

Research Article

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Cognitive Reasoning Skills in Preparatory Stage Students: A Study Based on Spearman's Two-Factor Theory in Iraq

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Abstract

Background/purpose. During puberty, cognitive growth extends beyond basic reasoning and testing, enabling faster, more complex thinking. Abstract reasoning—understanding concepts through logic and symbols without relying on senses—is crucial, especially in academic settings. As literature affirms its role in problem-solving and decision-making, this study aims to assess the reasoning levels of preparatory students to inform and improve educational practices.

Materials/methods. A descriptive approach was adopted to analyze this phenomenon as it appears in reality, aiming to provide a precise description of the characteristics of abstract reasoning ability. The study addressed the following key research questions: What is the level of abstract reasoning among preparatory stage students? How do gender, academic specialization, and school type influence this ability? The researcher used Mazloom's (2015) Abstract Reasoning Test, based on Spearman's (1927) theory, consisting of 61 multiple-choice items. The sample population consisted of 500 male and female preparatory students, stratified by sex and academic specialization, who were then selected through random sampling.

Results. Analysis conducted on the abstract reasoning ability tests administered to the 500 preparatory students demonstrated a statistically significant difference between their mean score (38.078) and the hypothetical mean of 30.5, yielding a t-value of 16.829, which exceeds the critical value of 1.96 at $\alpha = 0.05$ level of significance. This strongly affirms remarkable abstract reasoning ability in alignment with Spearman's (1904) perspective, arguing that such cognitive abilities facilitate streamlined problem solving, goal attainment, and overall academic functioning as heuristics propel achievement-oriented cognition.

Conclusion. The study illustrates the impact of mental maturity, teaching approaches, and family engagement on students' cognitive development within education systems firmly suggesting that policymakers should prioritize the pedagogical shift from rote memorization towards fostering advanced cognitive skill frameworks beyond mere recall to actively stimulate higherorder thinking skills as foundational principles underlying curriculum design are essential for fostering robust transformative pedagogies and strategies aimed at cultivating students' analytical, symbolic reasoning, and multifaceted problemsolving capabilities are crucial during early education stages.

1. Introduction

Many individuals struggle with difficulty reasoning and making informed decisions. This phenomenon may be temporary in some individuals, but in others, it may persist in all situations (AlAlusi & Khan, 1983, p. 221). The discovery of the underlying causal structure is considered one of the primary inductive problems faced by learners. Even though the complexity of the current situation is clear, the knowledge available about young learners is even more scarce when it comes to the acquisition of abstract representations that extend beyond their own experiences and require abstract reasoning. (Walker, 2015, p.14).

The weakness in abstract reasoning represents a core element that reflects a weakness in learning, forming concepts, problem solving, and the difficulties related to cognitive processes (Khalioi, 2018, p. 60). From Piaget point of view, a child can not logically reason before the age of eleven due to the inability to comprehend the correlations between the inputs and outputs logically in addition to the inability to provide good justifications, as in many instances, the roles of inputs and outputs are reversed (AlAlusi & Khan, 1983, p. 219).

An individual aligns in his mind a series of ideas prior to executing a job; thus, he solves the issue by planning ahead and attempts to recognize any similarities and overlaps among different objects, contrast between stimuli, and the confusion or conflict arising from multiple tasks (Lewis, 1981, p. 148).

Numerous scholars have emphasized the role of abstract reasoning in educational development; however, a gap remains in the empirical assessment of this skill among students in transitional academic phases, particularly in Iraq.

The purpose of this study is to explore the development of abstract reasoning skills among preparatory students in Iraq, grounded in Spearman's two-factor theory, and to analyze its pedagogical implications for cognitive and educational development.

This research addresses a significant gap in the literature by examining how abstract reasoning manifests in adolescents within a specific sociocultural and educational context, aiming to inform curriculum design and teaching strategies.

2. Literature Review

2.1. The Capacity for Abstract Reasoning

Abstract reasoning plays a fundamental role for learners because it reveals the common process of thinking among learners. The increase in technological and technical complexity for the modern age has further highlighted the process of abstract thinking and has made it a central topic for researchers who share the view that thinking at its core depends on the organic relationship between individuals, their environments as it is considered an important variable in the development of both verbal, nonverbal communication, methods of interaction with others and methods of selfexpression. These all require abstract reasoning to achieve Psychosocial adjustment (AlOtaibi, 2001, p. 3).

Abstract reasoning depends on a new element that differs for the initial inputs with which the abstract reasoning process starts. This happens due to an output that depends on the correlations between two things that previously did not seem to be correlated while observing the validity of logic (Khalioi, 2018, p. 60).

Sometimes it is referred to as daily reasoning, which is closer to everyday behavior that individuals conduct to solve problems in a way that aligns with their morality, purpose, and understanding of the world. According to Blooms definition of abstract reasoning; when students

employ abstract reasoning, they move closer to the highest levels of comprehension for the cognitive process (Knowledge, comprehension, application, analysis, synthesis, and evaluation) especially when the students try to arrange parts using abstract reasoning together to prove that the conclusions that they have arrived to are organized and logical (Shalabi, 2007, p. 78).

Abstract Reasoning, then, is a mode that aligns with other advanced thinking modes that any learner can not do without. It is also considered one of the fundamentals in gaining knowledge and improving logical processing which in turn help the learner reach new outputs in his cognitive activity, instead of being dominated by sensory perceptions, as well as their role in organizing prior experiences in a way that aids in confronting new problems (Inhelder & Piaget, 1958, pp. 76–79).

Furthermore, Abstract reasoning also presents a new element that differs from the starter input that initiated the process in the first place. This is done through an output that is derived from linking two things that, on the surface, appear to have no correlation whatsoever. This is done while preserving the validity of logic (Khalioi, 2018, p. 60).

According to Spearman (1927), Abstract reasoning is defined as the ability to visualize symbols, ideas, and abstract relationships, and to build logical ideas to reach conclusions and generate correlations between things (p. 18). Newton (2009) defined it as the individual's ability to understand complex concepts and comprehend new information outside their area of expertise (p. 2).

2.2. Concepts and Theoretical Background Employed in the Study

The History of Abstract Reasoning Testing stems from the research conducted by Charles Spearman in the 20th century, in which he employed a statistical technique called Factor Analysis to measure the correlation between the marks obtained by individuals on various tests. He concluded that those who do well in some Intelligence measuring tests will also do well in other tests (such as vocabulary tests, mathematics tests, or spatial ability assessments) and vice versa (Newton, 2009, p.3)

One of the features of Abstract reasoning is comprehending concepts and using them. This is the most complex and final step in the development of cognitive thinking in which ideas have adaptability, flexibility, and use concepts such as the characteristics or patterns shared among a diverse set of elements or events. Additionally, Abstract reasoning is a concept that compares in many instances practical thinking or thinking that depends on what is in front of the eyes and is present here and now, while a thinker who employs Abstract reasoning can visualize concepts that he has no prior experience with (Abu Jado, 2004, p. 77).

This study depends on the theory of the English researcher Charles Spearman who used factorial analysis to uncover intelligence, and various intellectual abilities which is why his theory was dubbed The (twofactor theory,) in light of the numerous developments that followed in the study of intelligence and mental activity, is considered the legitimate precursor to the factor analysis method (Sternberg & Grigorenko, 1995, p. 83).

Spearman's research, which he published in 1904, represents the starting point for objective research in cognitive development and psychometric measurement. Spearman views that all forms of cognitive activity have one main function or are correlated through several functions. While the elements of each cognitive form indicate that, for Spearman, cognitive activity has two main factors:

General Factor: dubbed after its initial (G), it means the ability to perform various tasks or the present ability to comprehend various cognitive or knowledge-based activities, regardless of the type of activity or its topic. Individuals use this factor in all their cognitive activities (Newton, 2009, p.4)

Special Factor: dubbed after its initial (S), it refers to the ability to perform a specific type of task, such as understanding vocabulary, mathematics, and memorization. Each of these tasks is different

and requires the use of the General Factor. Spearman also believes that the Special Factor is not related to intelligence; instead, it is the key to intelligence. It stems from individual differences in mental activities (Nofal & Abu Awad, 2010, p. 233), as illustrated in Figure 1.

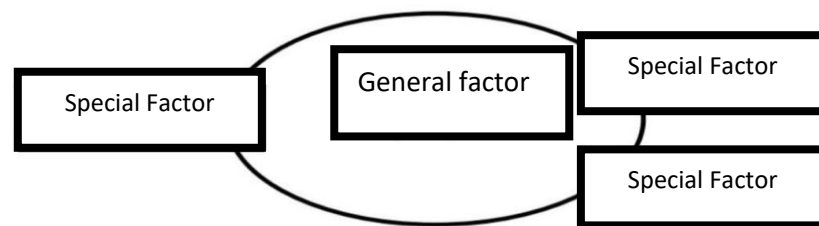


Figure 1. The Effect of the General & Special Factors (AlSheikh, 1982, p. 131)

Thus, any cognitive activity uses only one factor from the Special factors, while the General Factor is involved in all cognitive activities. Cognitive activities vary depending on whether they contain the General Factor and Special Factors. Therefore, for Spearman, the Purpose of mental measurement is to measure the general factor in individuals; the reason for this is that the general factor is Omnipresent in the mental abilities of individuals, thus it becomes the basis for predicting individuals' performance in each given situation. Additionally, measuring the special factor becomes obsolete because they are confined to one of the methods of mental performance" (Abu Hatab, 1983, p.74).

Spearman has lays out a set of rules for his theory. The innovative laws can be summarized as follows:

1. Descriptive or Qualitative Laws:

a. The Law of Perceiving Correlations, which can be identified as the connections that can be perceived between things. In other words, if the mind is faced with two things or more, it tends to perceive correlation/s that are apparent between said things. The idea that links these things is then called a correlation.

b. The Law of Perceiving Associations: It refers to things that have a correlation. If the brain is faced with one thing and a correlation, it tends to perceive the other thing that is correlated with the first (ElSayed, 1976: p. 294).

c. The Law of Experience Perception: This refers to the idea that every experience that is practiced tends to elicit direct knowledge of its characteristics and of the individual associated with it" (Newten, 2009, p. 5).

Spearman emphasizes the significance of correlations and associations in cognitive processes. In other words. If the brain is presented with two or more things, it tends to perceive the correlation between them. For example, the relationship between night and day is similar to when an individual is faced with something that has a correlation with something else; the individual tends to perceive the correlation that connects these two things. For example, the correlation between hearing and the ear, the correlation between sight and hearing. Furthermore, Spearman has adopted this type of visualization for the General factor, describing it as a comprehension of the correlations and associations in the development of a set of nonverbal items that became known by his name (Mahmoud, 1985, p. 92).

2. Quantitative Laws:

a. Range Rule: It can be defined as the emphasis that the brain tends to retain a certain amount of mental energy at any given moment, despite the quantitative fluctuations.

b. Law of Memory Retention: it states that memory and Retrieval refer to the process emphasizing that any cognitive mental event occurring in a person generates a tendency for it to recur (Abu Hatab, 1983, p.75).

c. Law of Volitional Control: This law posits that volitional (intentional) impulses can significantly influence cognitive mental activity.

d. The Law of Fatigue: It is described as any mental function that is formed because of its tendency to recur.

e. Law of Primary Readiness (or Law of Initial Preparations): which dictates that all previous laws, some of these laws, or one law must be achieved. The degree to which this is accomplished depends on certain fundamentals that control the upper limit, which are referred to as the laws of Primary readiness, primarily relying on pure physiological effects (Mahmoud, 1985, p. 93).

Lastly, Spearman proves that the General factor exists based on Quadratic Differences Equation of the Correlation Matrix, which illustrates that the quadratic difference is zero or close to zero. This is evidence of the existence of the General factor. If it is indicated otherwise, then, in Spearman's opinion, that indicates a miscalculation (Abu Hatab, 1983, p. 76).

The Main Characteristics of This Matrix Can Be Summarized as Follows:

1. All the elements of correlation are positive, which means that all mental tests intertwine in one field or in one direction.
2. The ratio existing between every two adjacent columns is constant; that is, the ratio of the cells of column (A) to the cells of column (B) to the cells of column (C) is a fixed ratio.
3. The sum of the correlation coefficients of each column in the correlation matrix decreases as we move toward its leftmost side.
4. The quadratic differences equation converges to zero. (Mahmoud, 1985, p.94).

3. Methodology

3.1. Research Design

From observing the problem of the current research, which is the ability of abstract reasoning in preparatory stage students, and after reviewing previously conducted research. This study employed a descriptive crosssectional survey design, which is appropriate for examining cognitive abilities as they naturally occur in a large population without manipulating variables (Arnout et al., 2020, p. 26) The design enables the researcher to quantitatively describe the characteristics of abstract reasoning ability among students and to investigate group differences based on gender and academic specialization. It describes the phenomenon precisely and clarifies its characteristics, while the quantitative expression provides a numerical description that indicates the extent and magnitude of the measured attribute (Jassim et al., 2024, p. 113).

Thus, the current research has adopted a descriptive approach, which is suitable for analyzing the phenomenon at hand as it appears in the real world, without interference from affecting factors, to provide a clear description of abstract reasoning for the selected sample.

3.2. Population and Sample

The current research population is comprised of preparatory stage students for the year 2023/2024 in the governorate of Diyala, which numbers 6868 male and female students. They are

distributed according to the variable of gender into 3969 male students, who comprise 59% of the sample, and 2899 female students, who comprise 41%.

The Sample of the research refers to the part of a society to which the current study is aimed. The researcher resorts to selecting the sample according to sound scientific principles to accurately represent the population (Virkson, 2017, p. 67).

A stratified random sampling technique was employed to ensure representation of both genders and specialization in the sample selection. A total of 500 random students from the research population were selected, comprising 294 males, which form 59%, and 206 females, forming the remaining 41%. The academic achievement, according to specialization, is distributed as follows: scientific specialization (349), representing 70%, and literary specialization (151), representing 30%.

3.3. The Model

After reviewing the literature addressing abstract reasoning ability, the researcher adopted Mazloom's (2015) Abstract Reasoning Test, which is grounded in Spearman's (1927) two-factor theory. Spearman defined abstract reasoning as "the ability to conceptualize abstract symbols, ideas, and relationships; to construct logical thoughts; to reach conclusions; and to generate connections among various elements." The test is designed to assess higher-order reasoning through nonverbal and symbolic stimuli, making it suitable for adolescent learners.

The test consists of 61 multiple-choice items, divided into two parts:

- Items 1 to 35: Four answer choices (A, B, C, D).
- Items 36 to 61: Five answer choices (A, B, C, D, E).

Scoring is dichotomous: 1 point for a correct answer and 0 points for an incorrect one. Therefore, the maximum score obtainable is 61, and the minimum is 0. The assumed (hypothetical) mean is 30.5.

To guide students, the test includes instructions emphasizing clarity and honesty. Students are informed that:

- They are not required to provide their names.
- Their responses are used solely for scientific research,
- Only the principal researcher will have access to their results.

A pilot application was conducted on a sample of 60 male and female students. Feedback confirmed that the items and instructions were comprehensible, and the average completion time was 39 minutes, ranging from 30 to 45 minutes.

To offer transparency without compromising test integrity, the following two illustrative items are adapted from the test structure. These do not replicate actual test items but reflect the cognitive domains assessed:

Sample Item (Pattern Completion):

Which figure completes the following sequence?

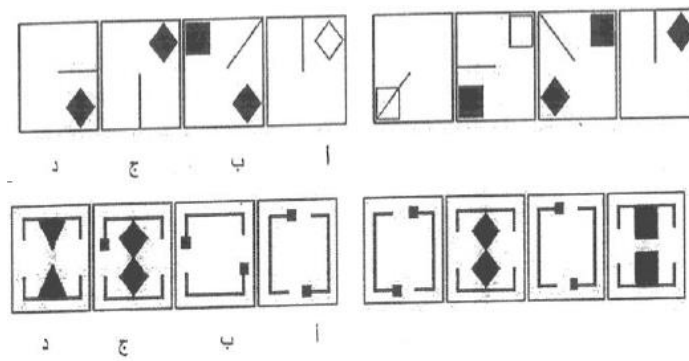


Figure 2. Pattern Completion

These examples are designed to demonstrate the abstract reasoning demands placed on test takers, particularly in terms of visual recognition, analogical mapping, and deductive logic. (*Adapted from Mazloom, 2015*)

3.4. Validity and Factorial Structure

For Ebel, the best way to validate the test scale items is to submit them for review by psychological assessment experts to solidify the validity of measuring the characteristic or attribute for which they were designed (Ebel, 1972, p. 555). That is why the items of the ability of abstract reasoning were laid out in an initial format that includes 61 items and put up for review by specialists in psychological sciences. The number of specialists is (13) who are asked to judge the validity of the items. The items and their representation in measuring what they were intended to assess. After retrieving the questionnaire, it is made clear that the specialists all agreed to the validity of all the items in question, with a 100% validation percentage.

3.5. Data Analysis

Data were analyzed using SPSS. The following statistical techniques were applied:

a. The Difficulty Level of the Items

The following steps are used to account for the difficulty of the items in the test:

1. The marks obtained by the male and female students were arranged from highest to lowest.
2. 27% was picked as the highest and lowest percentiles to represent the extremes of the two groups. It included 270 male and female students, with each gender occupying 130.
3. The number of students who committed an error was calculated for each item in the test from the two groups (the highest and lowest percentiles).
4. The difficulty formula was applied, and the values ranged between 0.337 and 0.652, as test items are considered acceptable if their difficulty index falls between 0.20 and 0.80. This means that all test items are deemed acceptable and valid for implementation.

b. The Discriminative Power of the Items

The Discriminative power is accounted for by correcting the questionnaires from the participants and then organizing the marks from highest to lowest in totality. Then, the two extreme groups were identified (Abduwauid et al., 2022, p. 372).

Ebel's standard is used to identify the Discrimination Index. The items that have a (0.30) discrimination strength were picked. After calculating the discrimination power for each item in the Abstract Reasoning Ability test, it was found that the values ranged from 0.333 to 0.741, indicating that the test items are effective and their discrimination indices are acceptable.

c. Effectiveness of the Distractors

The statistical analysis for the data comprising 500 male and female students was conducted to evaluate the effectiveness of the incorrect alternatives. The distractor effectiveness equation was used, and it was found that all the alternatives are effective.

d. Relationship Between the Item Score and the Total Score

(Point Biserial Correlation Coefficient) The genuine bivariate correlation is utilized to account for the correlation between the total score and the item score for the 500 male and female students. All items showed statistically significant correlations with the total score. (Point Biserial Correlation Coefficient) The genuine bivariate correlation is also utilized for the binary (discrete) score for each item (question). It was concluded that all Correlation coefficients indicate that all of them are statistically significant when compared with the critical value of 0.088 at a significance level of 0.05 and degrees of freedom (498). Table 1 illustrates this:

Table 1. (Point Biserial Correlation Coefficient) The Correlation Between the Item Score and the Total Score of the Abstract Reasoning Test

No.	Correlation Coefficient	No.	Correlation Coefficient	No.	Correlation Coefficient
1	0,564	22	0,334	43	0,601
2	0,479	23	0,510	44	0,666
3	0,632	24	0,523	45	0,627
4	0,569	25	0,454	46	0,554
5	0,554	26	0,436	47	0,524
6	0,668	27	0,407	48	0,431
7	0,637	28	0,449	49	0,555
8	0,554	29	0,344	50	0,416
9	0,545	30	0,323	51	0,456
10	0,635	31	0,493	52	0,449
11	0,594	32	0,452	53	0,505
12	0,579	33	0,452	54	0,508
13	0,347	34	0,500	55	0,377
14	0,346	35	0,634	56	0,394
15	0,462	36	0,568	57	0,355
16	0,498	37	0,334	58	0,425
17	0,575	38	0,394	59	0,257
18	0,681	39	0,489	60	0,631
19	0,578	40	0,508	61	0,598
20	0,548	41	0,548		
21	0,321	42	0,557		

e. Descriptive Statistical Indicators

After applying the scale to 500 male and female students for the current research group, the scores for each individual in the sample, as well as for each item on the scale, were accounted for. The scores were calculated to represent the raw score of the target sample for the Emotional Awareness Scale. Thus, based on the fact that the psychological concepts are distributed normally, the statistical indicators were calculated using measures of central tendency (arithmetic mean, median, mode), along with skewness coefficient and kurtosis coefficient, as these are among the characteristics of the normal distribution curve (Udayah, 2005, p.226). This was done in order to determine the degree to which the discrimination sample **scores** approximate or deviate from a normal distribution. Table 2 illustrates this:

Table 2. The Values of the Descriptive Statistical Indicators for the Abstract Reasoning Test

Statistical Correlation	Abstract Reasoning Test
Mean	38.08
Median	39
Mode	40
Std. Deviation	10.06
Variance	101.37
Sleekness	0,375
Kurtosis	0,449
Minimum	11
Maximum	59
Range	48

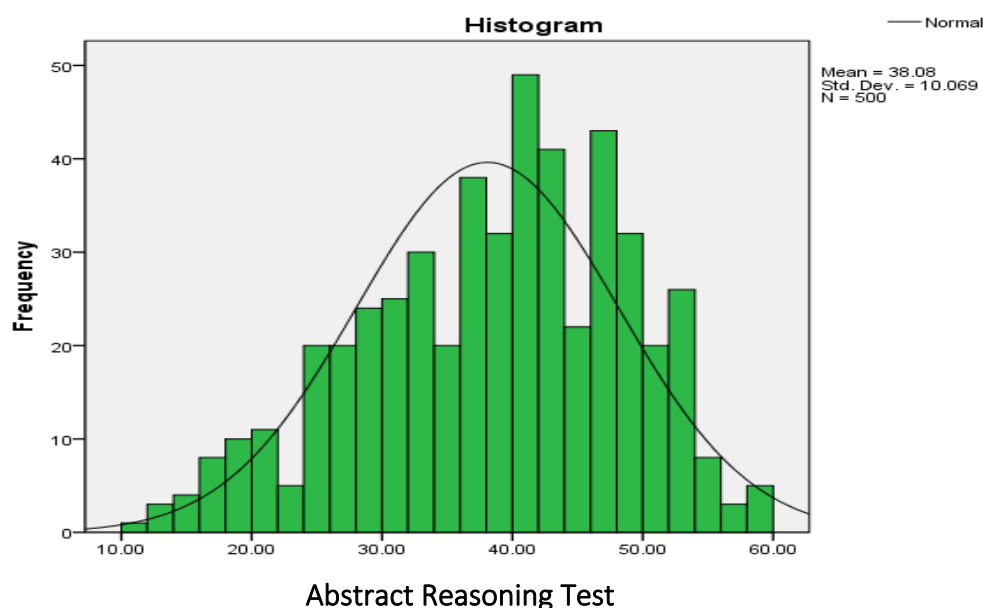


Figure 3. The figure of the Final Sample (N = 500) for the Abstract Reasoning Test

From Figure 3, it is deduced that the data for the current research paper sample is close to a normal distribution, characterized by skewness and kurtosis coefficients close to zero, along with the mean, median, and mode being approximately equal.

f. Steadiness

Steadiness is counted using the (Kuder-Richardson 20) test on a sample of 500 male and female students. The calculated value of Cronbach's alpha coefficient reached 0.88.

3.6. Ethical Considerations

Students participated voluntarily with informed consent. Anonymity and confidentiality were strictly observed, and data were used solely for scientific purposes.

4. Results

To validate the results, the researcher applied the test to the current research sample of 500 male and female students, and then used a second test for a one-sample analysis, as shown in Table 3 and Figure 4.

A one-sample t-test was conducted to determine whether the students' average abstract reasoning score significantly differs from the hypothetical mean of 30.5.

Table 3. The Arithmetic Mean, Standard Deviation, and T-value for the Abstract Reasoning Ability Test.

Variable	Sample Size	Arithmetic Mean	Standard Deviation	Hypothetical Mean	Calculated t-value		alpha level (0.05)
					counted	tabulated	
Ability of Abstract Reasoning	500	38.078	10.069	30.5	16.829	1.96	significant

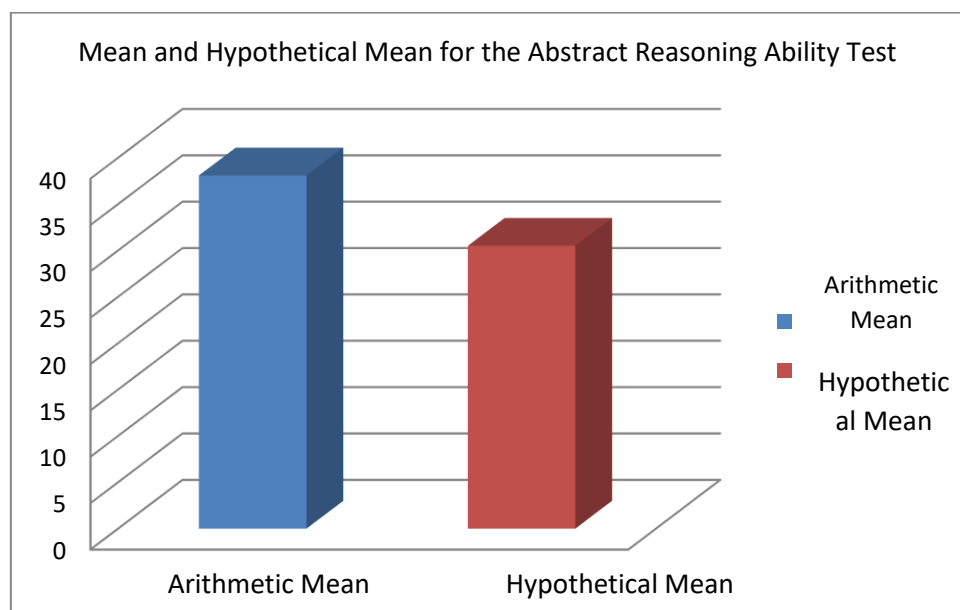


Figure 4. Arithmetic and Hypothetical Mean for the Abstract Reasoning Test

The figure illustrates that the calculated t-value is higher than the tabulated value by 0,05, and the degree of freedom (499), which indicates that the sample possesses the ability for abstract reasoning. Additionally, these results confirm that the students in this age group demonstrate the ability to process symbolic logic, make complex inferences, and approach abstract tasks with cognitive flexibility.

Additionally, the results also show that students in the preparatory stage have the ability for Abstract reasoning. This result is considered logical and factual because it aligns with Spearman's (1904) theory, in which Spearman emphasizes that the ability for abstract reasoning is a general ability that affects all manner of processes and activities related to knowledge. This effect differs based on the type of activity. Furthermore, this ability indicates that students are able to solve complex issues/ problems in a logical and reasonable manner. Thus, The researcher views these results as factual and logical because the preparatory stage students have the ability to set their goals and achieve their futuristic desires that hey have in their learning years and also in their practical years As well as measuring their mental abilities and identifying individual differences among students, it also clarifies which students are suitable for work and which are not.

5. Discussion

The results illustrate that abstract thinking in preparatory stage students has reached an advanced level; this reflects the evolution in cognitive structure during this developmental stage. The students' ability to process symbolic ideas, generate hypotheses, and analyze input suggests they have moved past the stage of "concrete thinking" and entered into what Piaget (1972) referred to as "formal operations." This aligns with Vygotsky's (1978) theory that advanced mental processes, including reasoning, emerge within the framework of social and cultural interactions. Moreover, the characteristics of contemporary curricula, especially in mathematics and the hard sciences, seem to foster this variety of reasoning when taught through inquisitive and critical engagement rather than rote repetition.

Students generating hypothetical situations devoid of direct real-world analogs and then proceeding to logically analyze them indicate a measurable level of sophistication with abstract thinking. This points towards reasoning that goes beyond sensory input, an essential quality of abstraction. Moreover, the heightened performance observed in tasks that require comparison, categorization, and correlation suggests the existence of a cognitive architecture that facilitates analysis and synthesis. This hypothesis, proposed by Case (1992), is compelling when one considers that robust abstract reasoning relies on the strong integration of one's working memory and executive function—a capacity that tends to strengthen in mid-to-late adolescence.

The results highlight the need to create a classroom atmosphere that fosters reflective thinking through the use of dialogue, open-ended questions, and discussions of social or moral dilemmas. This is supported by Adey and Shayer (1994), who emphasize the importance of combining scientific inquiry with a student's cognitive framework to enhance a learner's ability to reason abstractly. Lipman (1991) also emphasized the importance of a child's imagination and the ability to pose questions through his child-centric philosophy.

These explanations are further validated by the Wechsler Intelligence Scale for Children (WISC) with its inclusion of "Similarity" and "Matrix Reasoning" as measures of abstract thinking. Sattler (2001) points out that completing such tasks requires critical thinking skills and is directly linked to higher academic performance, as well as a versatile approach to solving problems.

Psychometrically, this research is validated by consistency with prior studies conducted on the same age group and cognitive domain, suggesting high structural credibility for the abstract reasoning construct examined.

The social dimension of abstract reasoning is also significant. The capability to critique societal standards and interpret multiple viewpoints goes hand in hand with abstract thought. Selman (1980) posits that development in this area enhances an individual's ability to navigate intricate social environments, and this change is observable in students' actions during and beyond the lessons.

This aligns with more recent Arabic research, such as Abdul Hadi (2020), who reported that the level of abstract thinking among intermediate students is linked to teachers' moderation of classroom dialogues, their engagement with student questions, and the depth of instructional activities. That study highlighted the fundamental issue of assessing students with tests that directly measure abstract reasoning, as opposed to tests grounded in memorization.

In consideration of these findings, it is apparent that there is too great a focus on traditional rote instructional teaching, highlighting the need to develop a more cognition-centered paradigm. This model enables learners to explore concepts, evaluate possibilities, and express their thoughts freely, thereby fostering deeper intellectual engagement.

Curriculum design, especially in science and mathematics, remains important as these disciplines help nurture abstract reasoning through symbol manipulation, inference, and analytical reasoning (Moshman, 2011). Moreover, a classroom atmosphere that encourages participation fosters mental engagement and strengthens students' capacity to think abstractly (Vygotsky, 1978).

Considering these insights, students should be encouraged towards abstract reasoning as a form of mental faculty that can improve education at the secondary level or assist in crafting better evaluation mechanisms for tertiary skills. Implementing effective evaluation tools triggers the need to strengthen curriculum frameworks built on reasoning-oriented exercises, particularly in fields that depend on indirect concept models for reasoning.

6. Limitations of the Study

Regardless of its benefits, this study is limited by several limitations that should be addressed. To begin with, the exploration utilized a cross-sectional design, focusing on abstract reasoning ability as if it were static. This approach severely limits our understanding of how such cognitive skills evolve over time across various educational levels. Additionally, although the Abstract Reasoning Ability Test used in this study had undergone some form of psychometric validation and organization, the ultimate data was dependent on students' performances during the test. Anxiety, the testing environment, or other uncontrollable factors during the test administration could impact their performance. Moreover, understanding that the sample region only covers Diyala Governorate poses critical concerns about whether the findings can be applied to other regions in Iraq, let alone on an international scale. The sociocultural and educational disparities between the governorates might shape the development of students' reasoning skills and their cognitive maturation differently.

Lastly, the lack of exploration and inclusion of variables such as psychological, motivational, parental involvement, or even socioeconomic standing, which could influence the development of abstract reasoning skills, highlighted another gap. Studies still need to be conducted while addressing these gaps by incorporating longitudinal frameworks, broadening the geographical scope of the sample population, and embedding qualitative analyses.

7. Conclusion

The quantitative analysis results show that a high percentage of preparatory stage students can perform tasks that require a high level of abstract thinking, indicating a shift from concrete, tangible thinking to a higher mode of thought characterized by mental flexibility and the ability to process symbolism.

This shift in knowledge does not occur overnight. However, rather it is the result of several factors, among which are the level of mental maturity, the type of pedagogical stimuli presented to students, and the level of support from the familial environment. These factors align with the insights provided by Piaget and Vygotsky's theories regarding cognitive development in adolescents.

The data reveal a noticeable discrepancy in students' performance when applying abstract reasoning in various situations. Their performance varied according to variables such as sex, academic achievement, and mode of study (private/public). All this indicates that abstract reasoning is connected to environmental and experience-based factors.

Additionally, some students encounter situations that require them to use abstract reasoning, describing such situations as exciting mental challenges. At the same time, other students could not pass the fundamental steps, which reflect core differences in modes of thinking and indicate that there are more precise modes of reasoning between learners.

The results also indicate that the most common form of abstract reasoning in students is exemplified by the ability to make logical comparisons and extract indirect causal relationships, as well as the ability to deal with abstract symbols and form complex conceptual structures.

Furthermore, the results indicate that the outputs of conventional pedagogical education depend on the memorization and retrieval of memorized information, which does not assist in reinforcing abstract thinking skills; rather, it may cause regression in students' thinking flexibility, which brings the current pedagogical teaching methods into question.

In addition, the study illustrates that abstract reasoning is connected to critical thinking skills, and the ability to make analyses and draw conclusions, which in turn reinforce the hypothesis that developing higher thinking skills requires a development that involves scientific and philosophical thinking.

Based on the analysis of the answers submitted by the students, it is clear that some of them possess the ability to comprehend implicit assumptions, forming indirect conclusions based on incomplete or symbolic evidence, which further indicates the development of logical visual thinking, higher than expected for this age group.

The results indicate that a classroom environment based on free interaction, encouraging free expression, and promoting freedom of speech strengthens abstract reasoning ability, while the opposite occurs when these factors are not present.

The study affirms that the ability for abstract reasoning is a learnable and developable skill, and is not limited to innate abilities. Some simple interactive experimental activities can improve students' performance in reasoning-based tasks.

This study offers a deeper understanding of the nature of abstract thinking among an important age group in the education system, thereby informing the development of educational policies that foster an environment conducive to the growth of higher-order reasoning skills.

8. Recommendations Section

Based on the above, the study proposes the following recommendations:

First, enrich the preparatory stage curricula with activities and strategies that encourage abstract reasoning, such as open-ended questions, deduction-based thinking, and symbolic mental models. Second, train teachers to use teaching methods that reinforce abstract thinking, especially in science and mathematics, as these two fields are considered ideal for developing this ability.

Third, rethink the traditional evaluation methods and develop new evaluation tools that are able to measure abstract abilities for students, not just memorization and retrieval. Fourth, conducting

comparative studies between the different learning stages (elementary, secondary, preparatory) to observe the evolution of abstract reasoning throughout Age and educational development.

Fifth, Encourage Qualitative research that explores how this type of thinking develops in a specific cultural and educational context, relying on observation techniques or in-depth interviews. Sixth, highlight the necessity to adopt an educational curriculum that is based on developing thinking in a way that it fuses upper mental skills, among which is abstract reasoning, into the pedagogical education plans for secondary and preparatory stages, and not for later stages. Seventh, designing pedagogical units specially catered to teaching abstract reasoning ability and Logical reasoning within multiple subjects, including applied activities based on problem-solving, cognitive comparisons, and abstract symbolic representations.

Eighth, retrain the teachers in the field of abstract thinking through thought-holding workshops focused on Discovery learning strategies, problem-based learning, and constructive logical debates. Additionally, the teachers should be provided with assessment tools to assess the level of development in students. Ninth, build a robust set of tools for measuring abstract thinking ability based on psychometric parameters and characteristics like Validity, reliability, discrimination, and correlation with achievement, and apply them periodically to monitor changes and developments in students' abilities across the academic years.

Tenth, incorporate extracurricular educational activities (such as scientific debates, competitions to analyze complex issues, intellectual plays, virtual scientific experiments) into the school environment, with the aim of providing a vital and flexible field for applying abstract thinking without the pressure of traditional academic performance. Eleventh, encourage cooperation between school and family to build an environment that fosters abstract reasoning by providing parents with consultation on the importance of engaging in logical discussions with their children, encouraging them to analyze rather than provide ready-made answers.

Twelfth, Direct the pedagogical policies towards refreshing the curriculums based on the requirements of the 21st century. It needs to focus on analytical thinking, deep understanding, and forming independent opinions, rather than relying on rote learning and repetition. Thirteenth, highlight the necessity of providing a safe classroom environment that encourages asking questions, experimentation, making mistakes, meditation, and less fear of failure. This atmosphere is the perfect environment for developing Reasoning abilities. Fourteenth, Linking the material to complex real-life scenarios, which forces the students to rearrange their thought process and employ their reasoning abilities in analyzing and making logical decisions.

Fifteenth, based on the current study, it is suggested that a comparative study be conducted between different pedagogical environments (e.g., government, private, model schools) to assess the impact of various contexts on the development of abstract reasoning skills, which will contribute to informing educational policies based on realistic results. Sixteenth, encourage researchers in the field of Educational Psychology to conduct long-term studies to observe the development in abstract reasoning ability in elementary and secondary stage students and analyze the impact of psychological variables (such as motivation, anxiety, and achievement) on the development of this skill. The seventeenth and final recommendation is to invite specialized pedagogical journals to highlight abstract reasoning research papers and open the door for publishing studies that address successful field experiences in teaching complex thinking skills, thereby exchanging experiences and expanding the practical impact of this research.

Declarations

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