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Logical inferences according to the Cognitive Development model among Preparatory school students

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***Abstract*---**The research aims to identify the level of logical inferences and its skills among students of the preparatory stage, and to identify the logical inferences & its skills according to the gender variable (male - female) and academic specialization (scientific – literary). The sample consisted of (400) male and female students who were selected by the random stratified proportional method from the three Karkh education directorates .The researcher built a logical inferences test that includes: (6) sub-skills: inference (Proportional, probabilistic, Synthetic, Hypothetical, Syllogistic, & Variables Controlling). The electrochemical properties of the test were verified. The following statistical methods were used: (Chi-square, Correlation Coefficient: Pearson, Biserial, Spearman Brown Correlation), one-sample t-test, two-way analysis of variance). The following results were obtained: 1) Preparatory school students possess a high level of logical inference; 2) Preparatory stage students have more structural & hypothetical inference skill than other skills; 3) The degree of logical inference males is higher than in females; 4) The degree of logical inferences among students of the scientific Branch is higher than that of students of the literary Branch; 5) Males outperform females in the skills of proportional and Synthetic inference; 6) Students of the scientific Branch outperform students of the literary Branch in all skills of logical inferences.

***Keywords*---**Logical inferences, skills among students, academic specialization.

Research problem

Logical inferences are the series of invisible mental activities that the brain performs when exposed to a stimulus that is received by one or more of the five senses in search of meaning in a situation, a purposeful and developmental

behavior formed by the interplay of capabilities, personal factors, cognitive, metacognitive, and knowledge Concerning the subject about which the thinking is taking place (Abu Jadu, 2009: 472).

Piaget asserts that the stage of adolescence is important in the emergence of the ability to reason logically * away from sensory stimuli, and that inferential abilities begin to appear, as these abilities develop, so does the ability to solve problems (Piaget, 1986: 101).

(Yussen & Santrok, 1982) see that (the adolescent in the stage of formal operations can think abstractly and logically and achieve a reality very similar to that which an adult can achieve) (Al-Tamimi, 2010: 33).

The results of studies varied about the students' ability to use logical inferences, and to determine the age at which it appears. A study by Laibi, 2011 concluded that inference is not formed in Iraqi adolescents in the preparatory stage until the age of (17-18) years, this result indicates that there is a knowledge gap between it and Piaget's assumptions of about (3) years.

Al-Fraiji's 2009 study concluded that students pass in their intellectual development through the four stages described by (Piaget & Enhalder), but the logical inferences only appeared by 25% at the age of 17, i.e. a clear temporal lag attributed to the general cultural retardation, or the shortcomings of our schools in their curricula and methods. While the study of Al-Qadri (2002) found that middle school students deal with logical inferences distinctly, and there are no differences between males and females in this type of mental operations. The study of Laibi 2011 found that there were no differences between the mean scores of the logical inferences of the members of the study sample and the gender variable. There are statistically significant differences between the mean scores of the logical inferences of the sample members and the variable of academic specialization in favor of the members of the scientific specialization.

The problem of the current research comes from the researcher's feeling about the existence of a clear contradiction between the results of studies and the postulates of the cognitive advancement model regarding the stage of logical inferences, so he decided to study this topic to resolve these contradictions through an objective scientific study, and the research problem can be summarized in the following question: What is the degree of logical inferences for students?

The importance of research:

The stage of adolescence is a stage of rapid growth, which includes changes in various aspects: mental, physical, and social. At this stage, mental abilities become more accurate in expression, such as verbal ability, numerical ability, and the ability to learn and the ability to acquire skills and information. It is noted that learning becomes logical, not mechanical. Perception, attention, and memory grow, and the ability to think formally increases.

Formal thinking is the highest stage of development according to Piaget. In the stage of formal operations, the individual reaches the peak of development in cognitive structures, so he is able to make logical reasoning in all its forms, solve hypothetical problems, and verbal problems and be able to deduce all possible possibilities in solving the problem, following the deductive approach in thinking (Abu Jadu, 2009: 179).

The importance of the stage of logical inferences lies in the adolescent's ability to use theories to solve many problems in an integrated manner, and he can apply many operations in solving one problem, organizing information, and interpreting it scientifically. It knows logically derived conclusions completely independent of factual reality (Al-Tamimi, 2010: 47).

According to Piaget, the formal processes go through two stages: in the first stage, the adolescent uses deductive reasoning to solve problems, while in the second stage he uses (inductive reasoning), that is, he can deduce the general from the specific, & the cause from the effect, and the second stage is one of the advanced stages & Cognitive Development (Obeidat, 2013: 78).

Logical inferences is one of the important abilities in the life of the adolescent, who should stand at his level for his great role in acquiring knowledge, solving problems, making decisions, and has the ability to impose and test hypotheses, & to choose alternatives away from material topics and on a symbolic and abstract basis, and the ability to organize. & research, thinking, reasoning, induction, and specific observation, to reach generalizations and principles, & solve problems (Al-Fariji, 2009: 32).

The importance of logical Reasoning is clear in the adolescent's ability to use (Logical Operation) to solve hypothetical or verbal problems correctly. This ability appears only in the adolescence stage or in its beginning, i.e. between (11-12) years or the stage of abstract or symbolic operations (Ali, 2008: 27 .Based on the foregoing, the importance of the research can be determined from both the theoretical and practical sides through the following:

1. It coincides with the importance of the preparatory stage as an important stage of study, as this stage prepares students cognitively, psychologically, and socially to continue their preparatory studies, and later their university studies.
2. It coincides with the importance of the age stage (adolescence), as the student at this stage passes through the most delicate stages of life, as most changes occur in the cognitive structure (mental openness) in the physical, emotional, & social aspects.
3. It is considered a feedback regarding decision-makers, and the responsibility in educational and educational institutions to know the importance of the level of logical inferences among middle school students.
4. It is considered a reference for researchers, as it provides them with a tool for measuring logical inferences, and thus constitutes a previous step that helps to conduct later studies in educational, educational, and research Universities.

Research aims: The current research aims to identify:

1. Logical **inference** for Preparatory school students.
2. Logical **inference**s (skills) Preparatory school students
3. The differences in the level of logical inferences according to the gender variable (males, females) and specialization (scientific, literary).
4. The differences in the level of logical inference skills according to the gender variable (males, females) and specialization (scientific, literary).

The limits of the research: determined by the study of the logical implications of the students of the preparatory stage (morning study) and the fifth grade (preparatory) of both sexes (males and females), and the academic specialization (scientific, literary), in the province of Baghdad, Karkh education directorates: the first, the second. And third.

Define terms:

(Logical inferences): Defined by Piaget: (The ability to solve problems using logical operations) (Wordsworth, 1990: 95). It includes logical inferences according to Piaget's model:

1. **(Proportional inference):** (ability to establish a relationship between two relationships to reach a solution to the problem that forms the basis of the relative relationship, according to the rules of proportionality (Labi, 2011: 11).
2. (**Probabilistic inference)**: (Probabilistic judgment about different situations and topics in an accurate & objective manner) (Al-Tamimi, 2010 : 77).
3. **(**Synthetic **inference): (**the ability to form different possibilities of associations and relationships in an attempt to find a solution to a problem) (Nielsen, 1996:79).
4. (**Hypothetic - Deductive inference)**: (It is the ability to put forward a set of hypotheses, try to test their validity, elicit a solution, and arrive at conclusions, i.e., Inference about possible outcomes) (Baron, 1992:300).
5. **(Logical Analogy) (Syllogism):** (the ability to draw conclusions from specific facts) (Al-Qadri, 2002: 227).
6. **(Variables Controlling):** (the ability to know the effect of one of the variables associated with the problem, and isolate and control the other variables not related to the problem) (Piaget & Inhelder, 1958:46).

The current research adopts Piaget's definition of logical inferences as a theory. The current research defines procedural logical inferences: it is the degree that the student will obtain when responding to the items of the subtests of logical inferences prepared for the purposes of the current research.

Theoretical framework;

The concept of logical inferences: Logical inferences are a mental process that aims to elicit results, extract abstract meanings of things, and relationships by means of hypothetical thinking through symbols, generalization, and the ability to make assumptions and verify their validity (Said, 2008: 30).

Logical inferences occur when the individual encounters a problem for which he does not find a ready solution or an experimental method, because he practices it to try to find out the causes and causes that lie behind things. .

Piaget looks at cognitive growth from two perspectives: Mental Structures (Mental Functions), and mental construction refers to the state of thinking that an individual has at some stage of his development, while mental function refers to the set of processes that an individual resorts to when interacting with stimuli of the environment it deals with. Therefore, Piaget believes that mental functions are fixed & do not change in humans, as they are inherited, and that mental structures are the ones that change with age. The cognitive structure includes the content of experience, as well as the strategy of thinking about it. It increases in number & complexity through the process of growth, as the outcome of the cognitive experiences of individuals increases (Al-Zogoul, 2005: 179).

Piaget calls the stage of formal operations (12 - & above) the stage of logical reasoning, because the cognitive structure of the adolescent undergoes qualitative changes during this stage, which makes him move from the focus on the content, to the form of the idea itself, and this stage is the height of development in structures Cognitive as the schemas reach the maximum levels of development and awareness by the fifteenth year of age and the adolescent is able to think logically in relation to solving all kinds of problems (Al-Fariji, 2009: 44). This stage is not related much to the tangible material reality, but is related to hypothetical situations and mathematical problems. They result from the individual's experiences in solving hypothetical problems, so individuals at this stage can deal with the processes of logical inferences, discover principles, or general rules. Logical inference includes a number of (Mental Processes): (Comparing), (Systematization), (Classifying), (Abstraction), (Generalization), (Analysis), (Synthesis), (Reasoning), (Deduction), (Induction). (Ali, 2008: 38).

The adolescent at this stage, as a result of his use of abstract logical operations, proposes alternatives, causes, causes, events, mental verification of the correctness of problem solutions, and becomes able to think in the same thinking process. To material things or direct experiences, as long as he acquires the concept of reversal, he will think in an abstract way and solve problems, as he sets hypotheses and suggests possible solutions within the available alternatives (Abu Jadu, 2009: 101).

The researcher believes that the nature of cognitive processes and their levels differ from one age stage to another, so the change that occurs in it is not only quantitative, but also qualitative, as the change from concrete to abstract occurs at an advanced age, or in a late state for some others, which leads to the disparity between learners as a result Variation in their cognitive experience.

Although most individuals have the ability to reach the stage of logical inferences, the social environment may affect the time it takes for the individual to reach this level. Deprived or culturally and socially poor environments hinder the rate of cognitive growth.

Research Methodology & Procedures

First: The research community: it consists fifth preparatory grade students (males & females) two branches (scientific & literary) numbering (21489) male & female students & (11092) students & they constitute (5.51%) & (10397) female students, comprising (5.48%) distributed by (12118) from the scientific branch & constituted (4.56%), & (9371) from the literary branch, & they constituted (6.43%.)

Second: The research sample: it consisted of (400) male and female students (1.86%) from the research community, they were chosen by stratified random method and proportionately from (6) middle schools (3) of which are for boys and the same for girls, at a rate of (207).) of males, and (193) of females, by (226) male and female students from the scientific branch and (174) male and female students from the literary branch, table (1)

Table (1) the basic research sample according to the Karkh education directorates, gender & academic specialization

Directorate	Gender	School name	scientific	literary	total
Karkh /1	Male	Omar Mukhtar	40	22	62
	Female	Al-Farabi	32	20	52
Karkh /2	Male	university	46	39	85
	Female	Al-Mustafa	45	44	89
Karkh /3	Male	Al-Harith 1	36	24	60
	Female	Babel	27	25	52
3		6	226	174	400

Third: The Research tool:

(**Logical inferences test**): The test was built in the following steps:

Determining the areas of logical inferences: After reviewing the studies that dealt with logical inferences, & analyzing the theoretical definition of Piaget according to his theory of cognitive advancement. The following areas of the test were determined: (Proportional inference: Probabilistic inference: Synthetic inference: Hypothetical - Deductive reasoning: Logical analogy: Variables Controlling).

The test items were formulated through: defining the areas included in the test, & reviewing the available tests that dealt with logical inferences as a study (Roberge & Flexer, 1980), (Tobin & Capie, 1981) & (Al-Qadri, 2002). Interviewing a group of experts in educational & psychological sciences for the purpose of identifying the logical reasoning skills that can be identified among middle school students. Based on what was mentioned, the researcher obtained (24) items representing the test items in its initial form.

Face validity: Ebel states that the best way to ascertain the apparent validity of the scale is to present its items to a group of arbitrators to judge their validity in measuring the property to be measured (Ebel, 1972: 555), accordingly the test in

its initial form was presented to experts Their number reached (14) experts, who are specialists in educational & psychological sciences to validity of the Items in measuring logical inferences, & the calculated value of (chi-square) was adopted as a criterion for the survival of the Items or not, & the value of chi-square (chi) for Items was a function of freedom 1) at the level of significance (0.05).

Test Correction method: The test items were corrected by giving a score of (1) for the correct answer & a score of (zero) for the wrong answer for all areas except for the field of synthetic reasoning, where the items were corrected by dividing the number of student answers by the number of correct answers.

Statistical analysis of the test items: The statistical analysis sample consisted of (400) male and female students with a percentage of (1.86) from the research community, they were selected by random stratified method and in a proportional manner from (6) middle schools, (3) of which are for boys and the same for girls, at a rate of (207) of males, & (193) of females, with a total of (226) male & female students from the scientific branch, & (174) male and female students from the literary branch.

Discrimination coefficient for the items of the logical inferences test: The discriminatory power equation was applied according to the Ebel 1972 criterion) which indicates that the item is good if its discriminatory power is (0.30) or more (Ebel, 1972: 406) as the discriminatory power was for all items between (0.32 _ 0.88) which is within the accepted standard.

The difficulty of the test Items: To verify the difficulty of the test paragraphs of logical inferences, the relevant equation was applied, and it was found that the difficulty coefficients ranged between (0.31 - 0.78) & Bloom indicates that the reading of the test is acceptable if its difficulty coefficient ranges between (0.20 - 0.20). 0.80) (Bloom, 1983: 107) & on this basis the level of difficulty of the test items was appropriate.

Finding the relationship between the degree of the Items and the total degree of the test: To verify this, the values of the correlation coefficient between the degree of each paragraph with the total degree of the test were calculated using (Point Biserial Correlation), & the correlation coefficients for all paragraphs were a function at the level of significance (0.05) & the degree of freedom (398).

The relationship of the Items score with the degree of the field: Ferikson indicates that (Point Biserial Correlation) is the most common method for calculating the correlations between the two-degree test items and the test score as a whole (Ferrickson, 1991: 515), when using the two-point correlation coefficient for the purpose of finding the relationship between the items score The total score of the test shows that all correlation coefficients are statistically significant at the level (0.05) & the degree of freedom (398).

Finding the relationship of the domain degree with the total score of the test: It was found that the values of all correlation coefficients are statistically significant at the level of significance (0.05), Table (2).

Table (2) Correlation coefficients of the relationship of the domain score with the total score of the test

Inference	Proportional	Probability	Synthetic	Hypothesis	Syllogism	Variables Controlling
Correlation coefficients	0.590	0.557	0.371	0.666	0.562	0.583

Test Reliability

(Test-Retest method): test was applied twice, with an interval of (15) days, on a random sample of (50) male and female students from two schools (Al-Quds for Boys) and (Al-Bayan for Girls), and the reliability coefficient was extracted through Calculating the Pearson correlation coefficient between the students' scores in the first application and their scores in the second application, and the correlation coefficient was (0.82). It can be said that the reliability coefficient of this amount is acceptable in the general balance for evaluating the semantics of the correlation coefficient (Gronland, 1981: 102).

(Split Half method): (200) questionnaires were drawn randomly, then the test items of (24) items were distributed into two groups according to their sequence to the set of odd items and the set of even items, (Person correlation coefficient) was calculated, then the Spearman Brown Formula was applied)) (because the correlation coefficient between the two groups represents the half-test correlation coefficient) to correct the correlation coefficient, & it reached (0.55), which is a high indicator of the test's stability.

The final test: After verifying the standard characteristics, the logical inferences test in its final form has become composed of (24) items, appendix (1), the total score of the test at its highest (24) degrees & at its minimum (zero) degrees, and with a hypothetical average (12) degrees, table (3).

Table (3) The final logical inference test

inference	N	Item Number	inference	N	Item Number
Proportional	4	4 , 3 , 2 , 1	Hypothesis	4	16 , 15 ,14 , 13
Probability	4	8 , 7 , 6 , 5	syllogism	4	20 , 19 , 18 , 17
Synthetic	4	12 ، 11 , 10 , 9	Variables Controlling	4	24 , 23 , 22 , 21

View & discuss results
Presentation & discussion of the results
The first aims: identify the level of logical inferences among students of the preparatory stage.

The answers were analyzed, and it was found that the sample mean (12,904) with a standard deviation (3,552) and the hypothetical mean (12), to find out the

significance of the difference, (One Sample T-test) was used, and it was found that the calculated T-value (5.091) is greater than the value T-table (1.96) at a level of significance (0.05) and a degree of freedom (399), which indicates that the research sample has a high degree in logical inferences, Table (4)

Table (4) T-test for the level of logical inference among school students.

Sample	mean	Std. Deviation	Hy Mean	t-Values		Level of Sig	D.F	Sig
				Calculated	Schedule			
400	12.904	3.552	12	5.091	1.96	0.05	399	Sig

This result agrees with the postulates of the theory of cognitive advancement of (Piaget) which indicates that (most of the cognitive processes represented in the ability to make logical inferences & the ability to think beyond the present appear in adolescence) (Wardsworth, 1990: 86).

This result is consistent with the study (Laibi 2011), the study (Al-Qadri, 2009), the study (Al-Fariji, 2009), which indicated that school students enjoy a high level of logical reasoning This result is attributed to the effective role of the environment represented by scientific and cognitive progress and the impact it has on the way the individual deals with the information he receives, making use of modern means of communication and exchanging experiences and information, which contributed to the development of the student's mental abilities represented by logical inferences.

The second aims: identify the logical inference skills: Arithmetic averages and deviations were calculated, and to find out the significance of the difference, (One Sample t- test) was used. Logical & Variables Controlling (low for students, Table (5)

Table (5) T-test for the difference between mean & the hypothetical mean for logical inference

Sample	inference	Mean	Std. Deviation	Hy Mean	t-Values		Level of Sig	Sig
					Calculated	Schedule		
400	Proportional	2.090	1.204	2	1.495	1.96	0.05	No Sig
	Probability	1.757	1.039		4.664-			No Sig
	Synthetic	3.328	0.884		30.040			Sig
	Hypothesis	2.388	1.135		6.846			Sig
	syllogism	1.910	0.984		1.815-			No Sig
	Variables Controlling	1.428	1.071		10.664-			No Sig

This result is consistent with the study (Laibi 2011), which indicated that the level of hypothetical inference is high among the sample members & contradicts the study (Al-Fariji 2009), which indicated that the level of skills (inference, deduction, logic of cases & proportionality) is high among the sample members.

The third aims: differences in the level of logical inference according to the gender variable (males, females) & specialization (scientific, literary).

The results showed that there are differences between means & deviations, Table (6).

Table (6) means & standard deviations according to the gender & specialization for logical inference

sample	Gender / specialization	Mean	Std. Deviation
207	Male	13.616	3.846
193	Female	12.192	3.080
226	scientific	14.288	3.522
174	literary	11.520	3.006

To verify the differences, two-way analysis of variance with interaction was used, showing that there are statistically significant differences between males and females in the logical inferences in favor of males. there are statistically significant differences between the two branches of study (scientific - literary) in logical inferences and in favor of the scientific. And there were no statistically significant differences in the interaction between gender & specialization in logical inferences. Table (7).

Table (7). two-way analysis of variance with interaction indicate differences in logical inference according to gender & specialization

Sources of variance	Sum of squares	D.F	Mean Sum of Squares	F. Values		Level of Sig	Sig
				Calculated	Schedule		
Gender	706.202	1	202.706	19.755	3.84	0.05	Sig to Male
specialization	766.598	1	766.598	74.709			Sig to scientific
Gender * specialization	2.848	1	2.848	0.278			No Sig
error	4063.378	396	10.261				
total	5035.530	399					

This result is consistent with the study (Laibi 2011), which indicated there are differences between the two genders (males - females) in logical inferences in favor of males & it contradicts the study (Al-Qadri, 2002) which indicated there are no differences between the two genders in the level of logical inferences.

Fourth aims: identify the differences in logical inferences (skills) according to gender & specialization: It was found there are differences between the means of males & females, & between the means of the scientific & literary Table (8).

Table (8) means & deviations according to gender & specialization variables for logical inferences

inference	sample	Gender / specialization	Mean	Std. Deviation	inference	sample	Gender / specialization	Mean	Std. Deviation
Proportional	207	Male	2,440	1,193	Hypothesis	207	Male	2,397	1,176
	193	Female	1,740	1,112		193	Female	2,380	1,096
	226	scientific	2,300	1,190		226	scientific	2,731	1,040
	174	literary	1,880	1,184		174	literary	2,046	1,125
Probability	207	Male	1,815	1,103	syllogism	207	Male	1,970	1,012
	193	Female	1,700	0,972		193	Female	1,851	0,955
	226	scientific	1,990	1,041		226	scientific	2,156	0,977
	174	literary	1,525	0,987		174	literary	1,665	0,931
Synthetic	207	Male	3,482	0,734	Variables Controlling	207	Male	1,511	1,160
	193	Female	3,175	0,991		193	Female	1,346	0,970
	226	scientific	3,488	0,798		226	scientific	1,6225	1,171
	174	literary	3,168	0,938		174	literary	1,235	0,924

To find out the significance of the differences) two-way analysis of variance with interaction was used for each of the logical inference skills according to gender & specialization & the results showed, Table (9).

Table (9) two-way analysis of variance with interaction indicate differences in logical inferences skills according to gender & specialization

inference	Sources of variance	Sum of squares	D.F	Mean Sum of Squares	F. Values		Level of Sig	Sig
					Calculated	Schedule		
Proportional	Gender	49,000	1	49,000	38,131	3.84	0.05	Sig to male
	specialization	17,640	1	17,640	13,727			Sig to science
	Gender * specialization	3,240	1	3,240	2,521			No Sig
	error	508,88	396	1,285				
	total	578,76	399					
Probability	Gender	1,323	1	1,323	1,289	3.84	0.05	No Sig
	specialization	21,623	1	21,623	21,068			Sig to science
	Gender * specialization	2,102	1	2,102	2,049			No Sig
	error	406,43	396	1,026				
	total	431,47	399					
ynth	Gender	9,456	1	9,456	12,830	3.84	0.05	Sig to male
	specialization	10,240	1	10,240	13,894			Sig to science

	Gender * specialization	0,723	1	0,723	0,980			No Sig
	error	291,85	396	0,737				
	total	312,26	399					
Hypothesis	Gender	3,062	1	3,062	0,026	3.84	0.05	No Sig
	specialization	46,923	1	46,923	39,738			Sig to science
	Gender * specialization	0,123	1	0,123	0,104			No Sig
	error	467,59	396	1,181				
	total	514,67	399					
syllogism	Gender	1,410	1	1,410	1,548	3.84	0.05	No Sig
	specialization	24,133	1	24,133	26,483			Sig to science
	Gender * specialization	0,473	1	0,473	0,519			No Sig
	error	360,85	396	0,911				
	total	386,86	399					
Variables Controlling	Gender	2,722	1	2,722	2,454	3.84	0.05	No Sig
	specialization	15,016	1	15,016	13,537			Sig to science
	Gender * specialization	1,103	1	1,103	0,994			No Sig
	error	439,25	396	1,109				
	total	458,09	399					

This result is consistent with the study (Al-Fariji 2009), which indicated that there are gender differences in the skill of logical measurement in favor of females & agree with it that there are no differences between the two genders in the skill of probabilistic inference and the skill of hypothetical inference, and it contradicts the same study that indicated that there are no differences between the two genders. in the skill of proportional inference. It contradicts the study (Al-Qadri, 2002), which indicated that there are no differences between the two branches (scientific - literary) in the skills of logical inferences.

The researcher believes that the existence of differences between the two types in the inference skills (proportional and synthetic) in favor of males may be due to the superiority of males over females in the abilities of logical-mathematical intelligence, and the current test has a logical inferential function.

As for the existence of differences between the two academic branches (scientific and literary) in the skills of logical inferences in favor of the scientific, this result is logical, as the nature and content of logical inference tests such as proportionality, probability, assumptions, logical measurement, and controlling variables related to the subjects of the scientific branch such as mathematics, engineering, chemistry and physics, which are Curricula of an abstract nature, through which students of the scientific branch practice thinking skills in general and logical inferences in particular.

As for the lack of interaction between gender and specialization in the skills of logical inference, this result was in agreement with the study of (Piaget, 1958), and the study of (Al-Qadri, 2002). This means that the skills of logical inferences are not affected by the interaction between gender and academic specialization, as well as the logical reasoning itself is not affected by this interaction.

Conclusions

Based on the results of the current research, the following conclusions can be reached:

1. Adolescents have the ability to solve their cognitive problems.
2. Adolescents tend to use probabilities and correlations, put forward hypotheses and try to test them when solving their problems.
3. Male students outperform female students, and students of the scientific stream over students of the literary stream in using the rules of logical reasoning.
4. The study materials and the curriculum have a positive impact on the students of the scientific branch to develop their logical inferences.
5. Males are better than females in using probabilistic abilities and establishing proportional relationships.
6. The interaction between gender and academic specialization has no effect on logical inferences.

Recommendations

1. Paying attention to teaching in order to develop logical inferences, especially proportional and probabilistic reasoning, and syllogism.
2. Encouraging students to come up with different solutions to the problems presented to them and not to be bound by traditional solutions, and to accustom them to freedom of expression of opinion.
3. Include in the curriculum activities that contribute to the development of logical reasoning skills.

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