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Analytical thinking and its realtion ship to the twenty_first century skills among female secondary school students in mathematics

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Abstract
The aim of the current research is to identify the nature of the correlation realtion between analytical thinking and twenty-first century skills among secondary school female students in the Salah al-Din Education Directorate / Dujail Education Department
To achieve this, the following null hypotheses were formulated:

1. There are no statistically significant differences at significance level (0.05) between the mean of the actual performance and the hypothetical performance of the third-grade intermediate students in the analytical thinking test.
2. There are no statistically significant differences at significance level (0.05) between the mean of the actual performance and the hypothetical performance among the third intermediate grade femalestudents in the twenty-first century skills test and scale
3. There is no statistically significant correlation at the significance level (0.05) between analytical thinking and the twenty-first century skills among third-grade intermediate female students in mathematics.
The research sample consisted of (295) female students of the third intermediate grade who were affiliated to middle and secondary schools in the General Directorate of Education of Salah al-Din / Department of Education of Dujail.
For the research developed two to collect the data as follows
: 1- Analytical thinking test: in its final form, where it consists of (20) test itemsfor 21_century skills test (the skill of learning and creativity): the test may consist of (14) items.
2- Scale of twenty-first skills (digital culture skill, media culture, profession and life skill): The scale consists of (30) items.
The appropriate statistical analyzes were conducted using the spss statistical analysis program the results obtained indicated that
There is a positive, good and direct correlation between analytical thinking and twenty-first century skills among third-grade intermediate female students in mathematics.

Keywords: Analytical thinking, twenty-first century skills, high school

chapter one
First: the research problem
In order to get a holistic picture of analytical thinking It requires learners to research analytical thinking, which is one of the thinking patterns, which is no less important than the rest of the other thinking patterns.
The control of the problems that students face is based on a system of interrelated thinking processes Understanding the differences between them is the key to success
So that students become productive members of society It requires them to be familiar with analytical thinking, as this society needs an infrastructure Which, in turn, needs students who are able to establish mental awareness of their methods of possessing analytical thinking and skills Making the right decisions and solving problems based on experiences, information, opinions and facts. The study conducted by (Al-Saadi, 2013) indicated that analytical thinking provides the learner with an opportunity to increase his analytical ability with rational thinking and reach new results that go beyond traditional patterns (Al-Saadi, 2013-14).

Where,, Analytical thinking is the learner's ability to identify the idea or problem And dismantling it into its elements and partial components, and organizing the information necessary to make a decision or issue a judgment
And building a standard for the purpose of evaluation and deduction In addition to that, analytical thinking was considered one of the most important basic steps associated with a number of other more complex thinking processes, such as (critical thinking, creative thinking, problem solving and decision-making),

Thus, the technological revolution poses an important challenge, which is the preparation of educated people with high capabilities in terms of using computers, solving problems and making decisions. One of these challenges is the provision of analytical thinking skills and the 21_century skills in our curricula and training of learners on them. To keep pace with other countries and curricula in development and progress,
Thus, the researchers saw that it is possible to define the problem of the current research by answering the following question:
What is the nature of the correlation between analytical thinking and twenty-first century skills among female secondary school students in mathematics?

Second, the importance of research:
The importance of the current research is evident in the importance of its variables, namely, analytical thinking and skills of the twenty-first century. The importance of research can be determined in two main aspects:

First, the theoretical importance
The theoretical significance is as follows:
1- Identifying one of thinking types , which is analytical thinking, and its relationship to the skills of the twenty-first century.

2- Identifying the nature of the correlation between analytical thinking and the 21_century skills for female secondary school students in mathematics.

3- The current research may help in guiding researchers towards Interest in studying the 21_century skills in research and other studies and at different age stages
Second, the practical importance
1- Ensuring that secondary school students in the General Directorate of Salah al-Din Education / Dujail Department possess analytical thinking, which is one of the higher levels of thinking and which has become one of the main objectives of teaching mathematics in various countries of the world.
2- Ensuring that female students in the secondary stage in the General Directorate of Salah al-Din Education possess the skills of the twenty-first century.

3- Researchers can benefit from the analytical thinking test and the twenty-first century skills test and scale for secondary school female students in mathematics

Fourthly : research hypotheses
1. There are no statistically significant differences at significance level (0.05) between the mean of the actual performance and the hypothetical performance of the third-grade intermediate students in the analytical thinking test.
2. There are no statistically significant differences at significance level (0.05) between the mean of the actual performance and the hypothetical performance among the third intermediate grade students in the twenty-first century skills test and scale
3. There is no statistically significant correlation at the significance level (0.05) between analytical thinking and the twenty-first century skills among third-grade intermediate students in mathematics.

Fifthly: Research limitations
The current research procedures were determined by a set of the following limits:-
1- The human limit: the third intermediate grade female students in mathematics.

2- Spatial boundary: the General Directorate of Education of Salah al-Din / Department of Education of Dujail.

3- Time limit: The first course for the academic year 2022-2021.

4. Objective limit:

The current research is limited to addressing the two variables: Analytical thinking, which included the following skills (observation skill, measurement skill, part-to-whole relationship skill, order and sequence skill, cause and effect skill) Twenty-first century skills that included (critical thinking, creative thinking, problem solving, communication, digital culture, technological culture, initiative and orientation, flexibility and adaptation, production)

Sixth: Define terms :

1- Analytical thinking:

He (1988, Gregory) defines it as a pattern of thinking represented by students' ability to confront the problems they are exposed to by dividing them into its parts on a regular basis , good planning and take care about details before making a decision and being able to collect the bigger value of information and the ability to clarify things and reach distinctive conclusions through facts and information (Gregory , 1989 : 101)

The researchers adopted the definition of (1988, Gregory) as a theoretical definition adopted in her research.

The researchers define it procedurally: as a mental activity represented by the ability of the third-grade intermediate students in the General Directorate of Salah al-Din Education / Dujail Education Department to analyze the subject Or the satiuation in mathematics, Its amount is identified by answering the analytical thinking test items prepared for them.

2- Twenty-first century skills (partnership for 21st century) defines it as They are the necessary skills that students need to succeed in school, work, and life.(p21 ,2009 : 1)

The researchers adopted the definition of the partnership organization for the 21_century skills as a theoretical definition adopted in its research, and the researchers know it procedurally.

These are the skills that the third intermediate grade students in the General Directorate of Salah al-Din Education / Dujail Education Department need to succeed in school, work and life, and they are represented in the areas (learning and creativity, digital culture, life and career skills

It is measured by the degree they obtain for their response to the test items and the twenty-first century skills scale prepared for the purposes of the current research.

Second chapter :

The first theme : theoretical background

First: Analytical thinking

(Harrison, A., & Bramson, 1982) sees it as the learner's ability to confront problems with caution in a systematic way and attention to detail Plan carefully before making a decision. In addition to collect information as much as possible, so that he can reach rational conclusions from the facts he knows (122: Harrison, A., & Bramson, 198).

Analytical thinking can be viewed as a mental process, which means a series of activities directed towards a specific goal or a series of changes that take a specific form.

And if we look at analytical thinking from this angle, we find that it represents one of the basic stages or steps related to a number of more complex thinking processes such as coordination thinking, critical thinking, problem solving, decision-making, scientific thinking, systemic thinking, and creative problem solving (Abdul Hamid, 1987:121),

As (Richard, 2006) pointed out that analytical thinking is the individual's ability to analyze information , deduce conclusions from the ideas and information available to him Through the relationship between this information, leading to logical conclusions, which in turn work to solve problems (Richard, 2006: 12)

and we can refer to analytical thinking that it is an organized mental process, and the process is defined in the framework of psychology as a series of activities directed towards a specific goal or a series of changes that can take a specific form.

When looking at analytical thinking from this point of view, we find that it represents one of the basic stages associated with a number of other, more complex thinking processes, such as Structural thinking, creative thinking, critical thinking, systemic and coordination thinking, and synthetic thinking (Amer, 2007: 15).

Analytical thinking skills

After the researchers reviewed a number of research studies, sources and literature that included analytical thinking, As I found a difference between specialists and researchers in their identification of analytical thinking skills, so the researchers decided to rely on the skills that he developed (Sternberg, 2003),

Indicators have been developed for each skill to serve as a basis for building the twenty-first century skills test, as shown in the following table:-

Table (1) Analytical thinking skills that will be adopted by researchers(

No	Name of skills	Indicators of skill
1	Observation skill	The ability to analyze and choose the characteristics, tools, and procedures that are appropriate to solve the problem situation. The learner's ability to organize information in his memory by observing mathematical problems. The learner's ability to draw geometric shapes The learner's knowledge of the details of geometric patterns and shapes through learner observation Which helps him to be able to gather information
2	Measurement skill	1-The learner's ability to analyze and segment the problem to reach an appropriate and organized solution to the difficult or complex problem situation. 2-The learner's ability to distinguish between the important parts of the problem and use the laws to reach an accurate solution. 3-- The ability of the learner to find the measurement of lengths of sides and angles. 4-- The learner's ability to determine the mathematical relationships between familiar items or similar images in new situations, that is, demonstrating a problem-solving or creative production.
3	The skill of determining cause and effect	The ability of the learner to give multiple reasons and justifications That stands behind the different ideas and opinions by collecting evidence that is related to the causes of the problem The ability of the learner to determine the causal relationships between things and their causes. The ability of the learner to solve mathematical operations and give reasons that show one thing as a reason for the occurrence of the other. The ability of the learner to use the mental process and how one thing can be a cause of the occurrence of the other
4	Sorting and sequencing skill	1-The learner's ability to collect and organize information and raise concepts or things that are related to each other in one way or another in a sequential format according to a specific criterion. 2-The ability to arrange arithmetic operations and data in order of priority. The ability of the learner to arrange and sequence or find the first terms of the sequence in a sequential manner - The ability to put events, information and things in a specific order, according to (quantity, type, style).
5	Part-to-whole skill	1-The learner's ability to understand the relationship and what could happen to the whole if part of it was lost or replaced. 2-The ability of the learner to analyze the component parts of each carefully. 3-The ability of the learner to determine the relationship between the component parts of the whole. 4-Enable the learner to achieve a deep understanding of the mathematical problem

(the table was made by researchers)

Second: Twenty-first century skills

The requirements of the twenty-first century require individuals to master a set of skills, and are based on a set of pillars, The term twenty-first century skills is often used to define what students are supposed to know, and what they can do, so that they can engage in the labor market and make decisions in the modern world. Proponents of this idea believe that curricula should be more concerned with what students can do with knowledge, and not merely with knowledge acquisition for the requirements of twenty-first century education. (Sheikh al-Eid, 2019: 26)

After the researchers reviewed many studies, research and literature that dealt with the skills of the twenty-first century, The researchers considered that the skills developed by the Partnership for Twenty-first Century Skills should be adopted as a basis for building a test and measure of twenty-first century skills, which are as follows:-

First: Learning and Innovation Skills

These are the skills that develop learners' abilities for professional and personal success in the twenty-first century. They are the keys to the doors of lifelong learning and innovative learning. The global economy of the twenty-first century requires high levels of imagination, innovation and creativity in order to invent new services and products.These skills are:-

• Creativity and innovation skills.
• Critical thinking and problem solving skills
. • Communication and collaboration skills.(Trilling & Fadel, 2009: 47)

Second: Information technology and media skills (digital culture):

Information, Media and Technology Skills: The following are the skills as mentioned by (Al-Tobi and Al-Fawair, 2016):

• Information culture skills.
• Media culture skill.
• ICT culture skills. (Al-Toubi and Al-Fawair, 2016: 5)

Third: Life and Career Skills

It is intended to develop the learner's skills to become self-directed, independent and able to adapt to change, project management, Taking responsibility and leading others to reach results. This group consists of the following main skills as mentioned by (Kivunja, 2015)

• Flexibility and adaptability skills.
• Initiative and self-directed skills.
• Social and cross-cultural skills.
• Productivity and accountability skills.
• Leadership skills and responsibility. (Kivunja,2015: 30)

The third chapter :

Search procedures :

The researchers followed a set of procedures that include (determining the curriculum, the research community, and choosing the research sample).

And then building the two research tools (the Analytical Thinking Test Tool, and the Twenty-First Century Skills Test Tool and Scale).

Firstly, the research method:

The descriptive approach was adopted, because it is the most appropriate approach in studying the correlation relationships between variables and revealing the differences between them.

Secondly, the research community:

The current research community is represented by all third-grade intermediate school students who study in public middle and secondary schools that are affiliated to the General Directorate of Education of Salah al-Din / Department of Education of Dujail District in Salah al-Din Governorate for the academic year (2022-2021),

Where the total number of female students reached (1131), distributed among (30) middle and secondary schools.Table (3) shows the distribution of third-grade intermediate school female students in the General Directorate of Salah al-Din Education / Dujail District Education

Third: the research sample :

The sample of the current research was (295) female students of the third intermediate grade.

Fourth: search tools :

The research includes two tools which are the Analytical Thinking Test and the Twenty-first Century Skills Test and Scale as follows:-

1. The purpose of the test has been determined
2. The theoretical concept of analytical thinking is defined.
3. Analytical thinking skills are identified.
4. Analytical thinking skills were demonstrated to the arbitrators
5. formulation of the test items :

The test items were determined for it, and the total test consisted of (20) items, with (12) items of the type of objective questions multiple-choice, and (8) essay questions and for each skill (4 items).

6. Presentation of the test items:

The test paragraphs were presented to a group of arbitrators and specialists in the field of mathematics and its teaching methods.

7. The researchers prepared the instructions for the test.

. 8. The test was applied to an exploratory sample of (120) female students from the third intermediate grade.

9. Answer Keys are set for the typical answer of the test items.

10. Appropriate statistical analyzes were conducted, such as (calculating the difficulty, ease, discrimination and effectiveness of alternatives).

11. Test validity (face validity , construction validity)

The researchers presented the paragraphs of the analytical thinking skills test to a group of arbitrators specializing in mathematics and its teaching methods, and some paragraphs were modified, and then the test has a face validity

2. The validity of the construction:-

The following has been verified: -

The correlation coefficient of the score of each item regard the total test score.

The correlation value ranged between (0.23-0.78).

Paragraph correlation coefficient regard the skill to which it belongs.

The correlation coefficients ranged between (0.35-0.93).

- Pearson correlation coefficient between each skill and the total score of the test.

The correlation coefficients range between (0.68-0.88)

So, all correlations are good because they are within the required range.

12. Reliability

The equation (Alpha Cronbach) was calculated to calculate reliabilitycoefficient or the internal homogeneity of the test items, as its value reached (0.84), which is a good percentage, so the test is ready for application.

The second tool:

Twenty-first century skills test and scale

1. The objective of the Twenty-first Century Skills Test and Scale has been establishe.
2. Twenty-first century skills identified.
3. The 21_century skills were presented to arbitrators and specialists.
4. The test and scale items for twenty-first century skills have been formulated.
   The researchers prepared (14) paragraphs of the two types, thematic number (6) and the article paragraphs (8) paragraphs, as the paragraphs of the total test amounted to (14) paragraphs, while the paragraphs of the scale amounted to (30) paragraphs.

5. The two researchers prepared special instructions for testing and 21_century skills.
6. An exemplary answer has been developed for the test and scale items that were adopted in the correction.
7. Presenting the test and scale items to arbitrators and specialists.
8. Statistical analyzes of the test were conducted and the (difficulty, ease, effectiveness of alternatives and discrimination coefficient) were calculated, as well as calculating the discriminatory power of the scale items using a t-test for each item, and the results were all significant.
9. validity: The researchers used two types of validity :
- face validity : the test and scale items were presented to a group of arbitrators and specialists, opinions were taken and some items were modified.
- Construction validity: - The Pearson correlation coefficient was extracted for the test and scale items, as all the coefficients were good and within the permissible range.
10. reliability :
The equation (Alpha Cronbach) was calculated to calculate the reliability coefficient or internal homogeneity of the test items and the scale, as its value reached (0.72) for the test items, while the reliability of the scale items was (93), which are good ratios, so the test and scale are ready for application.

Sixth: - Statistical means of interpreting the results:
The appropriate statistical means were used to search, including arithmetic means, standard deviations, t-test and the Pearson correlation coefficient equation.

The fourth chapter
First: present and Interpret the Results:
In this chapter, we present the results reached by the researchers, their analysis, discussion and interpretation. According to the objectives of the research mentioned, and to identify the nature and direction of that correlation relationship, the recommendations and suggestions that resulted from the current research are also presented.
Results related to the research hypotheses:
The first axis:
the results related to analytical thinking In order to identify the results related to the analytical thinking test among third-grade intermediate students in mathematics, the following null hypothesis was tested:
1. There are no statistically significant differences at significance level (0.05) between the mean of the actual performance and the hypothetical performance of the third-grade intermediate students in the analytical thinking test.
The researchers relied on the t-test for one sample in order to verify the validity of the hypothesis. The results indicated that the arithmetic mean of the actual performance of the students' scores was (26.420) and the hypothetical average was (21), By comparing the real and hypothetical averages between them, we see that the difference between them, we see that the actual mean is higher than the hypothetical mean, This means that the students possess analytical thinking, and to confirm this, the value of the t-test was extracted (11.541) at the significance level (0.00), which is less than the approved significance level (0.05), Therefore, we reject the null hypothesis and accept the alternative hypothesis, and this indicates that the difference is statistically significant between the true mean and the hypothetical mean and in favor of the actual mean,
This means that third grade intermediate female students have analytical thinking skills because the actual mean is statistically significant, as in Table (2)

Table (2) The T-test to measure the difference between the average actual performance and the average hypothetical performance of the female students for analytical thinking

Group	Arithmetic mean	Standard deviation	t-test	Significant level	Significance
Actual mean	26.420	8.067	11.541	0.000	Significant
Hypothetical mean	21				

The reason for this result may be attributed to the fact that the content of mathematics curricula for the intermediate stages includes activities, problems and exercises of higher levels.

It makes the students able to analyze and divide mathematical problem situations into their sub-parts, and to realize and understand the relationships between these parts and their ability to use classification and observation.
Finding solutions and evaluating them by passing judgment on them.
And reaching generalizations through these results and applying them in other situations that they are exposed to in their daily lives. In addition to the tendency and approval of most male and female teachers to use good teaching methods, which aim at developing students' thinking, as well as the accuracy of students in answering the analytical thinking test presented to them.

The second axis: the results related to testing and 21_century skills

. There are no statistically significant differences at significance level (0.05) between the mean of the actual performance and the hypothetical performance among the third intermediate grade students in the twenty-first century skills test and scale
The researchers adopted the t-test for one sample to test the validity of the hypothesis and reach the results, as the real arithmetic mean of the students in the twenty-first century skills variable was (83.617) and the hypothetical average reached (65) and by comparing the real and hypothetical averages, it becomes clear that the value of The t-test is (10.097) at the significance level (00.00), which is less than the approved significance level (0.05),
Therefore, we reject the null hypothesis and accept the alternative hypothesis, meaning that there are statistically significant differences in favor of the higher mean.
Therefore, we reject the null hypothesis and accept the alternative hypothesis, meaning that there are statistically significant differences in favor of the higher mean. That is, the difference is statistically significant between the actual mean and the hypothetical mean and in favor of the real mean. This indicates that the third-grade intermediate students in the General Directorate of Salah al-Din Education (Dujail District) possess the skills of the twenty-first century, as shown in Table (3).

Table (3) : The T-test to measure the difference between the actual performanceaverage and hypothetical performance average of the female students for the test &scale for 21_ century skills

Group	Arithmetic mean	Standard deviation	t-test	Significant level	Significance
Actual mean	83.617	31.669	10.097	0.000	Significant
Hypothetical mean	65				

The researchers believe that this result, which indicates that third-grade intermediate students possess the skills of the twenty-first century, may be due to the development in mathematics curricula for the previous stages, which keep pace with the developments and requirements of the current era, as it contains topics that require interpretation, conclusion, deduction and making the right decision.
In addition, it includes creative thinking skills in many sections of the current curricula, including (the life issues section think section, write section, and discover the error section). All of these topics require thinking at high levels, including creative thinking. In addition to including other topics in the mathematics curricula, including those related to solving mathematical problems, and others that include solutions based on previous topics in mathematics and this is called (mathematical communication), The curricula also include community mathematics, that is, the use of mathematics in the fields of life and other sciences. All of the above are among the skills of the twenty-first century, so we see that the third-grade students in the middle class possess these skills

The third axis: the results related to the correlation between analytical thinking and 21_ century skills

3. There is no statistically significant correlation at the significance level (0.05) between analytical thinking and the twenty-first century skills among third-grade intermediate students in mathematics
The researchers adopted the Pearson correlation coefficient to verify the hypothesis, and it became clear that the true arithmetic mean degree of analytical thinking reached (26.420) and with a standard deviation of (8.067), while the degree of the true mean of the 21_century skills was (83,617) and standard deviation (31.669), In order to find out the relationship between the research variables, the researchers used the

Pearson correlation coefficient, as the value of the correlation coefficient was (0.580**) () at the significance level (0.000), which is less than the approved significance level (0.05), Therefore, we reject the null hypothesis and accept the alternative hypothesis which states that there is a correlation between analytical thinking and twenty-first century skills, Through the results, it is statistically significant and indicates a good positive correlation, because the value of the correlation coefficient is confined between (1-0) and whenever the value approaches (1), the correlation coefficient is strong. This indicates the existence of a positive correlation between analytical thinking and the 21_century skills among female students of the third intermediate grade in mathematics. That is, any increase in their possession of analytical thinking will be accompanied by an increase in their possession of twenty-first century skills and vice versa. That is, with the increase in the skills of the twenty-first century, their analytical thinking increases, and Table (4) shows this:-.

Table (4) Pearson's correlation coefficient between female students' analytical thinking and twenty-first century skills

Variables	Arithmetic mean	Standard deviation	t-test	Significant level	Significance
Analytical thinking	26.420	8.067	0.580**	0.000	Significant
21_century skills	83.617	31.669			

The previous results are interpreted as follows:

The reason for this positive result may be attributed to what the mathematics curriculum for the third intermediate grade and the previous intermediate stages contains topics that require analytical thinking skills, including: Analyzing mathematical problems and life situations represented by mathematical problems, as it is used in understanding and solving them to a logical arrangement and measurement, As well as the link of sub-topics to reach new knowledge by linking the whole to the parts, as well as containing the knowledge of the correct solution and verification of the solution i.e. giving a judgment about the reasonableness of results by cause and effect, The curricula also contain the skills of the twenty-first century, as we see that mathematics topics in the new curricula contain sections such as (think, write ,numerical sense , discover error) and all of these require critical thinking, creative thinking and solving mathematical problems, It also contains topics that link mathematics with other sciences and some life issues that use the language of mathematics to solve and understand This is called mathematical culture, as well as the use of the language of numbers in mathematical puzzles.

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* * significance at the 0.01 . significance level

Second: Conclusions:

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

1) The third-grade intermediate students possess analytical thinking skills.
2) third intermediate grade female students have 21_ century skills
3) There is a positive, good and direct correlation between analytical thinking and 21_ century skills among female third-grade intermediate students in mathematics.
4) There is a positive, direct and good correlation between each of the analytical thinking skills and the sub-skills of the twenty-first century skills for the third intermediate grade female students in mathematics

Third: Recommendations:

Through the results they reached in the current research, the researchers recommend the following:

1) Directing the concerned authorities in the curricula to include the mathematics curricula on analytical thinking skills
2) Providing mathematical activities that develop analytical thinking skills as well as skills of the twenty-first century.
3) Training the female students to use analytical thinking in solving mathematical problems.
4) conduct seminars and social workshops for teaching staff and guiding them to use the skills of analytical thinking in the daily school activities.

Fourth: Proposals:

In light of the results obtained in the current research, the researchers suggested the following proposals:

1) Conducting similar research on other school stages and knowing the extent to which they possess analytical thinking and the skills of the twenty-first century.
2) 2) Conducting research that searches for the correlation between analytical thinking and other variables.
3) Conducting research that links twenty-first century skills with other types of thinking.
4) Making analytical thinking and twenty-first century skills an important input and basis in the process of teaching and learning mathematics.
5) Conducting programs that develop analytical thinking and twenty-first century skills among middle school students and focus on mental abilities in facing the mathematical problems they face in their daily lives.

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