Thinking Skills and Achievement in Mathematics in Ninth Grade Students in Jordan an Empirical Study

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ABSTRACT

This research aims at studying the relationship between achievement in mathematics and thinking skills of a (250) ninth-grade students (males and females) sample of public schools in Jordan, The research is based on the hypothesis that there are many reasons for the low achievement in mathematics, which has an effect of the students' performance on thinking skills scale, the research tried to answer the following question: Are there any differences between males and females in the level of achievement in mathematics and in on Thinking skills level performance? After testing the hypothesis and the sub hypotheses:

1. There is a positive correlation between achievement in mathematics and performance on Thinking skills.
2. There is a correlation between sex variable (male, female) in the level of achievement in mathematics and at the overall performance level on the thinking skills.
3. There is an impact on the level of achievement in mathematics (high, medium, weak) and the level of performance is on the thinking skills scale.

Keywords

Mathematical thinking, Achievements

Introduction:

Mental performance generally consists of a set of components, cognitive units, and cognitive processes understanding any information that is appropriate to images, symbols, and rules, and individual differences between people in this area due to the richness or poverty of their images, symbols, and rules within their cognitive units and their rules which is a Motivation in cognitive

Literature review:

Benidiktus and et. al, (2017) found a relationship between higher-order thinking skills and Students' great point average with a high level of higher-order thinking skills are expected to succeed in their next study in the study program of mathematics education. Students who have higher order thinking skills tend to get a high great point average in mathematics instruction. Human thinking skills can be classified into two major groups low order thinking skills and higher order thinking skills. The first three levels of bloom's taxonomy are the low order thinking is, which are remembering, understanding, and applying. Where higher-order thinking skills are the last three levels of bloom's taxonomy analyzing, evaluating, and creating. Moore & Stanley, (2010). Thinking skills in general are fundamental aspects of the educational process. A person's thoughts can affect the ability, speed, and effectiveness of learning. Therefore, thinking skills are associated with the learning process. Students who are trained to think to have a positive impact on the development of their education. Students with thinking skills could learn and for better performance. Yee, Othman, Yuns, Tee, Hasan, and Mohammad, (2011). Thinking skills are the ability to think that not only the ability to remember but also higher capabilities of thinking students with higher-order thinking skills activated when students are faced with an unfamiliar situation such as problems, uncertainties, questions, or dilemmas King, F. J., Goodson, L., & Rohani, F. (2013).

Thinking skills are valued and must be enhanced because they're believed to organize students better for the challenges both in advanced academic life and add the longer term and responsibility on day to day Pogrow (2005). Therefore, thinking skills are often wont to predict a student's level of success. Students who have an honest level of upper order thinking skills are expected to achieve their studies later and in their life generally.

Many researchers work to enhance students' thinking skills in their countries like in Singapore research on open-ended problems for higher order thinking in mathematics was conducted by Foong, (2000). Murray examines the implementation of thinking skills in secondary school mathematics classrooms in Georgia, (Murray,2011)). Furthermore, other studies investigate the connection between thinking skills and students 'academic performance. While in Malaysia research on higher-order thinking via mathematical problem posing tasks among engineering students was conducted by Ghasempour, Kashefi, Bakar, and Miri,(2012), Yee et al.(2011), students should be assisted to accumulate thinking skills either through the traditional teaching and learning environment or a self-instructional, individualized manual, (Ramos, Dolipas, and Vilamor (2013)) examined the relationship between Higher order thinking skills and academic performance in physics at the college level students, and he concluded that thinking skills level, comparison, analysis, and evaluation significantly influence the physics achievements of male students, while the Higher order thinking skills level on analysis, inference, and evaluation significantly influence the physics performance of a female student. Ramos et al. (2013), stated that thinking skills like creative and important thinking, analysis, problem-solving, and visualization. and skills involve arranging items, comparing, and composing

ideas and theories, and the ability to interpret and solve the problem. In the classroom, abilities, and skills that include the utilization of thinking skills are complex thinking that goes beyond basic recall of fact, like evaluation and invention, enabling students to retain information and to apply a problem-solving solution to real-world problems.

There are three main components in thinking skills i.e. critical thinking skills, thinking design, and systems thinking which are like the design thinking skills proposed by Wang and Wang (2011). There are at least two indicators in Thus, there are at least nine items as test instruments used to measure Higher order thinking skills. of students in mathematics instruction because the instrument has acceptable validity and reliability Tanujaya (2016).

Research Problem:

The weakness of students in our schools, in thinking skills in general and solving mathematical problem skills. Students Bad attitude towards the mathematics of most the students may be one of the most important reasons why they have low mathematics achievements, therefore psychologists and educators emphasize the importance of forming positive trends towards all subjects, especially mathematics because mathematics has a large role in having an important set of cognitive mental skills, the researchers believe that the main goal of teaching mathematics is to learn how to solve problems and since mathematics is the best tool for solving problems, this is why the main goal of teaching mathematics is to develop the students' problem-solving ability and, thinking skills. Since math-related thinking skills are a key to problem-solving skills they must be key skills mastered by students, therefore employed in other aspects and areas. Thus, the research problem is reflected in the student's low achievement in mathematics has led to a decrease in his ability to use thinking skills. And the research will try to answer the following question, is there a correlation between achievement in mathematics and performance on the thinking skills scale of the students in the ninth-grade students?

Research importance

1. Determine the relationship between mathematics achievement and thinking skills (mutual impact) contributes to increased interest in teaching mathematics and focusing on the mental processes of a mathematical nature.
2. Student's learning of thinking skills related to mathematics learning and contributes to conveying what the student has learned and experimenting within the field of his social life and proving his ideas on a scientific basis by understanding the basic components of each subject. to be able to prove and confirm it appropriately.
3. This research is one of the few types of research in the field of cognitive psychology, where there are few studies in this area.

Aim of the Study:

This study aims to study:

1. The relationship between the level of achievement (high, medium, Low) in mathematics and, the level of performance on the thinking skills scale of the sample as a whole and males and females separately.
2. The effect of the sex variable (male, female) in mathematics achievements and Performance level on the thinking skills scale.
3. suggest several proposals considering the research findings.

Research hypotheses:

1. There is a correlation between the level of achievement (high, medium, low) in mathematics and the level of performance on the mathematics related to thinking skills scale (analysis, abbreviation, composing, solution production, distinction comparison, flexibility, conclusion, decision-making, expansion, proof, generalization).
2. There is a significant difference in the level of achievement between males and females in mathematics and in the level of performance on the scale of associated to thinking skills mathematics (analysis, abbreviation, composing, solution production, distinction, comparison, Flexibility, conclusion, decision-making, expansion, proof, generalization.

Research methodology:

The research adopts the descriptive-analytical approach, considering that descriptive research is important in the fields of psychological and social study, it informs the important relationships between different phenomena, explains the meaning of data, provides researchers with useful and valuable information, has to understand the problem, its causes and suggest a solution for further studies. The following concepts which will be defined are going to be measured in this research**.**

a) Procedural definitions which are measured and tested the performance on the scale used in the current study.

1. **Achievement grade:** Low achievement score (low) in mathematics, these grades are between (0-4). Moderate achievement degrees (medium) these grades are between (5-7) grades. High achievement score (high) in mathematics: these grades are between (8-10) grades.
2. **Math Achievement Measure:** A Collection of Exercises Selected from the ninth Grade Book issued by the Jordanian Ministry of Education.
3. **Analysis skill**: The ability to analyze a subject into its parts and find the relationships between these parts. Fragmentation of information into elements that can be dealt with, in parts Real and perceived parts.
4. **Abbreviation skill:** The ability to choose a set of important ideas as an alternative to the topic.
5. **Composing (Connecting) skill:** the ability to reconnect and shorten the parts analyzed in a new way, which was measured by the sub-degree obtained by the examiner in his performance
6. **Producing solutions skill:** the ability to produce the greatest number of alternatives and solutions to any problem.
7. **Distinction skill**: the ability to identify the differences between the solutions chosen**.**

8. **Comparison skill:** The ability to identify the similarities and differences between the solutions chosen,
9. **Flexibility skill:** The ability to see the solution from different angles, prospects, and points of view.
10. **Inference skill**: The ability to reach a specific result, out of many results and outcomes solution, which facilitates the process of dealing with the problem.
11. **Comparison:** Identifying similarities and differences between existing information,
12. **Decision-making skill:** The ability to choose the appropriate alternative to start implementing it to solve the problem
13. **Expansion skill:** the ability to convert the shortcuts that are chosen to solve the issue on a set of words and relationships and try to apply them on a larger scale.
14. **Proof skill:** The ability to prove an idea by using a well-established decision or a fact,
15. **Generalization skill:** the ability to extract a general rule, judgment, or adjective from an information set and apply it to a new case which has been measured to the sb-degree obtained by the tester in his performance on the scale used in the current study

Study limitation:

The research was conducted on a random sample of males and females of ninth-grade students at public schools in Jordan, for the academic year 2018/2019.At the beginning of the first semester.

Research methodology:

Research tools:

1. The thinking skills scale prepared by the researcher was used based on Kurt's thinking education program For Thought Education by Edward de Bono, author of (12) Performance Question for each of the following skills: (analysis, abbreviation, Composing, solution production, distinction, comparison, flexibility, conclusion, decision-making, expansion, proof, generalization) each skill (10) levels.
2. The exam was applied to a sample of (50) students of ninth grade in the academic year 2018/2019. from different schools. Where a delayed exam applied was applied to the same sample after 15 days, to assure stability and reliabilities. the stability factor was (0.74) the Internal stability factor and (.0.86), the Internal consistency transactions were as in table (1) Where we note that the overall degree of the scale has been associated with these skills scales with correlation coefficients Statistically significant.

Table (1)
Internal consistency coefficients thinking skills test

	Analysis	Abbreviation:	Composing	producing solutions	distinction	Comparison	Flexibility	Inference	Decision	Expansion	Proof	Generalization	Final grade
Analysis	1												
Abbreviation:	0.197	1											
Composing	0.337	0.160	1										
producing solutions	0.518	-0.080	0.479	1									
distinction	0.033	0.230	0.203	0.090	1								
Comparison	0.633	0.300	0.154	0.579	0.271	1							
Flexibility	0.454	0.054	0.373	0.671	0.167	0.366	1						
Inference	0.342	0.002	0.306	0.295	0.170	0.252	0.187	1					
Decision	0.030	0.360	0.201	0.040	0.897	0.324	0.630	-0.07	1				
Expansion	0.171	0.994	-0.180	-0.100	0.352	0.384	0.061	0.14	0.384	1			
Proof	0.617	0.118	0.287	0.359	0.219	0.703	0.666	0.342	0.200	0.118	1		
Generalization	0.567	0.308	0.267	0.471	0.136	0.613	0.526	0.542	0.333	0.299	0.687	1	
Final grade	0.694	0.480	0.457	0.585	0.488	0.766	0.615	0.434	0.534	0.477	0.768	0.792	1

3. A mathematics test (prepared by the researcher and Math teacher in the field) was also used to a representative sample of the exercises and problems of the mathematics textbook of Ninth graders
4. A test was conducted on a sample of (50) students from the ninth grade in the academic year 2018/2019. Where the stability factor was calculated, it was (0.62), and the study of reliability was. (0.78) it was as follows:

Table (2)
Shows differences between groups (high _ weak) in math learning

Low Achievement.	*High Achievement*	t-Test
3.1	8.1	Mean
0.988888889	0.544444444	Variance
10	10	Observations
	0	Hypothesized Mean Difference
	17	df
	12.76884796	t Stat
	1.93461E-10	P(T<=t) one-tail
	1.739606716	t Critical one-tail
	3.86921E-10	P(T<=t) two-tail
	2.109815559	t Critical two-tail

A score out of (10) has been developed as a grade scale for who solve these exercises as follows

Table (3)

Shows achievement levels in mathematics

Level	Excellent	Very high	High	Moderate	Fail (low)
Grade	10	9	7-8	5-6	0-4

Because of the low number of Students in the level of Excellent of achievement and the level of a very high level of achievement, the achievement score in mathematics has been re-ranked in three new levels as in table (4)

Table (4)

Shows the distribution that the researcher has adopted for achievement levels in mathematics

Level	High	Moderate	Fail (low)
Grade	8-10	5-7	0-4

Research sample: A random sample of (250) students, (125) male and 125 females, was selected where sex variable (male, female), and variable achievement level (high, medium, low), as in the following tables:

Table (5).

The distribution of sample members relative to achievement levels was as follows:

High		Moderate		Low	
51		141		58	
Male	Female	Male	Female	Male	Female
20	31	70	71	30	28

Outcomes Analysis and Hypotheses Testing:

The research is based on a basic hypothesis, that there are underlying reasons for low Achievements in mathematics, which is reflected in students' performance in the thinking skills scale measure, To discuss this hypothesis, we begin to discuss the following issues :

1. There is a statistically significant correlation between the score of achievement in a subject Mathematics and the level of thinking skills scale of the research sample.

Table (6)

Correlation between achievement in mathematics and performance on the thinking skills scale

	Correlations	Math scale	Final grade
Math scale	Pearson Correlation	1	0.673**
	Sig. (2-tailed)		0.000
	N	250	250
Grade	Pearson Correlation	0.673**	1
	Sig. (2-tailed)	0.000	0.000
	N	250	250
Analysis skill	Pearson Correlation	0.456**	0.520**
	Sig. (2-tailed)	0.000	0.000
	N	250	250
Abbreviation kill	Correlation Pearson	0.254**	0.508**
	Sig. (2-tailed	0.000	0.000
	N	250	250
Composing	Pearson Correlation	0.390**	0.606**
	Sig. (2-tailed)	0.000	0.000
	N	250	250
Creating solutions	Pearson Correlation Sig.	0.542**	0.677**
	(2-tailed)	0.000	0.000
	N	250	250
Distinction	Pearson Correlation	0.135*	0.459**
	Sig. (2-tailed)	0.037	0.000
	N	250	250
Comparison	Pearson Correlation	0.612**	0.713**
	Sig. (2-tailed)	0.000	0.000
	N	250	250
Flexibility	Pearson Correlation	0.337**	0.467**
	Sig. (2-tailed)	0.000	0.000
	N	250	250
Conclusion	Pearson Correlation	0.388**	0.531**
	Sig. (2-tailed)	0.000	0.000
	N	250	250
Decision making	Pearson Correlation	0.131*	0.455**
	Sig. (2-tailed)	0.042	0.000
	N	250	250
Expanding	Pearson Correlation	0.233**	0.497**
	Sig. (2-tailed)	0.000	0.000
	N	250	250
Proof	Pearson Correlation	0.662**	0.746**
	Sig. (2-tailed)	0.000	0.000
	N	250	250
Generalization	Pearson Correlation	0.541**	0.651**
	Sig. (2-tailed)	0.000	0.000
	N	250	250

. Correlation is significant at the 0.05 level (2-tailed).

****. Correlation is significant at the 0.01 level (2-tailed).***

This table shows that (P< (0.05). which means accepting the hypothesis that there is a correlation between achievement in mathematics and thinking skills.

2. There are statistically significant differences in performance level on the thinking skills scale and the achievement levels in mathematics in the research sample

Table (7)

Shows the standard averages and deviations of the thinking skills scale by achievement levels in mathematics

Math scale		N	Mean	Std. Devi	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
						Lower Bound	Lower Bound		
1.Final Grade	High	51	49.94	10.97	1.567	46.79	53.09	32	67
	Mid	141	43.58	9.34	0.801	42	45.16	28	74
	Low	58	23.21	3.617	0.483	22.25	24.18	14	32
	Total	250	40.14	13.01	0.838	38.49	41.79	14	74
2.Analysis skill	High	51	3.39	1.967	0.281	2.82	3.95	0	7
	Mid	141	2.72	2.128	0.182	2.36	3.08	0	7
	Low	58	0.38	1.105	0.148	0.08	0.67	0	5

	Total	250	2.31	2.192	0.141	2.03	2.59	0	7
3.Abbreviation skill	High	51	3.37	1.679	0.24	2.88	3.85	1	7
	Mid	141	2.51	2.322	0.199	2.11	2.9	0	7
	Low	58	1.63	1.447	0.193	1.24	2.01	0	3
	Total	250	2.48	2.1	0.135	2.21	2.74	0	7
4.Composing skill	High	51	4.9	1.699	0.243	4.41	5.39	2	7
	Mid	141	4.26	1.695	0.145	3.97	4.54	2	7
	Low	58	2.59	1.424	0.19	2.21	2.97	0	6
	Total	250	4	1.823	0.117	3.77	4.23	0	7
5 Creating solutions	High	51	4.9	1.104	0.158	4.58	5.22	3	7
	Mid	141	4.56	1.08	0.093	4.38	4.74	2	7
	Low	58	2.84	1.005	0.134	2.57	3.11	2	5
	Total	250	4.23	1.317	0.085	4.06	4.4	2	7
6 Distinction	High	51	2.65	2.496	0.357	1.94	3.37	0	7
	Mid	141	1.61	2.157	0.185	1.24	1.98	0	7
	Low	58	1.64	1.531	0.205	1.23	2.05	0	5
	Total	250	1.83	2.139	0.138	1.56	2.1	0	7
7 .comparison	High	51	4.96	1.172	0.167	4.62	5.3	3	7
	Mid	141	5.01	1.235	0.106	4.81	5.22	2	7
	Low	58	1.75	1.325	0.177	1.4	2.1	0	5
	Total	250	4.24	1.851	0.119	4.01	4.48	0	7
8.Flexibility	High	51	5.16	1.663	0.238	4.69	5.64	3	8
	Mid	141	4.6	1.575	0.135	4.33	4.86	0	8
	low	58	3.48	1.627	0.105	4.25	4.66	0	8
	Total	250	4.6	1.575	0.135	4.33	4.86	0	8
9 .conclusion	High	51	4.67	1.784	0.255	4.16	5.19	2	7
	Mid	141	4.71	1.461	0.125	4.46	4.95	2	7
	Low	58	2.07	2.557	0.342	1.39	2.76	0	7
	Total	250	4.09	2.138	0.138	3.82	4.36	0	7
8.decision making	High	51	2.61	2.439	0.348	1.91	3.31	0	7
	Mid	141	1.61	2.157	0.185	1.24	1.98	0	7
	Low	58	1.64	1.531	0.205	1.23	2.05	0	5
	Total	250	1.82	2.123	0.137	1.55	2.09	0	7
9. Expanding	High	51	3.22	1.907	0.272	2.68	3.77	0	7
	Mid	141	2.51	2.322	0.199	2.11	2.9	0	7
	Low	58	1.63	1.447	0.193	1.24	2.01	0	3
	Total	250	2.45	2.127	0.137	2.18	2.72	0	7
10.Proof	High	51	5.1	1.514	0.216	4.57	5.43	3	8
	Mid	141	4.82	1.665	0.143	4.53	5.1	0	8
	Low	58	1.61	0.928	0.124	1.36	1.86	0	3
	Total	250	4.05	1.765	0.114	3.83	4.27	0	7
11.Generalization	High	51	5.1	1.195	0.171	4.76	5.45	3	7
	Mid	141	4.82	1.186	0.102	4.48	4.88	2	7
	Low	58	1.96	1.078	0.144	1.68	2.25	0	5
	Total	250	4.19	1.949	0.126	3.94	4.44	0	8

Table(8)

Shows the variance in the thinking skills scale according to the achievement levels in mathematics (ANOVA)

		Sum of Squares	df	Mean Square	F	Sig.
Total Grade	Between Group	22357.848	2	11178.924	145.615	.000
	Within Group	18271.355	247	76.770		
	Total	40629.203	249			
Analysis skill	Between Group	289.520	2	144.760	39.870	.000
	Within Group	864.140	247	3.631		
	Total	1153.660	249			
Abbreviation skill	Between Group	79.619	2	39.810	9.683	.000
	Within Group	978.505	247	4.111		
	Total	1058.124	249			
Composing skill	Between Group	159.964	2	79.982	29.835	.000
	Within Group	638.036	247	2.681		
	Total	798.000	249			
Find a solution	Between Group	144.875	2	72.438	63.483	.000
	Within Group	271.573	247	1.141		
	Total	416.448	249			
Distinction	Between Group	41.720	2	20.860	4.700	.010
	Within Group	1056.305	247	4.438		

	Total	1098.025	249			
Comparison	Between Group	454.167	2	227.084	146.709	.000
	Within Group	368.389	247	1.548		
	Total	822.556	249			
Flexibility	Between Group	80.268	2	40.134	17.197	.000
	Within Group	555.433	247	2.334		
	Total	635.701	249			
Groups Between	Between Group	296.445	2	148.223	44.056	.000
	Within Group	800.725	247	3.364		
	Total	1097.170	249			
Decision making	Between Group	38.492	2	19.246	4.392	.013
	Within Group	1042.835	247	4.382		
	Total	1081.328	249			
Expansion	Between Group	67.953	2	33.977	7.946	.000
	Within Group	1017.648	247	4.276		
	Total	1085.602	249			
Proofing	Between Group	441.791	2	220.895	172.026	.000
	Within Group	305.612	247	1.284		
	Total	747.402	249			
Generalization	Between Group	362.887	2	181.443	78.754	.000
	Within Group	548.333	247	2.304		
	Total	911.220	249			

From this table, we can see that p< (0.05) for the value (F) which means accepting the hypothesis that there are differences in thinking skills according to achievement levels in mathematics, in favor of a high level, then a medium, and then a low.

Table (9)

Scheffe test shows differences between averages in the thinking skills scale and achievement in mathematics

Multiple Comparisons Scheffe							
Dependent Variable	Achievement Levell (I)	Achievement Levell (J)	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Total Grade	High	Mid	6.358*	1.460	0.000	2.76	9.95
		Low	26.724*	1.714	0.000	22.50	30.95
	Mid	High	-6.358-*	1.460	0.000	-9.95	-2.76
		Low	20.367*	1.391	0.000	16.94	23.79
	Low	High	-26.724-*	1.714	0.000	-30.95	-22.50
		Mid	-20.367-*	1.391	0.000	-23.79	-16.94
Analysis Skill	High	Mid	0.667	0.317	0.112	-0.11	1.45
		Low	3.013*	0.373	0.000	2.09	3.93
	Mid	High	-0.667	0.317	0.112	-1.45	0.11
		Low	2.346*	0.303	0.000	1.60	3.09
	Low	High	-3.013-*	0.373	0.000	-3.93	-2.09
		Mid	-2.346-*	0.303	0.000	-3.09	-1.60
Abbreviation skill	High	Mid	0.860*	0.338	0.041	0.03	1.69
		Low	1.742*	0.397	0.000	0.77	2.72
	Mid	High	-0.860-*	0.338	0.041	-1.69	-0.03
		Low	0.882*	0.322	0.025	0.09	1.68
	Low	High	-1.742-*	0.397	0.000	-2.72	-0.77
		Mid	-0.882-*	0.322	0.025	-1.68	-0.09
Composing	High	Mid	0.641	0.273	0.066	-0.03	1.31
		Low	2.309*	0.320	0.000	1.52	3.10
	Mid	High	-0.641	0.273	0.066	-1.31	0.03
		Low	1.668*	0.260	0.000	1.03	2.31
	Low	High	-2.309-*	0.320	0.000	-3.10	-1.52
		Mid	-1.668-*	0.260	0.000	-2.31	-1.03
Solution	High	Mid	0.339	0.178	0.165	-0.10	0.78
		Low	2.059*	0.209	0.000	1.54	2.57
	Mid	High	-0.339	0.178	0.165	-0.78	0.10
		Low	1.720*	0.170	0.000	1.30	2.14
	Low	High	-2.059-*	0.209	0.000	-2.57	-1.54
		Mid	-1.720-*	0.170	0.000	-2.14	-1.30

From this table, we can see That (P < 0.05) and Scheffe value, means accepting the hypothesis that says there are differences in thinking skills and achievement levels in mathematics as the following :

- Differences in the overall degree of thinking skills at all levels in favor of the level High in mathematics
- Differences in the analysis skill between the high and low level in favor of the high, and between the Mid-level and Low in favor of the middle.
- Differences in the abbreviation skill at all levels in favor of a high level in Math.
- Differences in composition skill between high and Low level in favor of the high, and between the mid and the low in favor of the mid.
- Differences in the skill of producing solutions between high and weak level in favor of the high, Between the middle and the Low in favor of the middle.

As we can see that ($p > 0.05$) and (Scheffe) value means rejecting the hypothesis that there are differences in thinking skills and achievement levels in mathematics, as the following :

- There are no differences in the analysis skills, composition, and production of solutions between the level High and Mid-level mathematics achievements.

Table (10)

Scheffe test shows differences between averages in the thinking skills scale due to Mathematics achievement levels

Multiple Comparisons Scheffe							
Dependent Variable	(I)achievement level	(J)achievement level	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Discrimination Skill	High	Mid	1.043*	0.351	0.013	0.18	1.91
		Low	1.010	0.412	0.051	0.00	2.03
	Mid	High	-1.043-*	0.351	0.013	-1.91	-0.18
		Low	-0.033	0.334	0.995	-.86	0.79
	Low	High	-1.010	0.412	0.051	-2.03	0.00
		Mid	0.033	0.334	0.995	-0.79	0.86
Comparison of Skill	High	Mid	-0.056	0.207	0.965	-0.57	0.46
		Low	3.209*	0.243	0.000	2.61	3.81
	Mid	High	0.056	0.207	0.965	-0.46	0.57
		Low	3.265*	0.198	0.000	2.78	3.75
	Low	High	-3.209-*	0.243	0.000	-3.81	-2.61
		Mid	-3.265-*	0.198	0.000	-3.75	-2.78
Flexibility Skill	High	Mid	0.568	0.255	0.085	-0.06	1.19
		Low	1.681*	0.299	0.000	0.95	2.42
	Mid	High	-0.568	0.255	0.085	-1.19	0.06
		Low	1.113*	0.243	0.000	0.52	1.71
	Low	High	-1.681-*	0.299	0.000	-2.42	-0.95
		Mid	-1.113-*	0.243	0.000	-1.71	-0.52
Conclusion skill	High	Mid	-0.032	0.306	0.994	-0.79	0.72
		Low	2.602*	0.359	0.000	1.72	3.49
	Mid	High	0.032	0.306	0.994	-0.72	0.79
		Low	2.634*	0.291	0.000	1.92	3.35
	Low	High	-2.602-*	0.359	0.000	-3.49	-1.72
		Mid	-2.634-*	0.291	0.000	-3.35	-1.92

From this table we can see: That for (P< 0.05) and Schefft means accepting the hypothesis that there are differences in thinking skills due to achievement levels in mathematics, are the following:

- Differences in the distinction skill between the high and middle level in favor of the high.
- Differences in the comparison skill between the high and low level in favor of the high, and between mid-level and low level in favor of the mid.
- Differences in flexibility skill between high level and low level in favor of the high, and between the level mid-level and low level in favor of the mid.
- Differences in the conclusion skill between the high level and the low level in favor of the high level, and between and the mid-level and low level in favor of the mid.

As we can see that for (P > 0.05) and Scheffe value means rejecting the hypothesis that there are differences in thinking skills and the achievement levels in mathematics, as the following :

- There are no differences in the skill of distinction skill between a high level and a low level and between the mid-level and the is poor level and math achievements.
- There are no differences in comparison skills, flexibility skill, and conclusion skill between a high level, and the mid-level of mathematics achievement.

Table (11)

Cheffe test shows differences between averages in the thinking skills scale by mathematics achievement levels.

Multiple Comparisons Scheffe							
Dependent Variable	Achievement Level (I)	Achievement Level (J)	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Decision making Skill	High	Mid	1.002*	0.349	0.017	0.14	1.86
		Low	0.969	0.409	0.063	-0.04	1.98
	Mid	High	-1.002	0.349	0.017	-1.86	-0.14

		Low	-0.033	0.332	0.995	-0.85	0.79
	Low	High	-0.969	0.409	0.063	-1.98	0.04
		Mid	0.033	0.332	0.995	-0.79	0.85
Expanding Skill	High	Mid	0.717	0.345	0.117	-0.13	1.57
		Low	1.599*	0.404	0.001	0.60	2.60
	Mid	High	-0.717	0.345	0.117	-1.57	0.13
		Low	0.882*	0.328	0.029	0.07	1.69
	Low	High	-1.599-*	0.404	0.001	-2.60	-0.60
		Mid	-0.882-*	0.328	0.029	-1.69	-0.07
Proof Sill	High	Mid	0.426	0.189	0.081	-0.04	0.89
		Low	3.495*	0.222	0.000	2.95	4.04
	Mid	High	-0.426	0.189	0.081	-0.89	0.04
		Low	3.069*	0.180	0.000	2.63	3.51
	Low	High	-3.495-*	0.222	0.000	-4.04	-2.95
		Mid	-3.069-*	0.180	0.000	-3.51	-2.63
Generalization Skill	High	Mid	.184	0.253	0.768	-.44	0.81
		Low	3.036*	0.297	0.000	2.30	3.77
	Mid	High	-0.184	0.253	0.768	-0.81	0.44
		Low	2.852*	0.241	0.000	2.26	3.45
	Low	High	-3.036-*	0.297	0.000	-3.77	-2.30
		Mid	-2.852-*	0.241	0.000	-3.45	-2.26

From this table we can see: That for (P < 0.05) and Scheffe Value means accepting the hypothesis that there are differences in thinking skills by achievement levels in mathematics, like the following :

- Differences in decision-making skills between high and middle level in favor of the high.
- Differences in the expansion skill between the high and low level in favor of the high, and between the mid-level is and low in favor of the mid.
- Differences in the proof skill between the high and low level in favor of the high, and between the mid-level and low level in favor of the mid.
- Differences in the generalization skill between the high and weak level in favor of the high, and between the mid-level and the low in favor of the mid.

and for (P> 0.05) and Scheffe value which means rejecting the hypothesis says that there are differences in thinking skills by achievement levels in mathematics, in the following forms:

- There are no differences in decision-making skills between a high level and a low level and Between the mid-level and the low-level mathematics achievement.
- There are no differences in the expansion skill, proof skill, and generalization skill between the high level and the mid-level mathematics achievement

3. There are statistically significant differences in performance level on the scale of Thinking skills between males and females**.**

Table (12)

Shows the standard averages and deviations of the thinking skills scale by gender variable

Group Statistics	Sex	N	Mean	Std. Deviation	Std. Error Mean
Total Grade	Male	125	38.42	12.329	1.135
	Female	125	41.80	13.476	1.215
Analysis skill	Male	125	2.26	2.158	0.199
	Female	125	2.36	2.233	0.201
Abbreviation skill	Male	125	2.23	2.178	0.200
	Female	125	2.72	2.002	0.181
Installation skill	Male	125	3.82	1.800	0.166
	Female	125	4.17	1.836	0.166
The skill of producing solutions	Male	125	4.20	1.258	0.116
	Female	125	4.25	1.377	0.124
The skill of distinction	Male	125	1.61	2.108	0.194
	Female	125	2.04	2.155	0.194
Comparison of skill	Male	125	4.17	1.789	0.165
	Female	125	4.32	1.913	0.173
Flexibility skill	Male	125	4.33	1.536	0.141
	Female	125	4.57	1.709	0.154
The skill of the conclusion	Male	125	4.08	2.086	0.192
	Female	125	4.10	2.195	0.198
Decision-making skill	Male	125	1.61	2.108	0.194
	Female	125	2.02	2.125	0.192
Expansion skill	Male	125	2.19	2.203	0.203
	Female	125	2.70	2.028	0.183
The skill of proof	Male	125	3.87	1.687	0.155
	Female	125	4.22	1.827	0.165
Generalization skill	Male	125	4.03	2.000	0.184
	Female	125	4.34	1.894	0.171

Table (13)

Shows differences in the overall level of the thinking skills scale by gender variable

	Levene's Test		**Independent Samples Test** t-test for Equality of Means					95%	
	F	Sig.	t	df	Sig. (2-tailed)	mean Difference	Std. Error Difference	Lower	Upper
E.v. assumed	1.915	0.168	2.030	248	0.043	3.381	1.666	0.106	6.657
E.V not Assumed			2.034	247.469	0.043	3.381		0.100	6.663

This table shows that (P<0.05) for the value (t) which means accepting the hypothesis that there are differences in thinking skills between males and females overall grade in favor of Female

Table (14)
Shows differences in the thinking skills scale by gender variable

		Levene's Test		t-test for Equality of Means					95%	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Analysis skill	E. v.assumed	0.187	0.666	0.336	248	0.737	0.095	0.283	-0.463	0.653
	E. v. not assumed			0.336	247.986	0.737	0.095	0.283	-0.462	0.652
Abbreviation skill	E. v.assumed	5.090	0.025	1.807	248	0.072	0.487	0.270	-0.044	1.017
	E. v. not assumed			1.804	244.303	0.073	0.487	0.269	-0.045	1.018
Installation skill	E. v .assumed	0.039	0.844	1.486	248	0.138	0.349	0.234	-0.113	0.810
	E. v. not assumed			1.488	247.885	0.138	0.349	0.234	-0.113	0.810
	E. v. not assume			0.286	247.441	0.775	0. 049	0.170	-0.286	0.383
Distinctions skill	assumed	0.124	0.725	1.567	248	0.119	0.430	0.275	-0.111	00.972
	E. v. not assumed			1.567	247.908	0.118	0.430	0.275	-0.111	0.972
Comparison skill	E. v. assumed	0.756	0.386	0.619	248	0.537	0.148	0.239	-0.323	0.618
	E. v. not assumed			0.618	247.847	0.537	0.148	0.239	0.322	0.617
Flexibility skill	E. v. assumed	1.787	0.183	1.141	248	0.256	.239	0.209	0.174	0.651
	E. v. not assumed			1.138	247.010	0.255	0.239	0.210	-0.173	0.651
Conclusion skill	E. v. assumed	0.708	0.401	0.017	248	0.986	0.005	0.276	-0.539	0.549
	E. v. not assumed			0.017	247.979	0.986	0.005	0.276	-0.539	0.548
Decision-making skill	E. v assumed	0.051	0.821	1.519	248	0.130	0.414	0.273	-0.123	0.952
	E. v. not assumed			1.519	247.728	0.130	0.414	0.273	-0.123	0.951
Expansion skill	E. v. assumed	5.289	0.022	1.887	248	0.061	0.513	0.273	-0.024	1.050
	E. v. not assumed			1.871	244.378	0.062	0.513	0.273	-0.025	1.051
The skill of proof	E. v. assumed	1.284	0.258	1.529	248	0.128	0.347	0.227	-0.100	0.793
	E. v. not assumed			1.531	247.662	0.127	0.347	0.226	-0.099	0.793
Generalization skill	E. v. assumed	.000	0.994	1.226	248	0.221	0.308	0.251	-0.187	0.802
	E. v. not assumed			1.225	245.825	0.222	0.308	0.251	-0.187	0.802

This table shows that (P >0.05) for the value (t) which means rejecting the hypothesis that there are differences in thinking skills between males and females.

4. There are statistically significant differences in the level of math achievement scale between Male and females.

Table (15)
Shows the average and the standard deviation in the mathematics scale by gender variable

Group Statistics					
Sex variable		N	Mean	Std. Deviation	Std. Error Mean
Math scale	Male	125	5.16	2.096	0.193
	Female	125	6.03	1.987	0.179

Table (16)
Shows differences in the math scale by gender variable

Independent Samples Test									
Math scale	Levene's Test		t-test for Equality of Means						
								95%	
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
E. v.assumed	0.019	0.891	3.313	248	0.001	0.872	0.263	0.353	1.390
E. v. not assumed			3.310	243.876	0.001	0.872	0.263	0.353	1.390

From this table we can see: That (P<0.05) concerning the value (t) means accepting the hypothesis that there are differences in the level of performance on the mathematics scale between males and females in favor of females.

5. There are statistically significant differences in performance level (high) on the Mathematics scale between males and females.

Table (17)
The average and standard deviation in the mathematics scale (high level) is shown by the gender variable

Group Statistics					
Sex variable		N	Mean	Std. Deviation	Std. Error Mean
Math scale	Male	49	7.60	0.681	0.152
	Female	**49**	8.38	0.494	0.092

Table (18)
Shows differences in the mathematics scale (high level) by gender variable

Independent Samples Test									
Math scale	Levene's Test		t-test for Equality of Means						
								95%	
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper

E. v.assumed	4.643	0.036	4.650	47	0.000	0.779	0.168	0.442	1.116
E. v. not assumed			4.386	32.403	0.000	0.779	0.178	0.418	1.141

From this table we can see:
That (P < 0.05) for the value (t) means accepting the hypothesis that there are differences in the performance level on the mathematics scale (high level) among males and females in favor of female

6. There are statistically significant differences in performance level (medium) on a scale of Mathematics between males and females.

Table (19)

Group Statistics				
Sex Variable	N	Mean	Std. Deviation	Std. Error Mean
Male	125	5.72	0.734	0.112
Female	125	6.19	0.868	0.105

The average and standard deviation in the mathematics scale (intermediate level) is shown by the gender variable

Table (20)

Shows differences in the mathematics scale (mid-level) by gender variable

Independent Samples Test									
Math scale	Levene's Test		t-test for Equality of Means					95%	
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
E. v.assumed	4.552	.035	2.946	109	0.004	0.470	0.160	0.145	0.787
E.V.unassumed			3.059	100.061	0.003	0.470	0.154	0.165	0.775

From this table we can see: That (P < 0.05) for the value (t) means accepting the hypothesis that there are differences in the level of performance on the mathematics scale (intermediate level) between males and females For the in favor of females.

7. There are statistically significant differences in performance low level on a scale of Mathematics between males and females.

Table (21)

The average and standard deviation in the mathematics scale (low level) by gender variable

Group Statistics					
Sex Variable		N	Mean	Std. Deviation	Std. Error Mean
Math scale	Male	50	2.07	1.048	0.191
	Female	50	3.00	0.980	0.192

Table (22)

Shows differences in the mathematics scale (low level) by gender variable

Independent Samples Test									
Math Scale	Levene's Test		t-test for Equality of Means					95%	
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
v. assumed	0.587	0.447	3.425	54	0.001	0.933	0.273	0.387	1.480
E.V .unassumed			3.441	53.671	0.001	0.933	0.271	0.390	1.477

this table shows That (P< 0.05) for the value (t) means accepting the hypothesis that there are differences in the performance level on the mathematics scale (low level) among males And females in favor of Females.

Conclusion:

I. There was a positive correlation between achievement in mathematics and thinking skills performance, meaning that the higher the score in mathematics the higher rate of thinking skills scale and vice versa. This is an indication of the important role of mathematics in raising the level of performance on the thinking skills scale, and this is consistent with the results of the study. (Benidiktus and et. al, 2017) and the study of (Yee, Othman, Yunos, Tee, Hasan, and Mohammad, 2011).

Achievement in mathematics receives a great deal of attention from educators and parents due to the belief that there is a relationship between achievement in mathematics and the ability to think, and perhaps the most widespread method of developing thinking skills within any strategy, especially problem solving among school students, is to train students to solve mathematical issues based on the principle of the great similarity between methods of solving mathematical problems and methods of thinking strategies because both require the same type of mental activities, considering that mathematical problems faced Learners challenge their mental abilities to reach the right solutions. We note that most of the members of the sample received intermediate or poor grades in mathematics and this indicates that there is a decrease in the level of achievement in mathematics in most members of the sample, and this may be due to the weakness of students in the use of thinking skills in general and the poor training in the use of these skills in particular, it was noted that there is a low achievement in mathematics among students at different educational levels in Jordan and this is due to several reasons, including The government's policy of automatic promotion at the primary level, a large number of pupils in the class, the lack of interesting activities associated with mathematics, and the inadequacy of educational supervision These results point out again to the close relationship between the high achievement level in mathematics and the level of performance on the thinking skills scale, and these results are normal because those with higher achievements can use mental skills more than others, the smarter more analytical and more able to interpret which gives them the

ability to use these skills whether it's to solve a mathematical problem or a situation or in thinking skills.

II. In the case of differences between males and females, differences have emerged at all levels of achievement in mathematics for female, and at the overall degree in thinking skills for females, it is known that inference and mathematical abilities (mathematical intelligence) and the solution of issues that are the solution of typical problems (similarity between problem-solving and thinking skills in terms of the mental processes used) are superior to females over males.

III. Finally, the research has achieved its objectives, which are summarized in the following points:
   1. The results revealed a positive correlation between achievement in mathematics and performance on the scale of thinking skills.
   2. The results revealed an effect of the sex variable (male, female) in the Achievement level in mathematics and at the overall performance level on the thinking skills scale.
   3. The results revealed an effect of the level of achievement in mathematics (High, Medium, Low) performance level in the thinking skills scale.

Recommendation for further study

From the research findings, it can be said that it is a low level of achievement in mathematics in the research sample, so it is necessary to look for solutions to the problems related to the methods of teaching mathematics, because the solution of most or some of these problems may be a starting point in the way of expanding the cognitive field of students and the highly useful use of mental cognitive skills through the following proposals:

1. Work to develop the curriculum in general and mathematics curricula for the 9^{th} grade and, adopt various teaching methods such as teaching thinking skills, so that students can use mental cognitive skills without difficulty.
2. Work on weekly or monthly strengthening programs and, Strengthening lessons especially with the new situation in education due to the Corona pandemic math and other Subjects in general.
3. Conducting more research and studies aimed at monitoring the various obstacles to the application of methodological plans and procedures for training in mathematics in general as a prelude to reducing these constraints

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