NIU Journal of Social Sciences Copyright©2026
Nexus International University ISSN: *3007-1682*; 12(2): 275–288

Intuitive Thinking and its Relationship to Mathematical Proficiency among Female Students in the Second Intermediate Grade

ZINAH MEZAAL MAJEED
College of Basic Education, Al-Mustansiriya University, Iraq.
zinah.mezaal@gmail.com

Abstract. This study's overarching goal is to shed light on the association between second-intermediate-grade female students' levels of intuitive thinking and mathematical aptitude. Stratified random sampling was used to select 150 female students in the second intermediate grade from two schools affiliated with the Baghdad Directorate of Education, Al-Rusafa II: Itr Al-Ward and Al-Kawakib. Fifty students from each school made up the research sample. The research methodology followed a descriptive correlational approach. After ensuring their validity and reliability, the researcher administered a math competency exam and an intuitive thinking measure to the sample. The findings demonstrated that second-grade intermediate pupils outperform the theoretical mean for both intuitive thinking (mean of 72.84) and mathematical competency (mean of 30.38). Intuitive thinking and mathematical proficiency were found to be positively and statistically significantly correlated with one another (Pearson correlation coefficient = 0.64), although there were no discernible differences in either variable between the two schools' students. Based on these findings, the researcher emphasized the need of exposing middle school children to a variety of mathematical settings in order to foster intuitive thinking rather than restricting mathematics instruction to rote memory and rule application..

Keywords: intuitive thinking, mathematical proficiency, second-year intermediate stage, descriptive correlational approach.

1. Introduction

The capacity to swiftly arrive at plausible answers or estimations without going thru complex analytical methods is an integral part of mathematics, making it one of the topics most closely associated with distinct thinking styles. This skill goes beyond algorithms and mathematical techniques alone. This way of thinking is characterized by a lack of reliance on established forms of logical reasoning like induction, deduction, or step-by-step analysis in favor of a more intuitive and personal approach that draws on the individual's past experiences to generate findings or ideas (Asha, 2007, p. 15).

One distinguishing feature of intuitive thinking is that it is based on inferential concepts rather than hard evidence. Because it encourages students to make educated guesses about the outcomes of situations, its development among students is an important educational issue that needs careful handling. This is because punishing students for giving incorrect intuitive answers could make them afraid to express themselves in the future (Al-Safi, 2022, pp. 29-30).

On the other hand, the US National Research Council (NRC) used the phrase "mathematical proficiency" to describe when someone has mastered mathematics. They broke it down into five interdependent parts: conceptual understanding, procedural fluency, strategic competence, adaptive reasoning, and a productive disposition toward mathematics (Rayan-Shteiwi, 2019, p. 16). Source: Kilpatrick et al., 2001.

An important component of mathematical proficiency, adaptive reasoning, occurs in the learner when they provide informal justifications based on intuition and inductive logic to understand the relationships between mathematical concepts and procedures. This highlights the direct link between intuitive thinking and mathematical proficiency (Rayan-Shteiwi, 2019, p. 21).

Therefore, it is crucial to shed light on the five-factor relationship between intuitive thinking and

mathematical competence, particularly among female students in second intermediate grade, who are at a pivotal juncture in developing abstract mathematical ideas.

1.1 Research Problem

To navigate the intricacies of change in the context of the cognitive and technological revolution we are experiencing, today's learners must possess exceptional problem-solving abilities, the capacity to foresee and prepare for the unexpected, and the capacity to act swiftly and decisively. Unfortunately, teaching students to rely on their intuition and make daring mental leaps when faced with a problem is something that many of our schools fail to do (Ali and Hussein, 2022, p. 251).

To excel in mathematics, one must possess more than just memorization skills and the ability to follow procedures. The US National Research Council (NRC) identified five overlapping components that make up what is referred to as "mathematical proficiency" (Rayan-Shteiwi, 2019, p. 16). Researchers have found that many middle school students learn mathematics thru rote memorization rather than by using their intuition to make educated guesses and evaluate the reasonableness of those estimates. This might have an impact on how well they integrate the various components of mathematical proficiency.

There is a noticeable lack of research that directly connects intuitive thinking with mathematical proficiency, even tho both topics are becoming increasingly popular in educational literature. In fact, researchers in this area have stated that they have not found a study that aligns with their findings regarding the relationship between intuitive thinking and other cognitive variables (Ali and Hussein, 2022, p. 289), which supports the idea that there is a gap in the literature that needs to be filled, particularly for female students in the second intermediate grade who are going thru a developmental stage. Important for building complex mathematical ideas.

Given the foregoing, the following primary question serves to identify the issue with the present study:
How does the ability to think intuitively relate to how well female students in the second intermediate grade do in mathematics?

1.2 Research Questions

Considering the above, the primary objective of this study is to determine, for female students in the second intermediate grade, what the correlation is between intuitive thinking and mathematical competence. This primary inquiry gives rise to the following related inquiries:

- What percentage of female pupils in the second intermediate grade use intuition in their thinking?
- Female students in the second intermediate grade: how well do they do in mathematics? Mathematical competency has five parts: conceptual comprehension, procedural fluency, strategic competence, adaptive reasoning, and productive disposition.
- In the second intermediate grade, are female pupils more likely to demonstrate mathematical competency if they also demonstrate intuitive thinking?
- When the study is applied to several schools, does the amount of intuitive thinking and mathematical competency vary based on the school variable?

1.3 Research Hypotheses

To test for statistical significance at the 0.05 level, we develop the following null hypotheses in relation to the study questions:

- Among girls in the second intermediate grade, there is no link between logical reasoning and mathematical competence.
- When comparing the average scores of female students at Itr Al-Ward Intermediate School for Girls and Al-Kawakib Intermediate School for Girls, there are no discernible variations in terms of the level of intuitive thinking.
- On average, the math competency levels of female students at the two schools are not significantly different.

1.4 Objectives of the Study

The present study seeks to achieve the following objectives:

- Determining the extent to which female pupils in the second intermediate grade engage in intuitive thinking.
- Determining the target population's mathematical competency by evaluating their results across five domains: conceptual comprehension, procedural fluency, strategic competence, adaptive reasoning, and productive disposition.
- Analyzing the second intermediate grade female students' intuitive thinking and mathematical competency to determine the source and direction of the association.

- Whether your study involves more than one school, you need to figure out whether the school variable causes any changes in the levels of the two variables.
- Offering a methodical idea that might help math educators include exercises that foster intuitive thinking into their lessons to improve students' mathematical competence.

1.5 Significance of the Study

The importance of the current research stems from several considerations, which can be addressed at two levels:
First: The theoretical importance:

- An important contribution to the educational library in the field of mathematics teaching methods, this study addresses a direct relationship between intuitive thinking and mathematical proficiency—two variables that have not been adequately studied in Arabic literature.
- The research offers a well-coordinated theoretical framework that merges two under-explored areas of cognitive science: mathematics education and cognitive psychology. This intersection has hitherto received little attention, but this study aims to change that.
- Other researchers may be able to use the study's findings to test the hypothesis that intuitive thinking influences educational achievements at levels of education other than mathematical competency.

1.6 Second: Practical Importance:

- As a result of this study, math educators and administrators now have a method to gage their students' intuitive thinking abilities in a mathematical setting.
- Those in charge of mathematics education and curriculum development may use the study findings to their advantage by recognizing the need to foster students' intuitive reasoning skills in tandem with their mastery of more conventional procedural knowledge.
- The findings provide educators with a useful indicator of which of the five aspects of mathematical competence is more linked to intuitive thinking, enabling them to concentrate their teaching efforts more effectively on those areas.
- Given the dearth of literature on the topic in Iraq, this study is an effort to fill a gap in the country's library with studies that establish a connection between thot patterns and mathematical proficiency.

1.7 Research limitations

The current research adheres to the following limits:

- Mathematics instructors and supervisors may use the research-based assessment instrument for mathematical context intuition to gage their students' proficiency in this area at an early stage.
- The study findings aid those in charge of mathematics curriculum and pedagogy in understanding the significance of including activities that foster intuitive learning with more conventional procedural learning, rather than limiting themselves to enhancing just one element of learning.
- Thirdly, the findings show that intuitive thinking is most closely connected to one of the five aspects of mathematical competence, so instructors may focus their lessons on those areas.
- The study aims to fill a gap in the Iraqi library by investigating the relationship between thinking style and mathematics performance. This is important since there is a shortage of therapy in the local area.

1.8 Search terms

First: Intuitive Thinking

According to Asha (2007), "it is a quick and subjective method of knowledge, linked to the individual's previous experiences, that allows him to reach results, ideas, or solutions without relying on known logical thinking methods such as induction, deduction, or careful, step-by-step analysis" (Asha, 2007, p. 15).

"It is a style of thinking that encourages the learner to make intelligent guesses about the outcomes of the situations he faces, and it is inferred thru its tangible results rather than as a behavior that can be directly observed while it is occurring" (Al-Safi, 2022, pp. 29-30)

The overall score that a second-year intermediate student achieves when she answers the questions of the intuitive thinking scale that was established for this study is known as the procedural definition.

Secondly, being proficient in mathematics

"A term adopted by the US National Research Council (NRC) to express successful learning of mathematics, and it consists of five intertwined and overlapping components that depend on each other,

namely: conceptual understanding, procedural fluency, strategic competence, adaptive reasoning, and productive disposition" (Rayan-Shteiwi, 2019, p. 16)

The author provided the following definition: "It is the learner's possession of an integrated understanding of mathematical ideas that enables him to learn new ideas by linking previous concepts with new ones, in addition to accuracy and speed in using mathematical symbols, which gives him flexibility and fluency in solving problems" (Brook, 2021).

Operational definition: It is the two-year intermediate student's overall score on the five-part mathematical proficiency exam developed for this study.

Chapter Two: The theoretical Framework and Previous Studies

First: Intuitive Thinking

The Concept of Intuitive Thinking

Asha (2007) notes that analytical thinking types rely on well-known logical reasoning steps like induction and deduction, as well as careful, step-by-step analysis, while intuitive thinking relies on an individual's accumulated prior experiences to reach results, ideas, or solutions quickly and subjectively.

A hypothetical concept in nature, this kind of thinking is inferred from its tangible results and outcomes rather than being directly observed in action. For example, one might swiftly arrive at an answer or a reasonable estimate for a situation without providing a clear explanation of the steps that led to it (Al-Safi, 2022, pp. 29-30).

How analytical thinking differs from intuitive thinking and what makes the former different

An influential theory that attempts to explain this connection is the experimental cognitive self-theory. This theory postulates that people have two distinct ways of processing information: one is the analytical, rational system, which is slow, deliberate, and logical; and the other is the experimental intuitive system, which is fast, automatic, and emotionally driven. According to Ali and Hussein (2022, p. 259), these systems do not function alone but rather in a continuous and interacting fashion to produce behavior and conscious thot in the person.

With its minimal cognitive demands and guidance from emotion and experience, the intuitive system is able to process most everyday information outside of direct awareness, freeing up the limited rational system to concentrate on what truly demands conscious attention (Ali and Hussein, 2022, p. 259). In this approach, analytical thinking is seen as the polar opposite of intuitive thinking, which is why the two are seen as complimentary cognitive styles. You may get a head start on a solution using your intuition, but you need to use your analytical thinking skills to back it up..

The importance of developing intuitive thinking educationally
The significance of considering students' intuitive thinking in the classroom arises from the realization that it is counterproductive for teachers to relentlessly punish students for giving incorrect answers. This practice instills a fear of criticism and ridicule in the learner, making them reluctant to share their ideas or guesses in the future. This way of thinking may be fostered or stifled by the educator, the dominant social culture, and the family (Al-Safi, 2022, pp. 29-30).

In math, which demands both procedural accuracy and mental flexibility, the ability to think intuitively is crucial for middle school students because it encourages them to actively engage in problem-solving rather than passively waiting for answers to be handed to them (Al-Safi, 2022, pp. 29-30). There is a need in the Arab educational literature for additional research in this field, as noted by researchers who have examined intuitive thinking and its relationship to other cognitive variables. This highlights the significance of the field as a whole (Ali and Hussein, 2022, p. 289).

Second: Mathematical Proficiency

The Origins of the Concept and its Definition

The term mathematical proficiency appeared at the beginning of the twenty-first century, when it was adopted by a specialized committee of the US National Research Council (NRC) to express successful learning of mathematics, after an extensive review of the literature on cognitive psychology and mathematics education. This concept consists of five intertwined and overlapping components that depend on each other: conceptual understanding, procedural fluency, strategic competence, adaptive reasoning, and productive disposition (Rayyan-Shteiwi, 2019, p. 16). (Kilpatrick et al., 2001)

Components of Mathematical Proficiency

Having a good grasp of concepts: This involves being aware of the connections between different ideas, facts, and mathematical procedures. It helps the learner avoid making the same mistakes over and

over again by relating new concepts to what they already know (Rayan-Shteiwi, 2019, p. 17).

Procedural fluency: This is the capacity to apply mathematical methods with ease, precision, and creativity; rather than blindly applying steps from memory, the learner is able to assess the context and pick the most suitable approach. As Rayan-Shteiwi (2019, pp. 18-19) points out, there should be no competition between conceptual comprehension and procedural fluency in mathematics instruction.

Competence in strategy: This is the capacity to create mathematical problems, express them in various ways (verbally, visually, and symbolically), extract the data needed to solve the problem from any excess data that may be present, and finally, choose the best strategy for solving the problem (Rayan-Shteiwi, 2019, p. 20).
Among the five components, adaptive reasoning is the one most closely tied to intuitive thinking because it manifests itself in the learner's capacity to think logically, reflect, and justify; this includes offering informal justifications that depend on intuition and inductive reasoning to explain the relationships between concepts and procedures (Rayan-Shteiwi, 2019, pp. 20-21).

A productive disposition: This is the end result of the learner's achievement in the first four components; it includes a positive attitude toward mathematics as a reasonable, practical, and useful subject; self-confidence; and persistence when confronted with challenges (Rayan-Shteiwi, 2019, pp. 21-22).

The Nature of the Relationship between the Components of Mathematical Proficiency

Conceptual understanding and procedural fluency are no longer viewed as competing for mathematics teacher attention as they were in the older literature, but rather as complementary, mutually reinforcing components; A deep understanding of concepts facilitates meaningful acquisition of procedural fluency rather than mechanical memorization, while procedural fluency allows the learner more mental space to focus on understanding and reasoning rather than consuming it in performing basic computational steps (Rayan-Shteiwi, 2019, pp. 18-19).

Previous Studies

This part reviews a number of studies related to the two research variables, arranged from oldest to most recent within two axes:

The first axis: Studies dealing with intuitive thinking 1- Research conducted by Nour Al-Obaidi in 2019
Its stated goal was to shed light on the mathematical competence of mathematics majors in Iraqi universities. The research used a descriptive methodology and surveyed students from the University of Baghdad's Mathematics Department at the College of Education for Pure Sciences. Published master's thesis from the University of Baghdad in Iraq.

The Work of Amna Mansour Hussein on the Al-Safi Code (2022)

Finding out how college students think intuitively and cognitively sparsely, as well as how these traits vary by gender and area of study, was the primary goal of the study. A descriptive correlational method was used in the investigation. Using two measures developed by the same academics, the sample included four hundred male and female students from the University of Babylon. There was a statistically significant negative correlation between intuitive thinking and cognitive miserliness, and the results demonstrated that the students exhibited a high level of intuitive thinking. There were significant differences according to specialization (scientific/humanitarian), but no differences according to gender. (Ph.D. dissertation, Iraq's University of Baghdad).

Study by Kreitler and Benbenisty (Kreitler and Benbenisty 2020)

Its stated goal was to investigate college students' intuitive thot patterns in relation to their cognitive orientations. This study's sample included ninety undergraduates from the Behavioral Sciences major. A statistically significant correlation was found between decision-making and intuitive thinking and its components, demonstrating that intuitive thinking is a motivating network of beliefs and meanings that is intrinsic to one's cognitive tendency.
The second axis: Studies dealing with mathematical proficiency

Study by Al-Asmari, Noura Awadah (2022)

The purpose of this study was to provide a plan for the improvement of mathematical competence among female primary school pupils and to uncover the current state of several mathematical competency components. A descriptive survey design was used for the research, which included two instruments (a test and a self-report tool) administered to 298 female students at random from the fourth grade in Bisha Governorate (Saudi Arabia). Overall and across all subtests, female

students performed poorly on the mathematics proficiency exam, but their scores were about average on the productive disposition subtest. (No. 30, 2022, as published in the Journal of Educational Sciences, Imam Muhammad bin Saud University).

Saeed and Abdel-Ghani Hamid Yahya's (2024) research (number nine)

Its stated goal was to shed light on how well math instructors really use their mathematical knowledge in the classroom. Using a note card with 35 items divided into 5 categories, the descriptive research sampled 30 male and female educators. There were no significant variations according to grade or years of experience, and the findings revealed that generally, the level of practice was average (M=2.68) with evident diversity across areas. Conceptual comprehension was high, but procedural fluency and adaptive reasoning were inadequate. (The Journal of Human Sciences at Saeed University, Volume 7, Issue 1, 2024).

Research conducted by Kamila Abdullah Al-Omari in 2017

The study's overarching goal was to provide light on the mathematical competence of secondary school mathematics instructors. Imam Muhammad bin Saud Islamic University, Riyadh, Saudi Arabia (Master's thesis, unpublished).
Benefit from previous studies

Previous studies have benefited the current research in several aspects: 1-In developing the theoretical framework: Research, notably that of Al-Safi (2022), contributed to a more thorough theoretical grasp of intuitive thinking and the related mental processing systems. Reports from Al-Asmari (2022) and Saeed (2024) further clarified the five aspects of mathematical competence and provided procedural methods for measuring them.

In deciding on the right approach: Most prior research has highlighted how well the descriptive technique (whether survey or correlational) works for these two variables, thus the researcher has stuck with it for this study.

Thirdly, in terms of research instrument development, the researcher drew on the methods used in Al-Safi's (2022) study to construct and validate an intuitive thinking scale, as well as those used in Al-Asmari (2022) and Saeed (2024) to design a mathematical proficiency test for the present study.

When considering the anticipated outcomes, it is worth noting that recent research has raised concerns about the potential emergence of a comparable pattern of disparity between the components of mathematical proficiency in the sample studied here. This is in light of Saeed's (2024) study, which found a discernible decline in procedural fluency and adaptive reasoning when compared to conceptual understanding.

Reviewing prior research revealed a dearth of studies that establish a direct connection between intuitive thinking and mathematical proficiency with all five components. All of the studies that did exist either focused on one variable or attempted to establish a connection between intuitive thinking and other cognitive traits like cognitive miserliness. This highlights the uniqueness of the present study and the necessity for it in the field of education.

Chapter Three: Research Methodology and Procedures

First: Research Methodology

Among the many descriptive methods used in this study, the descriptive correlational method stands out for its ability to measure the strength of a relationship between multiple variables and to draw conclusions about the nature of that relationship in the absence of experimental manipulation of any of the variables. This methodology is well-suited to the present study since it will first characterize the target population's level of intuitive thinking and mathematical skill, and then use statistical analysis to show the nature of the association between these two variables.

Second: The Research Community

The research community consists of all second-grade female students in middle day schools affiliated with the General Directorate of Education in Baghdad/Rusafa II, for the academic year 2025/2026.

Third: The Research Sample

The research sample was (150) students, who were selected by a stratified random method from two different schools, where the sample was divided equally into (75) students from Attar Al-Ward Intermediate School for Girls, and (75) students from Al-Kawakib Intermediate School for Girls, affiliated with the (Baghdad / Al-Rusafa Second) Directorate 2025/2026.

Fourth: Research Tools

To achieve the objectives of the current research, the researcher prepared two tools:

- Intuitive thinking scale.

- Mathematical proficiency test.

Below is a description of each tool and the procedures for preparing it and verifying its characteristics:

First: Intuitive thinking scale

The objective of the evaluation

The purpose of this scale is to assess the degree to which female students in the second intermediate grade can use their intuition when solving mathematical problems. This includes their speed in making predictions or initial guesses, as well as their capacity to draw on prior knowledge and mathematical patterns and relationships to inform their subsequent judgments and solutions. (The work of Fischbein, 1987)

The research that informed the development of the scale characterized intuitive thinking as a subjective and fast way of knowing that is based on one's past experiences; this way of thinking allows one to get to answers, ideas, or solutions without having to rely on meticulous, methodical analysis. (The work of Fischbein, 1987)

Establishing the foundation

The researcher developed a twenty-item scale that is compatible with the characteristics of intuitive thinking in mathematics and tailored to the needs of female students in the second intermediate grade. Since the possible answers vary from "always" to "never," the researcher chose for the five-point Likert scale.

Directions for the scale

The researcher instructed the students to read each paragraph thoroughly and select the option that best reflects their behavior or mindset. They were reminded that there is no correct response and that the scale is meant to gage mindset rather than academic performance.

Answer alternatives

The researcher adopted the following alternatives:

Negative paragraphs	Positive paragraphs	Alternatives
1	5	Always
2	4	Often
3	3	Sometimes
4	2	Rarely
5	1	Never

Correcting the scale

The number of items on the scale was (20), and thus the total score ranged between (20-100) degrees. The higher the score that the student obtained, the higher her level of intuitive thinking, while the lower score indicated a lower level of intuitive thinking. The theoretical mean of the scale reached (60) degrees, and was calculated according to the equation:
Hypothetic mean = number of items x average weights of alternatives
theoretical mean = 20 x 3 = 60 degrees.

Second: Test of mathematical proficiency

Aim for the test

The purpose of this test is to assess the mathematical competence of second-intermediate-grade female students in relation to the five domains that make up mathematical proficiency: conceptual understanding, procedural fluency, strategic competence, adaptive reasoning, and productive disposition. According to the research's theoretical framework, these five components have been included into the present study. Source: Kilpatrick et al., 2001.

Creating the examination

There are a total of twenty items on the exam, with four items assigned to each of the five categories.

Study guidelines

For this assignment, the researcher had the students read all of the paragraphs, answer each one, and then document the processes they used to solve each problem, along with an explanation of why they needed to do so. The purpose of the exam, she told the children, is to determine pupils' mathematical competence, not their academic performance in the classroom.

Making the exam right

In order to fix performance paragraphs, the researcher used the following system:
- Two marks: for a fully accurate response that includes a suitable solution or explanation.
- One point: for a response that incorporates an accurate component of the answer or concept.

If the response is wrong or left unfinished, the value is zero.

In order to measure productive disposition, the researcher used a five-point scale. After collecting answer scores, they were compared to the item's corrective key score.

Fifth: The validity of the two tools

Validity means the extent to which the tool is able to measure the trait or variable it was designed to measure. To verify the validity of the intuitive thinking scale and the mathematical proficiency test, the researcher presented the two tools in their initial form to a group of arbitrators specialized in mathematics teaching methods, measurement, evaluation, and educational and psychological sciences. The researcher asked the arbitrators to express their opinions on:

- Whether the paragraphs are appropriate for their intended purpose.
- Paragraph phrasing that is clear.
- Language formulation that is sound.
- Paragraphs that are appropriate for female students in the second intermediate grade, taking into account their age and level of study.
- The paragraph is a part of the field that it measures.
- The appropriateness of the possible solutions.

In light of the arbitrators' opinions and suggestions, appropriate amendments were made to a number of paragraphs, and the two tools became valid for exploratory application.

Sixth: Exploratory application of the two tools

The researcher surveyed a subset of female students in the second intermediate grade to check if the instructions and paragraphs of the two tools were clear and to find out how long each tool took to complete. By default, thirty students from Al-Sadaf Intermediate School for Girls, which is associated with the Second Rusafa Education Directorate, were included in the survey sample. Results generally indicated that students had no major problems comprehending the directions or the questions on the exam, and that the scale was easy to grasp.

Seventh: Response time for the two tools

The answer time was calculated by recording the answer time of the first student and the answer time of the last student, then extracting the average between the two times. Typical data showed that the average appropriate time to answer the intuitive thinking scale was about (15) minutes, while the appropriate time to answer the mathematical proficiency test was about (45) minutes. Thus, the total time proposed for applying the two tools became about (60) minutes.

Eighth: Statistical analysis of the items of the intuitive thinking scale

After the exploratory application, the scale items were analyzed statistically with the aim of verifying their ability to distinguish between female students with different levels of intuitive thinking. The researcher used the item correlation coefficient with the total score of the scale, as the results showed that the correlation coefficients for the items with the total score ranged between (0.31 - 0.68), which are statistically acceptable coefficients, which indicates the consistency of the items with the total score of the scale.

Ninth: Analysis of the mathematical proficiency test items

The items of the mathematical proficiency test were analyzed to reveal the level of difficulty of the items and their discriminatory ability. The researcher used the difficulty coefficient and the discrimination coefficient for the substantive and performance paragraphs according to the nature of the paragraph. The results showed that the difficulty coefficients of the paragraphs ranged between (0.35-0.75), which is within the appropriate limits, and the discrimination coefficients ranged between (0.30-0.62).

Tenth: The stability of the intuitive thinking scale

To verify the stability of the intuitive thinking scale, the researcher used the Cronbach's alpha coefficient, due to its suitability to the nature of the scale's items with multiple alternatives. The Cronbach's alpha coefficient for the scale reached (0.87), which is a coefficient that indicates a good level of internal consistency between the scale's items. (Cronbach, 1951)

Eleventh: The stability of the mathematical proficiency test

To verify the reliability of the mathematical proficiency test, the researcher used Cronbach's alpha coefficient after applying the test to the exploratory sample, where the reliability coefficient reached (0.84), which is a good reliability coefficient that indicates the consistency of the test items in measuring mathematical proficiency. (Cronbach, 1951)

Twelfth: Final application procedures

After completing the procedures for preparing the two tools and verifying their psychometric properties, the researcher prepared the final version of the two tools and applied them to the research sample of (150) female students. The two tools were applied in similar conditions in terms of time and instructions, with emphasis on the students on the necessity of answering all the items and not leaving any paragraph unanswered. After completing the application, the answers were corrected according to the previously prepared correction keys, and then the data was entered into the computer for the purpose of performing the appropriate statistical treatments.

Thirteenth: Statistical methods

The researcher used a number of statistical methods appropriate to the research objectives, which are:

Mean: to determine the typical results of the mathematical competency exam and the intuitive thinking scale among the sample.

Standard deviation: to find out how far the scores of the sample members are from the total.

Thirdly, **the theoretical mean:** this will allow you to compare the tool's estimated mean with its theoretical mean.

The purpose of the Pearson correlation coefficient is to show how well people with higher levels of mathematical competence and intuitive thinking are related.

T-test with two independent samples: to find out whether the two schools' female students' average results on tests of mathematical ability and intuitive thinking are different.

The reliability of the two instruments is checked using Cronbach's alpha.

Identify the degree of difficulty of the mathematical competency test items (item difficulty factor, 7). A study conducted by Ebel and Frisbie in 1991

Item Discrimination Coefficient: For the purpose of revealing which mathematical competency test questions may differentiate between female students with high and poor scores. A study conducted by Ebel and Frisbie in 1991
9–Percentage: To provide an overview of some representative statistics and to evaluate the judges' views.

Chapter Four: Presentation and interpretation of the results

First: Presenting the results of the first question

What is the level of intuitive thinking among female students in the second intermediate grade?

To answer this question, the researcher extracted the mean and standard deviation of the scores of the sample members, which numbered (150) female students, on the intuitive thinking scale, and then compared it to the theoretical mean of the scale. Since the intuitive thinking scale consists of (20) items, and each item has five alternatives, the theoretical mean of the scale reached: 20 x 3 = 60 degrees.

Table (1)
The mean, standard deviation, and theoretical mean of students' scores on the intuitive thinking scale

Hypothetical mean	Standard deviation	Arithmetic average	Number	variable
60	8,91	72,84	150	Intuitive thinking

It is clear from Table (1) that the mean of the scores of the students in the research sample on the intuitive thinking scale reached (72.84) degrees, with a standard deviation of (8.91), while the theoretical mean of the scale reached (60) degrees. To determine the significance of the difference between the mean and the theoretical mean, the researcher used the t-test for one sample.

Table (2)
Results of a one-sample t-test for intuitive thinking scores

Connotation	Degree of freedom	Tabular value	Calculated T value	Hypothetical mean	Arithmetic average	variable
Function	149	1,976	17,64	60	72,84	Intuitive thinking

Table (2) shows that at a significance level of 0.05 and 149 degrees of freedom, the computed T-value was 17.64, which is higher than the tabular T-value of 1.976. As a result, there is a statistically significant difference between the two means, suggesting that second-intermediate-grade female students exhibited a greater level of intuitive thinking than the theoretical mean.

The outcome's interpretation: One possible explanation for this finding is that second-intermediate-grade female students have more mathematical background, which helps them to anticipate outcomes, find patterns and links

more rapidly, and develop early expectations for answers. A strong degree of intuitive thinking may develop in students who take mathematics classes since the topic presents many opportunities for students to depend on their prior knowledge, educated guesses, and rapid evaluations of the validity of their findings. (The work of Fischbein, 1987)

Second: Presenting the results of the second question

What is the level of mathematical proficiency with its five components among female students in the second intermediate grade?

To answer this question, the researcher extracted the means and standard deviations of the students' scores on the mathematical proficiency test, as well as the arithmetic average for each of its five components.

Table (3)
means and standard deviations for the components of mathematical proficiency

Standard deviation	Arithmetic average	Number of paragraphs	Components of mathematical proficiency
1,31	**6,52**	**4**	**Conceptual understanding**
1,47	**6,08**	**4**	**Procedural fluency**
1,58	**5,74**	**4**	**Strategic efficiency**
1,62	**5,31**	**4**	**Adaptive inference**
1,19	**6,73**	**4**	**Product tilt**
4,72	**30,38**	**20**	**Mathematical proficiency as a whole**

The results are in, and Table (3) shows that the students' average math proficiency exam scores were 30.38 degrees with a standard deviation of 4.72. In terms of individual components, the productive disposition component ranked highest with a mean score of 6.73, followed by conceptual understanding at 6.52, procedural fluency at 6.08, strategic competence at 5.74, and adaptive reasoning at 5.31. We compared the actual mean to the theoretical mean of the exam to show how proficient students were in mathematics generally. Given that the exam has twenty items and that forty points is the projected overall score, the theoretical mean is twenty points (40 ÷ 2 = 20)..

Table (4)
Results of a one-sample t-test for mathematical proficiency scores

Connotation	Degree of freedom	Tabular value	Calculated T value	Hypothetical mean	Arithmetic average	variable
Function	149	1,976	26,96	20	30,38	Mathematical proficiency

It is clear from Table (4) that the calculated T-value was (26.96), which is greater than the tabulated T-value of (1.976) at a significance level of (0.05) and a degree of freedom (149). Therefore, the difference between the mean and the theoretical mean is statistically significant, which indicates that the level of mathematical proficiency among female students in the second intermediate grade was higher than the theoretical level.

Interpretation of the result: This result can be interpreted by saying that female students possess an appropriate amount of mathematical knowledge, concepts, and procedures that enable them to deal with different mathematical situations. Also, a higher level of conceptual understanding and procedural fluency can contribute to enhancing the student's ability to choose the appropriate solution strategy, justify the results, and deal with mathematical problems more flexibly. (Kilpatrick et al., 2001)

Third: Testing the first hypothesis

"There is no statistically significant correlation between intuitive thinking and mathematical proficiency among female students in the second intermediate grade."

To verify this hypothesis, the researcher used the Pearson correlation coefficient between the students' scores on the intuitive thinking scale and their scores on the mathematical proficiency test.

Table (5)
Pearson correlation coefficient between intuitive thinking and mathematical proficiency

Significance level	Pearson correlation coefficient	Number	The two variables
0,05	0,64	150	Intuitive thinking Mathematical proficiency

It is clear from Table (5) that the two factors of mathematical skill and intuitive thinking were positively correlated with each other (Pearson correlation coefficient = 0.64), suggesting a clear link between them. The finding suggests that female students who score high on measures of intuitive thinking also tend to score high on measures of mathematical skill, as the correlation coefficient is statistically significant at the 0.05 level.

Conclusion about the first hypothesis: Following from the previous result, we can reject the first null hypothesis, which states that intuitive thinking and mathematical proficiency are not statistically correlated, and accept the alternative hypothesis, which states that the two variables are positively correlated and statistically significant.

The outcome's interpretation: Since intuitive thinking aids the learner in developing preliminary assumptions about the answer, finding mathematical patterns and correlations, and estimating the validity of the outcomes, it explains why there is a positive correlation. The capacity to generate, evaluate, and refine first assumptions is a precursor to conceptual comprehension, procedural fluency, strategic competence, adaptive reasoning, and creative flair—all of which are necessary for mathematical mastery. Adaptive reasoning incorporates logical argumentation and the use of intuition to arrive at mathematical interpretations or conclusions; thus, the present study's theoretical framework demonstrated the connection between intuitive thinking and adaptive reasoning.

Fourth: Testing the second hypothesis

“There are no statistically significant differences between the average scores of female students in the two schools on the level of intuitive thinking.”

To verify this hypothesis, the researcher used the t-test for two independent samples to reveal the significance of the differences between the average scores of students from the Itr Al-Ward and Al-Kawakib Intermediate Schools for Girls on the intuitive thinking scale.

Table (6)
T-test results for two independent samples in intuitive thinking by school

Connotation	Tabular value	Calculated T value	Standard deviation	Arithmetic average	Number	School
Non-functional	1,976	1,72	8,42	74,01	75	Medium rose fragrance
			9,31	71,67	75	Intermediate planets

The average grade point average for the girls attending Itr Al-Ward Intermediate School was 74.01, as shown in Table (6), while the average grade point average for the girls attending Al-Kawakib Intermediate School was 71.67. The reported T-value was 1.976, whereas the computed T-value was 1.72 at a significance level of 0.05 and 148 degrees of freedom.

Evaluation of Second Hypothesis: Difference between the two means is not statistically significant since the computed T-value is smaller than the tabulated T-value. Consequently, we accept the second null hypothesis, which states that the average levels of intuitive thinking among female students at the two institutions are not significantly different.

The outcome's interpretation: Since the pupils at both institutions are in the same academic year and have had equal exposure to mathematical material so far, it stands to reason that there would be little to no difference between the two in terms of the mathematical courses they take. Female students' levels of intuitive thinking may have converged at the two institutions because of the similarities in their educational experiences and study environments.

Fifth: Testing the third hypothesis

“There are no statistically significant differences between the average scores of female students in the two schools in the level of mathematical proficiency.”

To verify this hypothesis, the researcher used the t-test for two independent samples to detect differences between the average scores of female students in the two schools on the mathematical proficiency test.

Table (7)

Connotation	Tabular value	Calculated T value	Standard deviation	Arithmetic average	Number	School
Non-functional	1,976	1,3	4,51	30,91	75	Medium rose fragrance
			4,89	29,85	75	Intermediate planets

T-test results for two independent samples on mathematical proficiency by school

The average grade for girls attending Itr Al-Ward Intermediate School was 30.91, as shown in Table 7, while the average grade for girls attending Al-Kawakib Intermediate School was 29.85. A tabulated T-value of 1.976 at a significance level of 0.05 and 148 degrees of freedom is more than the computed T-value of 1.39.

Conclusion Regarding Third Hypothesis: There is no statistically significant difference between the two means since the computed T-value is less than the tabulated T-value. So, we accept the third null hypothesis, which states that the average mathematical skill of female students at the two institutions is not significantly different.

The outcome's interpretation: Female students' exposure to similar educational environments, curriculum, and mathematical learning experiences at both institutions likely explains why there are no statistically significant disparities in their mathematical aptitude. Girls' performance in arithmetic may converge in a few key areas if their ages and academic backgrounds are comparable.

Sixth: Discussing the results in general

Based on the findings of this study, female students in the second intermediate grade demonstrate a respectable degree of mathematical competency and intuitive thinking. This is because mathematics education encompasses more than just teaching students how to add and subtract numbers; it also involves teaching them to recognize and make sense of a variety of patterns, relationships, concepts, and strategies. These experiences are more prevalent among female students. There was a positive association between intuitive thinking and mathematical competence in the findings as well, suggesting that the student's capacity to identify mathematical links and establish initial expectations is related to her efficiency in handling mathematical circumstances. Intuitive thinking is a way of thinking that may help create mathematical knowledge, expectancies, and reasoning in mathematical circumstances. This conclusion is in line with the current research's theoretical notion of this style of thinking. Convergence in academic stage, curriculum, and educational experiences, as well as convergence in general learning circumstances, explains why there are no significant differences between the two schools in the two variables. (Kilpatrick et al., 2001; Fischbein, 1987)

Seventh: Conclusions

In light of the results of the current research, the following can be concluded:

- Female students in the second intermediate year have a level of intuitive thinking higher than the theoretical mean of the intuitive thinking scale.
- The students in the second intermediate grade have a level of mathematical proficiency higher than the theoretical mean of the test.
- There is a positive correlation between intuitive thinking and mathematical proficiency.
- There are no statistically significant differences between female students in the two schools in the level of intuitive thinking.
- There are no statistically significant differences between female students in the two schools in the level of mathematical proficiency.
- Productive tendency ranked first among the components of mathematical proficiency, while adaptive reasoning came last according to the reported data.

Eighth: Recommendations

In light of the previous results, the researcher recommends the following:

- Paying attention to developing intuitive thinking among middle school students through various mathematical situations.
- Encouraging students to make guesses and mathematical predictions before starting the detailed solution.
- Training female students to discover mathematical patterns and relationships.
- Paying attention to developing the components of mathematical proficiency in an integrated manner.

- Focus on adaptive reasoning and strategic competence, because of their importance in interpreting solutions and choosing appropriate strategies.
- Teaching mathematics should not be limited to memorization and direct application of the rules.
- Encouraging students to explain their answers and justify the steps for the solution.
- Providing classroom situations that allow students to discuss mathematics and present more than one solution method.

Ninth: Suggestions for Further Research

To complement the current research, the researcher proposes to conduct the following studies:

- An experimental study to reveal the effect of an educational program based on intuitive thinking on developing mathematical proficiency.
- Studying the relationship between intuitive thinking and creative thinking among middle school students.
- Study the relationship between intuitive thinking and solving mathematical problems.
- Conduct a similar study on other educational levels.
- Conduct a comparative study between males and females regarding intuitive thinking and mathematical proficiency.
- Studying the impact of modern teaching strategies on developing the components of mathematical proficiency.
- Preparing training programs for mathematics teachers to employ intuitive thinking in teaching mathematics.

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