

# The Impact of Logical Mathematical Intelligence on the Academic Achievement for Pre-Service Math Teachers

*This study discussed the level of logical mathematical intelligence of pre-service female mathematics teachers. The problem arises in adopting traditional curricula for teaching mathematics, which leads to low student achievement. The study objectives to measure the students' level of logical mathematical intelligence, and find out the level of students' achievement, and measuring the level of intelligence impact on the academic achievement. The study adopted the descriptive-analytical approach. The study population consisted of (45) pre-service female math teachers. A comprehensive sample was chosen. A questionnaire was used according to the (Likert) five-point scale, taking advantage of the MIDAS scale of multiple intelligences, which consisted of (17) statements, then the researchers developed the questionnaire up to (25) statements. The validity and reliability of the questionnaire were confirmed. The findings revealed that: The general average of the logical-mathematical intelligence level for the fourth-year students was in a high degree, when the arithmetic mean of the whole questionnaire was (3.71), standard deviation was (0.74). The marks of students' semester average were: Agree with a rate of 36.4%, strongly agree with a rate of 29.5%. The cumulative average was; 72.7% for a good level, and 25% for a very good level. Finally, there is a significant effect between the logical-mathematical intelligence of the female students, and the overall academic achievement in mathematics.*

**Keywords:** Logical intelligence, mathematics, Academic Achievement, pre-service female mathematics teachers.

## Introduction

Logical-mathematical intelligence is one of the eight types of intelligences cited in Gardner's Theory of Multiple Intelligences. The logical-mathematical learning style refers to the student's ability to think to solve problems, learn using numbers, abstract visual information, and analyze the relationship between cause and effect. Multiple intelligences are defined as: a cognitive design that seeks to explain how students use their intelligence to solve problems and form outcomes (Jaber, 2003). Gardner's theory developed to explain the difference between students in terms of intelligence type, nature and usage patterns of intelligence. The focus of the theory is on the educational process and the learners, when they think, produces and interacts to assist themselves, their inclinations and desires. The theory asserts that every individual in this life has multiple intelligences, which vary with one another, so that they are able to learn in various areas of life.

Students who learned the logical-mathematical intelligence method; They are often methodical and think logically. They are skilled at mental math problems, enjoy logic games and puzzles, and score excellent on IQ tests.

Students with logical-mathematical learning styles; They enjoy school activities, such as: mathematics, computer science, technology issues, using drafts, chemistry and any other sciences that require intelligence and determination. Math learners prefer to arrange things logically, and they often do well in regular, orderly environments. They have a strong memory, a high ability to analyze and problem-solving skill. They enjoy mathematical ideas and their applications in computer-aided design, and the use of computer applications and programming.

Students who excel in mathematics, learn best when they use computers, statistical and analytical software, and actually work on projects. They prefer goal-oriented activities that are based on the logic of mathematics over non-meaningful or imprecise educational activities. They undoubtedly find the study of statistics more attractive than the study of literary subjects.

Science teaching in general has focused on integrating thinking processes in learning the basics of mathematics, which facilitate learning scientific topics, and enhance students' ability to solve problems in life. Therefore, interest in logical-mathematical intelligence and students who think by reasoning, love to experiment, ask questions, reach logical and arithmetic solutions, and their need to discover things, to develop their skills in deduction and classification, and enhance their ability to deal with numbers.

### **Problem Statement**

Mathematics is a purely scientific subject, which includes static and boring topics, rich in numbers and symbols, and its study requires high scientific and logical thinking. Thus, its diverse subjects need diverse and appropriate teaching strategies, and a teacher who is characterized by efficiency and tact that enables the delivery of information, and interacts with the data of the subject in a manner that motivates students and attracts them to enjoy studying the subject of numbers. Which therefore affected the achievement level of the pre-service female math teachers (Wardat et al., 2023).

It is noted that the teaching strategies currently used with students in teaching scientific subjects such as mathematics, are no more than general strategies prepared in advance to suit all students, and most of them rely on direct indoctrination, and they are not effective in achieving the goals of mathematics, and boring methods are taken without taking into account the students' tendencies, abilities and desires. These strategies made a group of students get low scores in achievement tests, accompanied by alienation, boredom, and negative attitudes towards the study materials, the teachers themselves, or the school in general (Tashtoush et al., 2023 c; Al-Masarwa, 2015). The problem of low academic achievement in mathematics is classified as one of the intractable problems that are still present in the educational field, in addition to the lack of students' motivation towards it.

Through the researchers's experience and her work in teaching mathematics, she noticed shortcomings in the students' abilities to complete solving equations correctly, and weaknesses in the related calculations. Some

female students suffer from low academic achievement and reluctant to study mathematics, as a result of their low motivation. Therefore, several studies were recommended, including: Al-Rashidi (2011); Hussein (2015); The necessity of paying attention to the logical-mathematical intelligence strategy, because of its impact on raising students' achievement (Rasheed & Tashtoush, 2023).

Perhaps one of the reasons for the low achievement of students in mathematics; The returns to the drawback of traditional curricula in mathematics education, which lead to the low achievement of students in mathematics, foremost of which is the focus on typical training and memorization, as the goal of the traditional curriculum was; Teaching arithmetic skills, and memorizing rules and theories, through training and repetition without focusing on understanding and application (Tashtoush et al., 2023 a; Fannakhosrow et al., 2022; Al-Yasiri, 2010). A number of factors influence this, including: the lack of development and modernity in the curricula, their inclusion of old topics that have lost their value, their lack of an element of suspense, and the presentation of concepts to students separate from each other. In addition to the poor preparation of mathematics teachers, and the use of traditional methods of teaching (Tashtoush et al., 2023 b; Yamin, 2013).

In light of the foregoing; This study comes to determine the impact of logical-mathematical intelligence on the academic achievement of mathematics for the fourth-year female students majoring in mathematics at Sohar University.

### **Objective of the Study**

This study objectives to: Measuring the level of logical-mathematical intelligence for pre-service female mathematics teachers in mathematics at Sohar University in the Sultanate of Oman. Measuring the level of educational attainment of pre-service female mathematics teachers. Determine the impact level of logical-mathematical intelligence of pre-service female mathematics teachers on the academic achievement of mathematics.

### **Importance of the Study**

The theoretical importance lies in discussing logical-mathematical intelligence as an important modern topic related to student intelligence, through which it is possible to explain individual differences between students, and raise the level of their educational attainment. Mathematics was known to be one of the difficult subjects for a large percentage of students. As well as this study can form an academic point of view; To be a reference for researchers to benefit from for future studies, by looking at the theoretical aspects, the method of addressing the subject, the study procedures, and the tool used in it.

As for the practical (applied) importance, it provides a practical opportunity for mathematics teachers, to better understand the role of logical-mathematical intelligence, in its various aspects and methods of application, in order to employ this aspect in the classroom. In addition, it opens the way for the application of modern strategies in the field of mathematics teaching, and the construction of modern teaching and learning strategies by specialists in preparing curricula. It also develops the ability to provide strategies, tools and experiences that can be used in the educational field to increase the outcome on teaching and learning. The logical-mathematical intelligence is distinguished from the rest of the other intelligences; In that it is concerned with the efficient use of numbers, and the ability to think logically. It is evident from this; Students who have this kind of intelligence are usually systematic students and think in a logical and systematic order, and they have the skill of solving mathematical problems.

### Study Terminology

**Multiple Intelligences:** Gardner defined them (Gardner, 1983) as the ability to solve problems encountered by the individual, or the ability to produce culturally valuable work for the life that a person lives. He believes that the concept of intelligence should be expanded to include various abilities that reveal the potentials of creativity in individuals, thus including the following types of intelligences, as stated in his theory: music, social, physical, spatial, mathematical logic, subjectivity, linguistic, natural.

**Logical-Mathematical Intelligence:** It is one of the types of multiple intelligences of Gardner, defined as the ability to use numbers efficiently in understanding general principles, reasoning, and logically solving problems and problems (Tashtoush et al., 2023 d; Al-Miraj, 2013). The researchers define it procedurally: it is a set of teaching and learning steps and procedures carried out by the teacher. And students, sequentially, when teaching and solving problems in order to achieve desirable learning outcomes.

**Thinking Patterns:** They are a series of mental activities that the brain performs when discussing a topic, judging something, or solving a specific problem in math (Najm, 2007).

**Educational Achievement:** It is reaching a certain level of information gathering and carrying out the required skills, and this is measured by standardized tests or teachers' reports (Ahmed, 2010). The researchers define it procedurally as the total score that the students will obtain in the achievement test, which was prepared by the researchers according to Bloom's cognitive levels, these are: (memory, understanding, application, higher levels).

**Theoretical Framework:** The researchers discusses in the following paragraphs; The variables of the study, it works to provide information and details from the literature related to the variables of the study; In order to expand the perceptions of the researchers as well as the readers, and discuss the relationships between those variables.

**Multiple intelligences theory:** Gardner (1983) argues that traditional theories of intelligence do not adequately estimate human intelligence through traditional intelligence tests; Because it depends on a small rate of mental abilities. In addition, it is not fair, when you ask people to solve problems linguistic or verbally only. We find that tests that measure spatial ability; They do not allow young children to manually manipulate objects or build three dimensional structures. Moreover, traditional intelligence tests can measure school performance, but they are tools through which professional performance cannot be known. Which means that there is a gap between the measured ability of the student on the one hand, and his actual performance on the other hand (Fannakhosrow et al., 2022; Sayed, 2001).

In contrast to this limited view of intelligence "in its traditional sense" which focuses on linguistic ability and logical mathematical ability; Gardner found scientific evidence that people have multiple intelligences, but to varying degrees. Therefore, he prepared a theory called the theory of multiple intelligences, when he explained it; The abilities possessed by people fall into eight intelligences, covering a wide range of human activity in different age groups. He also sees that any individual possesses eight intelligences, which are (Gardner, 1983): Linguistic intelligence: the individual's ability to use and construct language according to its meanings in a variety of tasks. Logical-Mathematical Intelligence: It refers to the ability to think logically, solve problems, infer and draw conclusions, distinguish between models and understand relationships. Visual-spatial intelligence: It is the ability to employ and perceive the place accurately through the skills of visual discrimination and spatial inference. Physical-kinesthetic intelligence: which expresses the ability to relate the body's organs to the mind, when performing some tasks, such as: sports, or the surgeon's use of the hands during work, the sculptor and the mechanic. Musical intelligence: the ability to produce music and rhythm. Social intelligence: the ability to positively interact socially with others. Personal intelligence: It means the ability to realize his feelings and motives, plan his life successfully, and make the right decisions. Natural intelligence: It means the ability to discover and classify things in nature such as plants, animals, and rocks

In addition to the above multiple intelligences, Gardner (1997) pointed out that there are two other types of intelligence: spiritual intelligence and existential intelligence. Spiritual intelligence includes interest in issues of the universe and metaphysical or extrasensory sciences. Existential intelligence is concerned with issues of human existence such as life and death.

### **Concepts of Logical Mathematical Intelligence**

Multiple intelligences are considered one of the high-end activities of the human mind, and these intelligences are classified as problems that are the product of creative minds. Intelligence and experimentation are an essential element in education, to develop students' abilities in the aspect of

mathematical logic, which is described as the intelligence of numbers, and to interact with them with skill and high efficiency. Al-Hayhi (2018) indicates that students who possess this talent that God Almighty bestows on human beings; It means having the ability to think logically and abstractly scientific, and possessing the skill of critical thinking, deduction, elicit, and creativity in organizing and presenting ideas.

Ali (2003) indicates; To the ability of students with multiple intelligences to solve problems, learn with numbers, circulate abstract information, and analyze relationships. It is therefore the brilliance of numbers that emerge through dealing with arithmetic operations (Ibrahim, 2011). It expresses the ability of these students to solve problems according to logic, scientific thinking and deal with numbers with high skill (Khawaldeh, 2004).

According to Gardner's theory, logical-mathematical intelligence means inference, calculations and patterns, and is used in schools by working through numbers, analyzing information and situations, solving problems, and how to make things (Hussain, 2008 a).

This intelligence includes logical models and relationships, in solution, interpretation, and abstract thinking such as (since - then, cause and effect), and arithmetic operations in logical-mathematical intelligence include classification, tabulation, inference, generalization, deduction and conclusion, hypothesis testing and statistical treatment. From the above, the researchers conclude the concept of intelligence. Mathematical logical: the ability of students to deal and interact with numbers and symbols, and to solve their problems by calculations, classification, inference and relationships analysis (Al-Demirdash, 2008).

### Mathematical Thinking Patterns

There are several patterns of mathematical thinking, including: deductive thinking, visual thinking, critical thinking, creative thinking, analytical thinking, convergent thinking, and creative thinking. The study will focus on presenting the most important patterns of thinking in mathematics, which are considered among the main patterns of thinking in mathematics, namely:

**Visual thinking:** Campbell (1995: p. 180) defines it as “the thinking that depends on the shapes, diagrams, and images presented in the various situations and relationships. The use of the visual approach in classroom instruction is important, given its importance in understanding the scientific content, as the presentation of these forms within the curriculum helps students to understand, improve their performance, and achieve them in those lessons. Visual thinking is based on two processes, namely: the sense of sight to identify objects. Understanding them, and imagining to form new images through recycling and reusing past experiences and mental imagination. Vision and imagination are the basis of cognitive processes in the brain that crystallize according to the memory of previous experiences (Obeid and Afana, 2003; Tashtoush et al., 2022 a).

**Deductive thinking:** It is a logical mental process in which the student approaches known facts with their validity. To get to know something unknown, which is the result of those issues. Al-Afoun and Mosaheb, (2012) see that this type of deductive thinking means: the ability to logical analysis, deduction, awareness of relationships, and linking between causes and results, and includes processes such as abstraction, establishing relationships, solving problems, evaluating opinions, and drawing conclusions. Obaid and Afana, (2003) enumerate the requirements of inferential thinking, through the individual performing a number of operations, represented by the following: extracting the apparent features of the situation, testing hypotheses, setting rules related to the elements, analyzing and codifying the common elements, predicting the existing relationships between the components, obtaining results. And linking it to it causes in order to solve the problem.

**Critical thinking:** “It is the individual’s ability to express a supportive or opposing opinion in different situations, with convincing reasons for each opinion” (Al-Khalili, 2005: 23). And Mustafa (2002: 45) defines it as “the ability to judge, understand and evaluate things according to specific criteria by asking questions, making comparisons, studying facts carefully, and classifying ideas, for the purpose of arriving at the correct conclusion that leads to solving the problem.” In this paragraph, critical thinking skills as presented by Obaid and Afana (2003); Distinguishing between provable facts and allegations, distinguishing between what is related to the topic or not related to it, determines the accuracy, determines the credibility of the source of information, diagnoses ambiguous data, diagnoses logical fallacies, recognizes inconsistency in the course of reasoning or conclusion, adopts solid proof, deciding on a topic to take action, predicting the consequences of the decision or solution.

**Creative thinking:** It is a mental activity that aims to search for solutions or previously unknown results (Saada, 2003). The Torrance tests and the Guilford tests are the most prevalent tests of creative thinking, when they refer to the most important creative thinking skills to be measured (Garwan, 2011; Tashtoush et al., 2022 b). These skills are: **Originality:** The most important characteristics are related to creative thinking, as it means novelty and uniqueness. **Flexibility:** It is the ability to generate diverse ideas that are not expected, and work to change the direction of thinking. Among the forms of flexibility are: automatic flexibility, adaptive flexibility, and the flexibility to abandon old frameworks when dealing with contemporary problems. **Fluency:** The ability to generate a number of ideas when addressing an issue, with speed and ease of generation. It is the process of remembering and recalling previous information or experiences. **Overflow:** It is the ability to enrich an idea with various new details, or a solution to a problem. **Anticipating problems:** It means awareness of the existence of problems or weaknesses in the environment. Some individuals are faster than others in predicting the problem and verifying its outbreak. Anticipating the problem is the first step in the search for a solution (Tashtoush et al., 2020 a).

## Literature Review

In presenting the theoretical literature, the researchers by presenting a selection of literature, assert the following: confirm the existence of a gap in those studies that justify conducting the current study, and confirming that this topic has not been discussed or researched by the researchers, according to this methodology and according to this study population. The other side, which is no less important, is expanding the perceptions of the researchers and the reader through the discussions that took place in those studies, about the relationships between the variables of each study, in addition to benefiting from the adopted approaches, the tools used in them, the questionnaire's topics and statements, the methods of analysis used in them, and knowledge of the results that have been achieved. reached, and recommendations of those studies. This will undoubtedly help the researchers and reader to gain additional experience in the subject of the study. The following paragraphs present two sets of studies, the first on multiple intelligences, and the second on logical-mathematical intelligence.

### Studies on Multiple Intelligences

Marjan and Al-Shirawi Study (2021); The aim of the research is to standardize the MIDAS (Multiple Intelligences Developmental Assessment Scales) scale of multiple intelligences for female students of physical education at Sohar University in the Sultanate of Oman, and to identify the extent of the availability of multiple intelligences among female students of the physical education program at the College of Education and Arts at Sohar University, and the differences in these multiple intelligences for female students. The authors used the descriptive approach on a sample of (64) female students, who were chosen by the intentional method (Tashtoush et al., 2020 b). The MIDAS scale was used, which consisted of (119) statements distributed in (8) axes that represented multiple intelligences. The most important results resulted in verifying the calculation of the psychometric properties of the MIDAS scale for the research sample, and the intelligence ratio among the sample members came in the following order of intelligence (physical, kinesthetic, spatial, social, linguistic, musical, natural, logical, mathematical, personal). The presence of statistically significant differences indicated the disparity according to the type of intelligence. The results showed a high percentage of good, very good and excellent responses in intelligence that can be developed more through motor skills and various sports activities such as: (physical kinetic intelligence, spatial intelligence), while it decreases in intelligence that does not appear clearly in specialized activity such as intelligence (natural, linguistic).

Nasara and Al-Anzi Study, (2018); The aim was to identify the multiple intelligences and their relationship to the level of performance of handball juniors in the State of Kuwait. The authors used the descriptive approach on a



sample of (320) handball juniors who were selected in a deliberate way from the juniors registered in the Kuwait Federation season (2015/2016). The most important results were; The presence of statistically significant differences between handball juniors in multiple intelligences, in addition to the importance of linguistic intelligence in sports performance, and a positive direct relationship between multiple intelligences and the level of skill performance among handball juniors in the State of Kuwait.

Hussein Study, (2015); The aim was to identify the effect of the multiple intelligences' strategy on the achievement and attitude towards chemistry among first-grade intermediate students in Iraq. The author used the quasi-experimental approach, and prepared an achievement test and an attitude questionnaire towards chemistry. The study sample included (57) female students, and the results showed: There are statistically significant differences in the achievement test and attitude questionnaire in favor of the experimental group that studied according to the strategies of multiple intelligences.

### **Studies on Logical Mathematical Intelligence:**

Sevranj (2016) study, aimed at identifying the effect of using logical-mathematical intelligence on the achievement of English language for students of the Faculty of Technical Sciences in Turkey. The author used the quasi-experimental approach, and prepared an achievement test, and the study sample included (51) students. The results of the study showed that the experimental group that used logical mathematical intelligence was superior to the control group in achievement in English language.

Al-Masarwa Study, (2015); The aim was to reveal the degree of logical-mathematical intelligence and linguistic intelligence and their relationship to the achievement of eighth-grade students in Arabic and mathematics in Jordan. The author used the descriptive analytical method, and the intelligence questionnaire was developed, and the study was applied by comprehensive survey on (263) male and female students. The results of the study showed: that the degree of students' possession of logical intelligence was moderate, and it was found that there is a positive relationship between each of the logical intelligence and students' grades in mathematics.

Study of Abu Zina and Abd, (2012); The aim was to investigate the development of students' mathematical thinking ability, across grades from the eighth to the tenth, in addition to the relationship of mathematical thinking with the student's learning style. The sample of the study was (1,148) male and female students who were chosen from the eighth to tenth grades in the Amman First Education Directorate. The Mathematical Thinking questionnaire prepared by the authors was used, and its validity and reliability were verified by appropriate methods, and the "VARK" Questionnaire was used to detect the students' preferred learning styles. The results of the study revealed a growth in the ability to think mathematically, when the student moved from one class to another. As the results showed; The students' preferred learning style changes

with the different grades. It also showed that the students' performance on the Mathematical Thinking Test was higher for those with a visual style, while for those with an auditory style; Their performance was the least. That study concluded with a number of recommendations calling for attention to activating the role of the curriculum and adopting teaching strategies that support mathematical thinking and are in line with students' learning styles.

Najm Study (2012); It aimed to reveal the effect of a proposed training program for the development of mathematical thinking on direct and delayed achievement (retention) in mathematics for seventh grade students. To achieve this purpose, the study sample was selected from (182) male and female students of the seventh grade, divided into four sections, two sections for males, one of them represents the experimental group, and the other is the control group. And two divisions for female students, one experimental and the other control. Then the two experimental groups studied the training program that aimed to develop patterns and skills of mathematical thinking, while the two control groups studied the textbook in the traditional way. The measurement tool consisted of an achievement test in mathematics, which was used to measure students' achievement, immediately after the study was carried out for direct achievement, and after four weeks of its implementation for deferred achievement. To answer the study questions and test its hypotheses, two-way analysis of variance was used. The results indicated a positive impact of the proposed program for the development of mathematical thinking; In improving direct and delayed achievement (retention) in mathematics, in favor of both experimental groups of male and female students, and their superiority over the two groups that studied in the traditional way of teaching.

### **Methodology**

The study adopted the descriptive analytical survey method, in order to reach results capable of answering the questions of the study, in describing and measuring the level of logical-mathematical intelligence for the pre-service female mathematics teachers at Sohar University in Oman. It also adopts the quantitative approach in collecting data.

### **Participants**

The study population consisted of all pre-service female mathematics teachers. They are (45) female students. As for the study sample, the researchers chose a comprehensive sample for all members of the study community, due to the small size. The sample is employed in two areas, the first: an exploratory sample of (10) students to verify the psychometric properties of the questionnaire. As for the second part of the sample, which numbered (35) students, it will depend on the answer to the questionnaire after verifying its validity and reliability.

## Instruments

To achieve the goal of the study, the researchers prepared a questionnaire according to the five-way (Likert) scale, to measure the level of logical mathematical intelligence among female students, by making use of the MIDAS scale for multiple intelligences, which consisted of (119) statements distributed on (8) types of intelligences. The questionnaire included (17) statements related to logical-mathematical intelligence, and included statements (from 28 to 44) from its questionnaire. Then the researchers developed the questionnaire as follows: The last statement No. (44) of the MIDAS scale was split off because it is complex, which states: (the ability to plan social activities, make home repairs, or solve mechanical problems); So, it became in two phases: the first: (I have the ability to plan student activities), and the second: (I want to repair household appliances and mechanical faults). In addition, the researchers added (7) statements to the questionnaire by making use of the theoretical literature and the questionnaires used in previous studies. Thus, the questionnaire in its initial form consists of (25) statements.

According to Creswell (2012); The validity of the data provides valid assurances that the interpretation of the test results for the construction of the questionnaire that the test is supposed to measure matches its proposed use. There are two basic types of validity: external and internal, and both are very important in analyzing the relevance, feasibility and usefulness of scientific research. External validity refers to the ability to generalize results to the target employees. While internal validity refers to the validity of the measurement and the test itself. The following paragraphs present the psychometric properties of the questionnaire.

It is a technical procedure for examining the apparent variables of the questionnaire intended to be used. Thus, determines the value of the questionnaire by looking at its statements and the questionnaire's axes (Tashtoush et al., 2023 b; Fannakhosrow et al., 2022; Rasheed & Tashtoush, 2021; Hardesty & Bearden, 2004). Accordingly, the researchers distributed a questionnaire of logical-mathematical intelligence level to (5) arbitrators from professors specializing in education, and in the field of mathematics at Sohar University in Oman, in order to know their opinions in the questionnaire; In terms of the accuracy of the statements and their relevance to the axis to which they belong, in addition to the fulfillment of the statements to answer the study questions, and finally the accuracy of the linguistic formulation. The arbitrators were grateful for their comments, and all comments and amendments were considered. Their estimates of the apparent validity of the questionnaire ranged between 83% and 91%. The total of the questionnaire's expressions remained at (25) after the arbitration.

**Internal Consistency Validity of the Questionnaire:** The internal consistency is the validity of the content or purport, and in order to measure the internal validity of the logical mathematical intelligence level questionnaire, the questionnaire was applied to a small sample of (10) students from outside the main sample, in order to extract the Pearson correlation coefficient, and

Statistical Package for the Social Sciences (SPSS) was used, to measure the score of each statement with the axis to which it belongs. The following tables display the Pearson correlation coefficients for the questionnaire items.

*Table 1.* Pearson Correlation Coefficients for the Expressions of the Logical-mathematical Intelligence Level Questionnaire (n = 10)

Statement NO	correlation coefficient	Statement NO	correlation coefficient	Statement NO	correlation coefficient	Statement NO	correlation coefficient
1	**0,635	2	**0,743	3	**0,671	4	**0,545
5	**0,574	6	**0,524	7	**0,467	8	**0,416
9	**0,671	10	**0,466	11	**0,594	12	**0,608
13	**0,711	14	**0,559	15	**0,69	16	**0,707
17	**0,635	18	**0,629	19	**0,492	20	**0,526
21	**0,728	22	**0,471	23	**0,698	24	**0,686
25	**0,425	/		/		/	

Table (1) shows that Pearson's correlation coefficients for the questionnaire ranged between (0.425 and 0.812), so the degree of each statement has been correlated with the overall score of the questionnaire at a significance level of (0.01), which means that the questionnaire statements enjoy a high degree of internal consistency.

As for the structural validity of the questionnaire; It does not apply to this questionnaire since it consists of one field, namely; Logical mathematical intelligence, and when you are limited to one domain, the Pearson internal correlation coefficient is sufficient.

**Reliability:** Means the stability of the questionnaire; It is so clear that its expressions give the same results, if distributed to the same sample, after a period of time and in the same circumstances. And whether the measurements of a variable in a study always behave the same as the results of a previous examination of the same variable (Cronbach & Meehl, 1955).

For the purpose of determining and measuring the stability of the instrument; A double application is made on a small sample of (10) female students, to extract the "Alpha Crunbach" stability coefficient for determining the stability of the study tool, and to test whether the questionnaire works perfectly.

*Table 2.* Cronbach's Alpha Stability Coefficients for Questionnaire Expressions (n=10)

Statement NO	alpha coefficient	Statement NO	alpha coefficient	Statement NO	alpha coefficient	Statement NO	alpha coefficient
1	0,751	2	0,787	3	0,778	4	0,645
5	0,826	6	0,596	7	0,567	8	0,616
9	0,698	10	0,616	11	0,598	12	0,678
13	0,703	14	0,579	15	0,696	16	0,613
17	0,507	18	0,649	19	0,592	20	0,604
21	0,624	22	0,571	23	0,618	24	0,516
25	0,542	/		/		/	

Table (2) above shows that Cronbach's alpha stability coefficient was high, when it ranged from (0.516) to (0.826), which means that the degree of stability for all questionnaire expressions was high, and it shows the stability and validity of the study questionnaire for measuring what it was designed for.

**Interpretation of the Means:** Since the questionnaire adopted a five-pointed gradient (Likert), the lowest degree in it (Very Disagree equals 1 degree), and the highest degree (Very Agree equals 5 degrees). Thus, the difference between the highest and lowest level is (4) degrees, and when dividing these degrees by the number of levels of the questionnaire (5); The value of each gradation is (0.8), the following table shows that:

*Table 3.* Interpretation of arithmetic averages

Means Ranges	Interpretation
4.20 to 5	strongly agree
3.40 to 4.19	agree
2.60 to 3.39	neither agree nor disagree
1.80 to 2.59	disagree
1 to 1.79	strongly disagree

### Supported Statistical Methods

Using (SPSS), the researchers relies on the following statistical methods in analyzing the study data: descriptive analysis; To extract arithmetic means, standard deviations, percentages and rank when analyzing data for sample answers. Pearson correlation coefficient; To measure the validity of the internal consistency of the questionnaire. Cronbach's alpha stability coefficient; To measure the stability of the resolution. Single linear regression analysis.

### Findings

**The first question: What is the level of logical-mathematical intelligence of the fourth-year female students majoring in mathematics at Sohar University in the Sultanate of Oman?**

To answer this question, the sample response data to the questionnaire were entered into the Statistical Package for the Social Sciences (SPSS) version (22). The results of the analysis were as shown in the following table:

*Table 4.* Arithmetic Averages and Standard Deviations of the Sample Response at the Level of Logical-mathematical Intelligence of the Female Students (n = 35)

Rank	Statement NO	The arithmetic mean	standard deviation	level
1	When I was a student, I used to learn arithmetic and mathematics easily, such as: addition, multiplication and fractions.	4,27	0,78	Strongly agree
2	At school I had an interest in arithmetic and mathematics.	4,44	0,89	Strongly agree
3	I do well in advanced mathematics classes, such as algebra and calculus.	3,91	1,02	Agree

4	I have a desire to learn science matters.	3,31	1,12	neither agree nor disagree
5	I've always wanted to solve scientific problems.	3,62	1,07	neither agree nor disagree
6	I know and play chess.	1,67	1,07	Strongly disagree
7	I am good at solving jigsaw puzzles.	3,84	0,93	Agree
8	I play crossword puzzles.	3,18	1,28	neither agree nor disagree
9	I manage my cash expense budget well.	3,02	1,23	neither agree nor disagree
10	My memory is good at memorizing phone numbers and addresses.	2,78	1,15	neither agree nor disagree
11	I can perform calculations; As addition, subtraction, multiplication and division mentally.	4,07	0,86	Agree
12	I love discovering how things work.	3,69	1,08	Agree
13	I love everything related to nature, such as: animals, plants, fish.	3,71	1,34	Agree
14	I like to collect things and learn everything about a subject, such as: horses, football, etc.?	3,20	1,12	neither agree nor disagree
15	I am proficient in project work that uses arithmetic and mathematics.	3,60	1,12	Agree
16	I enjoy working with numbers such as calculating the rate of oil exchange per kilometer or calculating the cost of things.	3,00	1,40	neither agree nor disagree
17	I have the ability to plan student activities	3,29	1,12	neither agree nor disagree
18	I have a curiosity in space sciences, galaxies and stars.	3,38	1,32	neither agree nor disagree
19	I have a persistent tendency to keep things organized.	3,91	1,16	Agree
20	I want to fix household appliances and mechanical faults.	2,47	1,18	Disagree
21	I know how tennis game runs are calculated.	1,68	0,83	Strongly disagree
22	I am skillful at choosing passwords for email.	2,96	1,30	neither agree nor disagree
23	The digital currency "Bitcoin" is a major achievement in financial transactions.	2,67	1,17	neither agree nor disagree
24	I prefer to make administrative transactions digital, not paper.	3,44	1,25	Agree
25	I often admire computer operations.	2,91	1,29	neither agree nor disagree
<b>The general average level of logical-mathematical intelligence</b>		<b>3,71</b>	<b>0,742</b>	<b>Agree</b>

Table (4) shows that the general average of the level of logical-mathematical intelligence for the fourth-year female students; It was in a agree degree, when the arithmetic mean of the questionnaire as a whole was (3.71) and a standard deviation of (0.74). The sample responses ranged from strongly agree to strongly disagree, when the averages ranged from (4.44 to 1.67).

First came the statement No. (2): "At school I had an interest in arithmetic and mathematics" with a Strongly agree grade with an arithmetic mean of (4.44) and a standard deviation of (0.89). It was followed by statement No. (1): "When I was a student, I was learning arithmetic and mathematics easily, such

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as: addition, multiplication and fractions" with a strongly agree, with an arithmetic mean of (4.17) and a standard deviation of (0.78). And in third place came statement No. (11): "I can perform arithmetic operations, such as addition, subtraction, multiplication and division mentally" with a agree rating, arithmetic mean (4.07) and deviation (0.86). While statement No. (6): "I know and play chess" came last with a strongly disagree rating, with an arithmetic mean (1.67) and a standard deviation (1.07).

**The second question: What is the level of educational attainment of the fourth-year female students majoring in mathematics?**

To answer this question, the grades of the semester average, and the cumulative average of the pre-service teachers were extracted for the academic year 2021/2022. The following table shows the results.

*Table 5. Semester Average Grades and Cumulative Average for Fourth Year Female Students (n = 35)*

Average	Less than 2,49		2.5 to 2.99		3 to 3,49		More than 3,5	
	NO	Percentage	NO	Percentage	NO	Percentage	NO	Percentage
Semester average	-	-	5	%11,4	26	%59,1	13	%29,5
Cumulative average	-	-	1	%2,3	32	%72,7	11	%25

The table shows that the grades of the fourth-year female students were generally high, as no female student got an average of less than (2.49). In the semester average, we find that the performance of the female students was: a good level of 36.4%, and a very good level of 29.5%. As for the cumulative average grades, they were; 72.7% for a good level, and 25% for a very good level.

**The third question: What is the effect of the level of logical-mathematical intelligence of the fourth-year female students majoring in mathematics on the academic achievement of mathematics?**

To answer this question, linear regression analysis was used; To find out the effect of the main variable, the level of logical-mathematical intelligence, on the dependent variable on the educational attainment of female students in mathematics. The following table shows the results.

*Table 6. Regression analysis of the effect of logical-mathematical intelligence on educational achievement (n = 35)*

Axis	Source of variance	Sum of squares	Degree of freedom	Mean of squares	F-value	Significance level
Logical intelligence	between groups	0,086	2	0,378	6,882	0,046
	within groups	9,311	54	0,236		
	Total	9,397	56			
Educational achievement	between groups	1,14	2	0,53	7,219	0,031
	within groups	10,253	54	0,186		

	<b>Total</b>	11,393	56			
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The table shows that the significance of differences for the logical-mathematical intelligence rate, and the total academic achievement of the female students in mathematics, was that the F-values were (6,882) and (7,219), respectively, which are statistically significant values at a significance level less than ( $0.05 \leq \alpha$ ) which indicates On the existence of a significant effect between the logical-mathematical intelligence of the female students, and their overall academic achievement in mathematics.

This result is consistent with the results of the study of (Al-Masarwa, 2015; Rasheed & Tashtoush, 2023; Najm, 2012), which resulted in a positive relationship between logical-mathematical intelligence and students' grades in mathematics.

### Conclusion

Logical-mathematical intelligence is one of the eight types of intelligence methods. Students who have learned the logical-mathematical intelligence method; They score excellent on IQ tests. They are often methodical and think logically. They are skilled in mentally solving mathematical problems, as they have a strong memory, a high ability to analyze and problem-solving skill, so they agree in the collection of scientific topics. The comprehensive sample of all pre-service teachers was adopted. The study reached the following results:

- The general average of the logical-mathematical intelligence level for the fourth-year students was high, when the arithmetic mean of the questionnaire as a whole was (3.71) and a standard deviation was (0.74).
- The grades of the female students in the semester average were: good at 36.4%, and very good at 29.5%. The cumulative average was; 72.7% for a good level, and 25% for a very good level.
- There is a significant effect between the logical-mathematical intelligence of the female students, and the overall academic achievement in mathematics.

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