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Logical - Mathematical Intelligence and Academic Achievement of Higher Secondary Students

Dr.M.Kanmani[1] , N.Nagarathinam [2]

[1]Associate Professor, Department of Educational Technology,
Tamil Nadu Teachers Education University(TNTEU), Chennai. Tamilnadu.
[2]Ph.D , Research Scholar, Department of Educational Technology,
TNTEU, Chennai. Tamilnadu.

ABSTRACT

logically. It can include the ability to use formal and informal reasoning skills such as deductive reasoning and to detect patterns. Present study aims to find out the relationship between logical-mathematical intelligence and achievement in mathematics of higher secondary students. Fifty five higher secondary students were selected randomly as sample for the study. Survey method was adopted for the study. The data was collected using the test on Logical-Mathematical Intelligence (LMI) and achievement in mathematics. Critical ratio, chi-square test and Pearson's product moment correlation were applied to test the hypotheses. Interpretations were drawn based on the findings. Logical-mathematical intelligence of the higher secondary students was found to be an *average* and there was a *high positive correlation* between logical- mathematical intelligence and achievement in mathematics.

I INTRODUCTION

Logical-Mathematical Intelligence is the capacity to reason, calculate, recognise patterns and handle logical thinking. It can include the ability to use formal and informal reasoning skills such as deductive reasoning and to detect patterns.

According to Howard Gardner (1983), logical-mathematical intelligence involves the ability to detect patterns, reason deductively and think logically. This intelligence is most often associated with scientific and mathematical thinking. It uses numbers, math and logic, to find and understand the various patterns that occur in our lives: number patterns, visual patterns, thought patterns, colour patterns and the list goes on.

The logical-mathematical people are inclined to think more conceptually and abstractly than others and are sometimes able to see patterns and relationships that others will often miss. A logical-mathematical learner is very systematic, organised and loves the challenge of a complex problems to solve. Students become aware of how other people go around certain problems. Pupil's thought processes are different and by sharing ideas, the logical-mathematical learner is capable of seeing actually how many ways are there in solving a certain problem. Many professions use logical intelligence to perform their daily tasks, such as accountants, engineers, computer programmers, and mathematicians. Even ordinary people use their logical intelligence to accomplish their

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everyday activities, such as balancing a check book, solving word problems, number puzzles, and comprehending the latest scientific discovery in their monthly magazine.

Students strong in logical intelligence can think in numerical terms, mathematical patterns, and logical sequences. Students who lack mathematical intelligence can work on developing this mental ability through a series of exercises. Students who engage in regular logical-mathematical intelligence activities will learn how to manipulate their environment by experimenting with objects in an orderly fashion. Students can engage in a variety of logical- mathematical intelligence activities in the classroom, including brain teasers, strategical games, logical puzzles, and any games that challenge the student to plan ahead accordingly.

II REVIEW OF RELATED LITERATURE

Sex differences in self-esteem of different aspects of intelligence was studied by **Beatrice Rammsteat and Thomad H Rammsayer(2000)**. Males rated their mathematical, logical and spatial intelligence higher than females, while females gave higher scores than males for musical and interpersonal intelligence.

Begum and Phukan (2005) studied the correlation between academic achievement and intelligence. It is revealed from the study that intelligence of students were positively correlated with academic achievement.

Panda (2005) studied the correlation between academic achievement and intelligence. It is revealed from the study that there was no significant difference in intelligence level of students of different categories of schools. There was low relationship between academic achievement and intelligence in different categories of schools.

General mental alertness and intelligence in relation to academic achievement of students at the secondary level was studied by **Chamundeswari and Sumangala (2006)**. It is revealed from the study that there was no significant difference between intelligence of students at the secondary level in government & matriculation and corporation & government schools. There was significant correlation among the intelligence, achievement in mathematics at the secondary level in different types of schools.

The direct and indirect effect of general intelligence and cognitive abilities on mathematics achievement was studied by **Taub et al. (2008)**. The following CHC (Cattell–Horn–Carroll (CHC) taxonomy of intelligence) broad cognitive ability factors demonstrated statistically significant direct effects on the mathematics achievement variables: Fluid Reasoning, Crystallized Intelligence, and Processing Speed. In contrast, across all age levels, the general intelligence factor demonstrated indirect effects on the mathematics achievement variable.

The relationship of intelligence with self-confidence and academic achievement of secondary school students was studied by **Dhall and Thukral (2009)**. It is revealed from the study that there is a significant relationship between academic achievement and intelligence of secondary school students and the level of intelligence is significantly differing in boys and girls of secondary school.

Anitha.T.S et al. (2013) conducted a study on the multiple intelligence levels of Secondary school students of Government and Private schools in Secunderabad". The results revealed that there was a significant difference between multiple intelligence levels of government school students and private school students. Girls have more

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multiple intelligence levels than the boys. Government school students excel in three areas i.e., logical, interpersonal and intrapersonal than the private school students. Boys students are good at spiritual/naturalistic intelligence.

Through, there are many studies were done on the variables mentioned, but no study was taken up with the variables Logical-Mathematical Intelligence and Academic Achievement. Hence the investigator has selected these two variables for the study.

III NEED AND SIGNIFICANCE OF THE STUDY

Logical-mathematical intelligence involves the mental capacity to understand numbers, scientific processes, logic and reasoning. The Logical-mathematical approach works well with students because it requires them to rely on their own theories. It will hopefully gives them the confidence that they need to be able to stand up and say what they believe is right and wrong. It is about appreciating the worth in their own opinions and how they have the right to voice their thoughts in the classroom.

IV OBJECTIVES OF THE STUDY

i. To find out the level of logical-mathematical intelligence and achievement in mathematics of higher secondary students.
ii. To find out whether there is any significant relationship between logical-mathematical intelligence and academic achievement in mathematics of higher secondary students.
iii. To find out whether there is any significant association in achievement in mathematics of higher secondary students with respect to educational qualification of fathers and mothers.
iv. To find out whether there is any significant association in logical-mathematical intelligence of higher secondary students with respect to educational qualification of fathers and mothers.
v. To find out whether there is any significant difference in achievement in mathematics of higher secondary students with respect to
   a. Gender
   b. Group of study
   c. Type of school
vi. To find out whether there is any significant difference in logical-mathematical intelligence of higher secondary students with respect to
   a. Gender
   b. Group of study
   c. Type of school

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V METHODOLOGY

Survey method was adapted for the study

Sample Selection

Fifty five higher secondary students were selected using random sampling technique from various schools of Kanchipuram district for the study.

Research Instruments Used

A test on ***Logical-Mathematical Intelligence*** **(LMI)** and an **Achievement Test** were constructed and validated by **Dr.M.Kanmani and Nagarathinam (2016)**.

Logical-Mathematical Intelligence

Description of the tool

The draft tool contained thirty five items to assess the logical-mathematical intelligence of higher secondary students.

Validity

Content validity was found using item-wise analysis. The items which have difficulty value between 40 and 60, and discrimination index $\geq$ 0.4 were selected. Hence, twenty six items were selected.

Reliability

Split-half technique was used to establish the coefficient of reliability of LMI test and it was found to be 0.9. Hence the tool is *highly reliable*.

Scoring procedure

One mark was awarded for correct answer and no mark was awarded for wrong answer.

Achievement Test

Description of the tool

The draft tool contained fifty items to assess the achievement test of higher secondary students.

Validity

Content validity was found using item-wise analysis. The items which have difficulty value between 40 and 60, and discrimination index $\geq$ 0.4 were selected. Hence, twenty eight items were selected.

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Reliability

Split-half technique was used to establish the coefficient of reliability of achievement test and it was found to be 0.5. Hence the tool is *reliable*.

Scoring procedure

One mark was awarded for correct answer and no mark was awarded for wrong answer.

Statistical techniques used

Critical ratio (t-test), Chi-Square test and Pearson's product moment correlation techniques were used for analyzing the data.

Hypothesis testing

Hypothesis 1: *There is no significant relationship between logical- mathematical intelligence and achievement in mathematics of higher secondary students*.

Variables	'r'	Table value
Logical-mathematical intelligence and Achievement in mathematics	0.91	0.254

(at 5% level of significance the table value is 0.254)

It is inferred from the above table that the calculated value of 'r' (0.91) is greater than the table value of 'r' (0.254) at 5% level of significance. Hence the null hypothesis is ***rejected***. Therefore, there is a significant relationship between logical mathematical intelligence and achievement in mathematics of higher secondary students. Further, it can be stated that there exist high positive correlation between logical- mathematical intelligence and achievement in mathematics of higher secondary students.

Hypothesis 2: *There is no significant association between achievement in mathematics of higher secondary students with respect to their fathers' and mothers' educational qualification*.

Achievement Categories	Mothers' qualification			Fathers' qualification		
	Low	Average	High	Low	Average	High
Illiterate	1(1.27)	3(2.63)	1(1.09)	1(0.25)	0(0.52)	0(0.21)
10^{th}	4(4.32)	10(8.96)	3(3.7)	7(4.58)	9(9.49)	2(3.92)
12^{th}	4(4.32)	8(8.96)	5(3.7)	5(4.83)	12(10.01)	2(4.14)
UG	3(2.8)	5(5.8)	3(2.4)	1(3.3)	8(6.85)	4(2.83)

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PG	2(1.27)	3(2.63)	0(1.09)	0(1.01)	0(2.1)	4(0.87)
Chi-square ('χ^2')	***0.945***			***0.029***		

(at 5% level the table of significance value 'χ^2' is 15.51)

It is inferred from the above table that the calculated values of 'χ^2' (0.945 and 0.029) are less than the table value 15.51 at 5% level of significance. Hence the null hypothesis is ***accepted***. Therefore, fathers' and mothers' educational qualification of higher secondary students did not associate significantly in achievement in mathematics.

Hypothesis 3: *There is no significant association between logical- mathematical intelligence of higher secondary students with respect to their fathers' and mothers' educational qualification*.

Logical - Mathematical intelligence Categories	**Mothers' qualification**			**Fathers' qualification**		
	Low	**Average**	**High**	**Low**	**Average**	**High**
Illiterate	2(1)	2(3)	1(1)	0(0.2)	1(0.6)	0(0.2)
10th	3(3.4)	10(10.2)	4(3.4)	4(3.6)	10(10.8)	4(3.6)
12th	3(3.2)	11(9.6)	3(3.2)	5(3.8)	10(11.4)	4(3.8)
UG	3(2.2)	7(6.6)	1(2.2)	2(2.6)	8(7.8)	3(2.6)
PG	0(1)	3(3)	2(1)	0(0.8)	4(2.4)	0(0.8)
Chi-square('χ^2')	***0.79***			***0.83***		

(at 5% level of significance the table value 'χ^2' is 15.51)

It is inferred from the above table that the calculated values of 'χ^2' (0.79 and 0.83) are less than the table value 15.51 at 5% level of significance. Hence the null hypothesis is ***accepted***. Therefore, fathers' and mothers' educational qualification of higher secondary students did not associate significantly in logical-mathematical intelligence in mathematics.

Hypothesis 4: *There is no significant difference between boys and girls higher secondary students' achievement in mathematics.*

Gender	**N**	**Mean**	**S.D**	**t**
Boys	30	16.3	4.61	0.397
Girls	25	17.52	4.28	

(at 5% level of significance the table value 't' is 1.67)

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It is inferred from the above table that the calculated value of 't' (0.397) is less than the table value of 't'(1.67) at 5% level of significance. Hence the null hypothesis is ***accepted***. Therefore, boys and girls higher secondary students' do not differ significantly in achievement in mathematics.

Hypothesis 5: *There is no significant difference in achievement in mathematics of higher secondary students with respect to group chosen.*

Group	N	Mean	S.D	t
Bio- Mathematics	29	16.1	3.69	0.346
Computer science-Mathematics	26	17.96	5.03	

(at 5% level of significance the table value 't' is 1.67)

It is inferred from the above table that the calculated value of 't' (0.346) is less than the table value of 't'(1.67) at 5% level of significance. Hence the null hypothesis is ***accepted***. Therefore, higher secondary students whose major group was biology-mathematics and computer science – mathematics did not differ significantly in achievement in mathematics.

Hypothesis 6: *There is no significant difference in achievement in mathematics of higher secondary students with respect to type of school.*

Type of School	N	Mean	S.D	t
Government Aided School	19	17.52	4.42	0.46
Self Financing School	36	16.69	4.5	

(at 5% level of significance the table value 't' is 1.67)

It is inferred from the above table that the calculated value of 't'(0.46) is less than the table value of 't'(1.67) at 5% level of significance. Hence the null hypothesis is ***accepted***. Therefore, higher secondary students studying in government aided and self financing schools did not differ significantly in achievement in mathematics.

Hypothesis 7: *There is no significant difference between boys and girls higher secondary students' in logical-mathematical intelligence in mathematics.*

Gender	N	Mean	S.D	t
Boys	30	16.17	4.71	0.39
Girls	25	17.88	4.26	

(at 5% level of significance the table value 't' is 1.67)

It is inferred from the above table that the calculated value of 't' (0.39) is less than the table value of 't'(1.67) at 5% level of significance. Hence the null hypothesis is ***accepted***. Therefore, boys and girls higher secondary students do not differ significantly in their logical- mathematical intelligence in mathematics.

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Hypothesis 8: *There is no significant difference in logical-mathematical intelligence in mathematics of higher secondary students with respect to group chosen*.

Group	N	Mean	S.D	t
Biology- Mathematics	29	17.62	4.63	0.47
Computer science-Mathematics	26	16.19	4.41	

(at 5% level of significance the table value 't' is 1.67)

It is inferred from the above table that the calculated value of 't' (0.47) is less than the table value of 't'(1.67) at 5% level of significance. Hence the null hypothesis is ***accepted***. Therefore, higher secondary students whose major group was biology-mathematics and computer science – mathematics did not differ significantly in their logical-mathematical intelligence in mathematics.

Hypothesis 9: *There is no significant difference in logical-mathematical intelligence in mathematics of higher secondary students with respect to type of school*.

Type of School	N	Mean	S.D	t
Government Aided School	19	15.95	5.31	0.14
Self Financing School	36	17.47	4.07	

(at 5% level of significance the table value 't' is 1.67)

It is inferred from the above table that the calculated value of 't' (0.14) is less than the table value of 't'(1.67) at 5% level of significance. Hence the null hypothesis is ***accepted***. Therefore, higher secondary students studying in government aided and self financing schools did not differ significantly in their logical-mathematical intelligence in mathematics.

Findings

i. 60 and 65 percentages of higher secondary students had an ***average level*** of logical- mathematical intelligence and achievement in mathematics respectively.

ii. There is ***high positive correlation*** between logical-mathematical intelligence and achievement in mathematics of higher secondary students.

iii. Fathers' and mothers' educational qualification of higher secondary students ***did not associate significantly*** in logical-mathematical intelligence and achievement in mathematics.

iv. Boys and girls higher secondary students ***do not differ significantly*** in logical-mathematical intelligence and achievement in mathematics.

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v. Higher secondary students whose major group was biology-mathematics and computer science – mathematics ***did not differ significantly*** in logical-mathematical intelligence and achievement in mathematics.

vi. Higher secondary students studying in government aided and self financing schools ***did not differ significantly*** in logical-mathematical intelligence and achievement in mathematics.

VII RESULT DISCUSSION

(i). The study revealed that 60 and 65 percentages of higher secondary students had an ***average level*** of logical-mathematical intelligence and achievement in mathematics respectively. This result contradicts with the study result of **Kavitha Madhusudan (2009)** and **McMahon et al. (2004)**. (ii). There was ***high positive correlation*** exists between logical- mathematical intelligence and achievement in mathematics of higher secondary students, which coincides with the study result of **Dhall and Thukral (2009)** and **Kavitha Madhusudan (2009)** and contradicts with **Panda (2005)**.

(iii). Boys and girls higher secondary students do not differ significantly in logical- mathematical intelligence and achievement in mathematics, which coincides with the study result of **Anitha.T.S et al. (2013)** and contradicts with **Dhall and Thukral (2009)**. (iv). Higher secondary students studying in government aided and self financing schools did not differ significantly in logical-mathematical intelligence and achievement in mathematics, which coincides with the study result of **Chamundeswari** and **Sumangala (2006), Panda (2005)** and **Anitha.T.S et al. (2013)**.

Educational implications

There is High positive correlation was exist between logical-mathematical intelligence and achievement in mathematics of higher secondary students. The students may use logical- mathematical intelligence to play logical/mathematical games with friends and family.Further they can learn to use an abacus, work on logic puzzles and brain teasers, draw flowcharts of all the key processes in their work and can come up with new ideas. They can themselves on tape talking out loud about how to solve logical or mathematical problems, to apply inductive and deductive reasoning skills to provide solutions and to overcome complex mathematical and logical challenges as well as solving critical and creative problems. Special lectures on complex concepts may be arranged to facilitate their learning. Guidance programme can be provided in schools according to their knowledge level.

VIII CONCLUSION

The purpose of the present study was to find the level of logical mathematical intelligence in mathematics of higher secondary students. The study result may be useful in the field of education, which may serve as data base for further research.

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