship between self efficacy and academic performance. *International Journal of Health & Medical Sciences*, 1(1), 28-34. <https://doi.org/10.31295/ijhms.v1n1.36>
- El-Garawy, Wissam Khalaf Jassim (2016): Building the formal thinking skills of fifth grade students in the field of physics, Journal of the Faculty of Education for Educational and Human Sciences, University of Babylon ,No.25, pp.661-681.
- Hamma, Al-Ham Ahmed (2019): A proposed model for teaching chemistry according to theories of cognitive learning, 1st Edition, Ibn Al-Nafis House for Publishing and Distribution, Amman Jordan.
- Ibrahim, Majdi Aziz, (2005): Thinking from an educational perspective (its definition - its nature - its patterns), 1 World Books, Cairo – Egypt.

- Jarwan, Fathi Abdul Rahman (2011):Talent, Excellence and Creativity, 2nd Edition, Amman -Jordan.
- Khalidah, Akram Saleh (2016): Language and reasoning, I 1, Dar Al-Hamed Publishing and Distribution, Amman - Jordan.
- Lee,Muhammad Jassim, Bassem Muhammad Al-Obaidi,Alaa Muhammad Al-Obaidi (2015):Acquiring Knowledge and Teaching Evidentiary Thinking ,Dibono Center for Teaching Reflection.
- Military,Kifah Yahya Saleh,Muhammad Saud Suf Yer Al-Shammari,Ali Muhammad Al-Obaidi (2012): Learning Theories and Their Educational Applications ,1st Edition, July, published Damascus-SyriaDistribution.
- Mustafa,Fahim (2002): Thinking skills in the stages of general education (kindergarten -primary - non-adadi -thesecondary) A future vision for education in the Arab world,Dar al-Fikr al-Arabi,Cairo- Egypt.
- Nielsen, S.(1996):. " Adolescence : A Contemporare View". 3ed ., Horcourt brace college londen Sydney Tokyo.
- Piaget, J & Inhelder, B (1958): The Growth of Logical Thinking from Children to Adolescence. Translated by Parscns, A & Milgram, S, Routlodge & kegan palul Ltd London
- Piaget, Jan. (1970): The formative epistemology,translated,presented and commented by Mr. Navadi, publisher of the House of Formation, Damascus-Syria.
- Razooqi, Raad Mahdi, Suha Ibrahim Abd (2013):Thinking and its Types, C2, i 1 Library of the Faculty of Printing and Publishing Baghdad -Iraq.
- Saeed, Suad Jabr(2008): The Psychology of Thinking and Self-Aware , The Modern Book World of Publishing and Distribution,Amman -Jordan.
- Said,Adnan Hekma Abd (1999): The impact of using two models of cooperative learning in chemistry on achievement and the development of deductive thinking in students the first intermediate grade (doctoral thesis )Faculty of Education for pure sciences -Ibn Al-Haytham University of Baghdad.
- Widana, I.K., Dewi, G.A.O.C., Suryasa, W. (2020). Ergonomics approach to improve student concentration on learning process of professional ethics. *Journal of Advanced Research in Dynamical and Control Systems*, 12(7), 429-445.
- Wordsworth, P. J. (1990): Piaget's Theory of Cognitive Advancement
- Zeitoun, Hassan Hussein,Kamal Abdel Hamid Zeitoun (2003):Learning and Teaching from a Constructivist Perspective,1st Edition, The World of Books,Cairo-Egypt .