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## Assessing logical mathematical intelligence of young adolescents: A sample study from Haryana, India

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### Abstract

The current transition from industrial society to information society places intelligence at the core of education. In 1983, Howard Gardner, an American psychologist, developed the theory of Multiple Intelligences. This theory states that people possess cluster of different intelligences and along with that they learn in many different ways. The opportunity to learn in different ways make learning process at any stage of life more efficient is also likely to make learning more effective. Attention to an individual's preferred mode of learning or thinking promotes improved achievement (Tomlinson, 1999). In this way, students will have optimum learning if the concepts, principles and skills being taught are presented in their preferable learning style and they will be able to express themselves well. The present study was intended to examine the influence of various human ecological factors on logical –mathematical intelligence of senior secondary school students in Mahendergarh district. Questionnaire method was used for the study. The data was collected using *Multiple Intelligence Assessment Tool developed by Kaur, 2006* on a study sample consisting of 200 students from senior secondary schools of both areas of Mahendergarh (Haryana) i.e., rural and urban. The study revealed that family type, number of siblings, residential surrounding, duration of interaction with grandparents, school environment and relationship with the teachers were significantly associated with logical mathematical intelligence of the respondents.

**Keywords:** Logical mathematical intelligence, human ecological variables, young adolescent girls, Haryana, India

### Introduction

Howard Gardner, in his introduction to Multiple Intelligence theory (1983) stated that “human cognitive competence can be well described in terms of a set of abilities, talents or mental skills which he considered as intelligences. Every individual by his/her birth is gifted with some of such types of intelligences and individuals differ in the degree of their intelligence and in the nature of their combination”. Now the question here is whether juveniles have these intelligences and how various human ecological factors affect their existing type of Multiple Intelligences and how this particular intelligence can strengthen the individual based on their capacity in the right manner. In many societies, however, adolescence is narrowly associated with puberty and the succession of physical changes culminating in reproductive maturity. Along with that the adolescence phase is implicit in broader terms that include maturation in various terms including physical, psychological, social and moral terrain. The *adolescence* typically refers to the period between ages 12 and 20 and is roughly equivalent to the word *teens*. Sometimes, they are also called as children in conflict with law or juveniles. Adolescents face lots of difficulties at a very young age; they are very badly affected due to the problems they come across due to their abrupt physical changes, psychological dilemmas, career selection, family and social pressure to perform according to set rules and regulations in a way to fit in the social structure. As the name suggests multiple intelligence depicts presence of more than two skills in an individual. Being intelligent doesn't have means to be excellent in academics, even an entity that is good in arts can be called as “intelligent”. Intelligence is present within everyone by birth and it can be refined through practicing it. With this thought Howard Gardner structured a theory named Multiple Intelligence theory. This theory opposes the traditional concept of intelligence and brought into light the modern concept of intelligence. The theory categorizes intelligences into nine kinds. They are listed as- naturalistic, logical mathematical, musical intelligences, existential, interpersonal, bodily kinesthetic, intrapersonal, verbal and visual spatial intelligences. The logical-mathematical learning style is one of eight types of learning styles, or intelligences, defined by developmental psychologist Howard Gardner's theory in Theory of Multiple

Intelligences. This learning style refers to the ability to reason, to solve problems and to learn by using numbers, abstract visual information and through the analysis of cause and effect relationships. Logically-mathematically intelligent people are typically methodical and think in logical or linear order. They may be skilled at solving math problems in their heads and are drawn to logic puzzles and games. The strengths of such people are in math, logic, seeing patterns, and problem-solving. They like to play with numbers, find logical methods to answer typical questions classify and categorize. They are also comfortable working with the abstract. Such students enjoy school activities such as math, technology, drafting, computer science, design, chemistry, and other core sciences. These students favor logical order in instruction and often work best in structured, organized environments. Such students have strong visual analysis, memory and problem-solving skills. They get benefit from bringing raw mathematical and conceptual thoughts into reality through hands-on projects such as computer-assisted design, creating electronic devices, or programming computers due to their natural tinkering and building capability. Such students learn best when they're taught using logically-mathematically focused teaching material such as visual materials, computers, statistical and analytical programs and hands-on projects. They also prefer structured, goal-oriented activities which are based on math reasoning and logic rather than less structured, creative activities with imprecise learning goals. Logical-mathematical learners would find a statistical learning more attractive than analyzing literature or keeping a journal. They may also like creating tabular information into graphs, charts, timelines and even categorizing collections. As part of a group project, the mathematical logical learner may crave to contribute by making an agenda or list, setting numerical ideas, putting steps into a sequence, ranking brainstorming goals, keeping track of the progress of the group, and constructing data reports regarding failure or success of the undersigned project. The mathematically and logically talented student may opt for careers such as in computer programming, database designing, systems analysis, network analysis, computer technician, and engineering either chemical, electronic or mechanical. Professions that deal with numbers will plea too such as an accountant, book-keeper, financial and investment consultant, auditor, mathematician, and statistician. They may also get involved in various other career options such as drafting, architecture, physics, astronomy, and other areas of science. In medical and allied professions, they may be attracted towards medical technology, pharmacy, and medical specialties.

Arum, Kusmayadi and Pramudya (2018) <sup>[1]</sup> conducted research on 9<sup>th</sup> grade students to identify profile of students' logical-mathematical intelligence in general and specifically in each indicator. It is also analyzed and described based on students' sex. The results show that students' logical-mathematical intelligence was identified in the moderate level. In addition, the level of both male and female students are also mostly in the moderate level. On the other hand, both male and female students' logical-mathematical intelligence is

strongly influenced by the ability to classify and understand patterns and relationships. It seems that students' logical-mathematical intelligence was not optimal because more than half students were identified in moderate and low level.

Thangapappa, *et al.* (2014) <sup>[10]</sup> concluded that religion, caste, family status, types of college, parents' qualification, parents' occupation and annual incomes of parents' have no remarkable significant relationship with multiple intelligence. Ayesha and Khurshid (2013) <sup>[2]</sup> concluded that students from higher income families have higher scores on multiple intelligence inventories.

Beceran (2010) <sup>[3]</sup> found a relationship between children's intelligence types and their parents' educational level and socio-economic status. He concluded that parent's educational level and their socio-economic status directly affects children's intelligences.

## Materials and Methods

**Method of the study:** In the present exertion questionnaire cum schedule method was employed.

**Sample:** For rural area sample, one block was selected at random from Mahendargarh district. From randomly selected block one village having Government High/Senior Secondary Schools and Private High/Senior Secondary Schools was taken purposively. For urban area sample, one Government High/Senior Secondary Schools and Private High/Senior Secondary School was taken randomly from the selected city.

**Sampling Procedure:** A list of adolescent girls in the age group of 12-14 years was procured from both the selected schools of both areas. A sample of 200 respondents was taken randomly from the list of chosen schools of rural and urban areas. Out of 200 young adolescent girls, 100 from urban and 100 from rural areas was preferred randomly. The present sample of 100 adolescent girls constituted of 50 girls each from Government and Private Schools.

**Instrument of the study:** Questionnaire cum interview schedule developed by Kaur in 2006 was implemented in the present research work. The tool consisted of nine subscales regarding Multiple Intelligences domains, namely, linguistic, logical mathematical, bodily kinesthetic, visual spatial, interpersonal, intrapersonal, naturalistic and existential intelligences. This tool was preferred as it was reliable and its retest reliability coefficients for nine components of the Multiple Intelligence were in the range of 0.63 to 0.86 and for interobserver reliability coefficients it was ranging from 0.61 to 0.90. Tool was also justified as valid because it's content validity ratio, which was ranging from 0.2 to 0.8 and also its cross validity was ranging from 0.02 to 3.49.

**Analysis of the data:** As present study was intended to examine the influence of various human ecological factors on logical –mathematical intelligence of senior secondary school students in Mahendargarh district. Hence, Chi square test of independence was used to measure the degree of association between dependent and independent variables.

**Results and Discussion**

**Table 1:** Association of human ecological variables with logical mathematical intelligence n=200

S. No.	Variables	Above Average	Average	Below Average	Chi square value
		F (%)	F (%)	F (%)	
1.	<b>Age</b>				
	12-13 years	23 (11.5)	75 (37.5)	72 (36.0)	1.57
	13+ years	5 (2.5)	10(5.0)	15 (7.5)	
2.	<b>Family type</b>				
	Nuclear	15 (7.5)	45 (22.5)	49 (24.5)	6.67*
	Joint	11 (5.5)	40 (20.0)	39 (19.5)	
	Extended	1 (0.5)	-	-	
3.	<b>Number of siblings</b>				
	1-2	16 (8.0)	65 (32.5)	61 (30.5)	8.16*
	More than 2	13 (6.5)	18 (9.0)	27 (13.5)	
	Graduate/PG	5 (2.5)	20 (10.0)	4 (2.0)	
4.	<b>Residential surrounding</b>				
	Underdeveloped	15(7.5)	59 (29.5)	51(25.5)	3.56*
	Developing	12 (6.0)	25 (12.5)	36 (18.0)	
	Fully developed	0 (0.0)	1 (0.5)	1 (0.5)	

\*Significant at 0.05

**Note:** Figures in the parentheses indicate percentage

Table 1 depicts data regarding the influence of human ecological variables on logical mathematical intelligence. Chi square test of independence has been used to measure the degree of association between dependent and independent

variables. Family type (6.67), number of siblings (8.16) and residential surrounding (3.56) were observed to be significantly associated with logical mathematical intelligence of the respondents.

**Table 2:** Association of human ecological variables with logical mathematical intelligence n=200

S. No.	Variables	Above Average	Average	Below Average	Chi square value
		F (%)	F (%)	F (%)	
1.	<b>Grandparents' stay</b>				
	Yes	17 (8.5)	55 (27.5)	64 (32.0)	1.64
	No	10 (5.0)	30 (15.0)	12 (6.0)	
2.	<b>Duration of interaction with grandparents</b>				
	<1-3 hours	21 (10.5)	59 (29.5)	58 (29.0)	2.89*
	3-6 hours	5 (2.5)	25 (12.5)	29 (14.5)	
	More than 6 hours	1 (0.5)	1 (0.5)	1 (0.5)	
3.	<b>School environment and relationship with the teachers</b>				
	Good	10 (5.0)	42 (21.0)	45 (22.5)	3.43*
	Average	5 (2.5)	7 (3.5)	11 (5.5)	
	Poor	12 (6.0)	36 (18.0)	32 (16.0)	
4.	<b>Relationship with peers</b>				
	Good	14(7.0)	47(23.5)	53 (26.5)	1.90
	Average	9(4.5)	25(12.5)	27(13.5)	
	Poor	4(2.0)	13(6.5)	8(4.0)	

\*Significant at 0.05

**Note:** Figures in the parentheses indicate percentage

Table 2 presents data regarding the influence of human ecological variables on logical mathematical intelligence. Chi square test of independence has been implemented to measure the degree of association between dependent and independent variables. Duration of interaction with grandparents (2.89) and school environment and relationship with the teachers (3.43) were found to be significantly associated with logical mathematical intelligence of the respondents.

**Conclusion**

Although, there have been numerous researches carried out worldwide on Multiple Intelligence, a very few studies have been conducted in India. Logical-Mathematical intelligence is not only useful in academic issues but it also has substantial efficacy in applied fields. Keeping in view, the importance of Logical-Mathematical intelligence and this wide research gap, the present study has been undertaken. Results of the present

research study were tabulated as follows:

Table 1 depicted that family type, number of siblings and residential surrounding were significantly associated with logical mathematical intelligence of the respondents. According to Gunawan (2011) [8], one of the multiple intelligences that play a key role in mathematics learning among school going students is logical-mathematical. As students' logical-mathematical intelligence is valuable for problem-solving skills. The results of Rahbarnia, *et al.*, (2014) [9] also supported that there was a positive correlation between logical-mathematical intelligence and mathematical problem solving capacity of the students. Thangapappa, *et al.* (2014) [10] concluded that religion, caste, family status, types of college, parents' qualification, parents' occupation and annual incomes of parents' have remarkable significant relationship with multiple intelligence.

Table 2 presents data regarding the influence of human

ecological variables on logical mathematical intelligence. Chi square test of independence has been implemented to measure the degree of association between dependent and independent variables. Duration of interaction with grandparents, school environment and relationship with the teachers was found to be significantly associated with logical mathematical intelligence of the respondents. To enhance logical-mathematical intelligence among girl students, provide opportunities to handle long chains of reasoning in girl child, enhance both hemispheres equally, and provide different activities and challenges that promote mathematical skills, engage more in designing and decorating along with that use effective teaching strategies which facilitate the strength of girl child. Though these are the suggestions to enhance logical-mathematical intelligence and visual-spatial intelligence among girl students, it is not empirically proven. Hence such studies can be undertaken in these areas. The teachers must help the girl students to enhance logical-mathematical intelligence and visual-spatial intelligence by exposing them to a variety of ways of learning, to better individualized for their interests and needs, and to use teaching strategies that make learning more efficient, successful and enjoyable (Borek, 2003) <sup>[4]</sup>. We can also foster meaningful learning experiences by using multiple teaching tools and strategies and by building positive, supportive relationship with these children.

### Recommendations

Some children are talented to learn just about anything via their logical skills. They are gifted to calculate and exert out relationships and connections between items. They like mental challenges in which questing out solutions to logical, abstract and mathematical problems and have good deductive reasoning skills. On a lesser extent, logically mathematically intelligent adolescents may simply surpass at games involving expertise and strategy such as chess or computer battle games. Logical-Mathematical Intelligence may also be understood as the talent to appreciate and calculate the consequence of actions upon objects or ideas and the relationships among them. Logically mathematically intelligent adolescents 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.

To exhibit strong Logical-Mathematical Intelligence, it is not necessary for children to be good at numbers there are also various other predictors such as act of selecting key points in a logical, systematic numbered sequence support this intelligence.

Logical / Mathematical Intelligence of children can be developed by:

- Parents can play logical/mathematical games with their children
- Parents can teach children to use an abacus at an early age
- Parents and teachers can work on logic puzzles and brain teasers with children
- Teachers can help children to learn basic computer programming
- Parents can arrange a course in basic mathematics or science at an evening class
- Teachers can use flowcharts of various activities or area of work and then come up with new ideas for children to make routine schedule more effective

- Parents can encourage children to read the business sections of the newspaper and look up unfamiliar economic or financial concepts
- Parents can plan visit a science museum with their children
- Parents can involve children in their household chores involving logical skills such as preparing grocery list and calculating monthly expenses
- Parents can help their kids with their mathematics/science homework
- Parents can purchase a telescope or a microscope and can encourage children to discover a myriad of new worlds.

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