

THE CONNECTION BETWEEN ABSTRACT CONCEPTS AND LOGICAL AND MATHEMATICAL ABILITY IN VISUALLY CHALLENGED CHILDREN

¹Dr.K.Madhavi,² Dr. Sudhakar Venukapalli

¹ Principal. Professor of Education,

¹ Department of Education

¹panineeya mahavidyalaya college of education, Hyderabad, India.

Abstract: The purpose of the study was to determine the level of readiness in formal operational logical and Mathematical abilities namely Proportionality thinking Probability thinking Correlation thinking of High School students of visually impaired children. This empirical study is essentially an exploratory clinical research. The approach of this investigation is quantitative and is supported by simple description. The researcher involved students individually and also in group to collect data by clinical method. Two different independent normally distributed populations with respect to the variables are selected for this study. To understand and examine the above hypotheses, visually impaired children and sighted children of class IX in Hyderabad are considered as the populations. The tools used to collect data are 1. The Test of logical Operations in mathematics (TLO – A Paper Pencil Test). Designed and constructed on the basis of Piaget’s seven logical operations.2. The modified Piagetian Logical-mathematical Test Battery. The researcher has adopted quantitative research techniques for the purpose of data representation, classification and interpretation. Inferential statistical technique ,chi-square and correlation are adopted for the purpose of testing the hypothesis. Interpretations are drawn on this basis of parametric and non-parametric statistical techniques

IndexTerms -:Logical and mathematical abilities, formal operational Proportionality thinking Probability thinking Correlation thinking.

I. Introduction

The perception about student’s learning mathematics is an a collection or disconnected and meaningless facts and procedure .Hence the primary goal of the mathematical education is to promote students' learning with understanding. A logical mathematical ability is related to reasoning, calculations, logic, critical thinking, and abstract thinking, all of which are related to the complexity of mathematics. People with highly developed logical mathematical abilities are able to understand systems and patterns, can rely on abstract thinking to solve problems, and can make logical and practical decisions more easily than most people. Children differ significantly with respect to their logical and mathematical abilities. These abilities of children need to be studied in relation to sighted children.

Keywords: logical mathematical ability, abstract thinking, Proportionality thinking, Probability thinking, Correlation thinking.

2. Objective of this study

- 1.To explore the Proportionality thinking of children with visual impairment and normal sight and to compare these abilities with respect to their gender background.
- 2.To explore the ability of Probability thinking of children with visual impairment and normal sight and to compare these abilities with respect to their gender background.
3. To explore the Correlation thinking of children with visual impairment and normal sight and to compare these abilities with respect to their gender background.

3. Hypotheses

1. Proportionality

a) Children with visual impairment and children with sight differ significantly with respect to their proportionality thinking.

b) Girls and boys belonging to visual impairment differ significantly with respect to their proportionality thinking.

c) Girls and boys belonging to sighted category differ significantly with respect to their proportionality thinking.

2. Probability

- a) Children with visual impairment and children with sight differ significantly with respect to their Probability thinking.
- b) Girls and boys belonging to visual impairment differ significantly with respect to their probability thinking.
- c) Girls and boys belonging to sighted category differ significantly with respect to their probability thinking

3. Correlation

- a) Children with visual impairment and children with sight differ significantly with respect to their Correlation thinking.
- b) Girls and boys belonging to sighted category differ significantly with respect to their correlation thinking.
- c) Girls and boys belonging to visual impairment and sight categories differ significantly with respect to their correlation thinking

4. Research Procedures:

4.1. Population and Sample:

Two different independent normally distributed populations with respect to the variables are selected for this study. To understand and examine the above hypotheses, visually impaired children and sighted children of class IX in Hyderabad are considered as the populations. While selecting the school a few variables like, physical facilities, medium of instruction, learning resources, residential facilities, enrolment and willingness to conduct the study are considered.

The researcher after a through field survey and wide consultations with the head of the institutions has identified 8 schools of sighted children and 3 residential schools catering to the educational needs of the visually impaired children that are willing to conduct the study. From these schools by adopting random sampling technique the Devnar school for Blind, Mayur Marg, Begampet, Hyderabad-500016 and Raghunatha Model High School, Chaitanapuri, Hyderabad -500060 are finally selected. By random stratified sampling technique the researcher selected total 64 children from IX standard. Out of which 32 children are visually impaired who were selected from Devanar blind school and 32 sighted children from Raghunatha model high school for the present study

4.2. Standardization and tools

For studying the cognitive behaviour of children especially for the visually impaired, the researcher did extensive survey of the research literature in various libraries was being made and consulted various experts in the field to develop, select, and administer the tool which could be equally suitable to both visually challenged and sighted children. The tools used to collect data are

1. The Test of logical Operations in mathematics (TLO – A Paper Pencil Test). Designed and constructed on the basis of Piaget's seven logical operations.
2. The modified Piagetian Logical-mathematical Test Battery.

4.3. Data Analysis: Techniques and Procedures

The researcher has adopted quantitative research techniques for the purpose of data representation, classification and interpretation. Inferential statistical technique, chi-square and correlation are adopted for the purpose of testing the hypothesis. Interpretations are drawn on this basis of parametric and non-parametric statistical techniques.

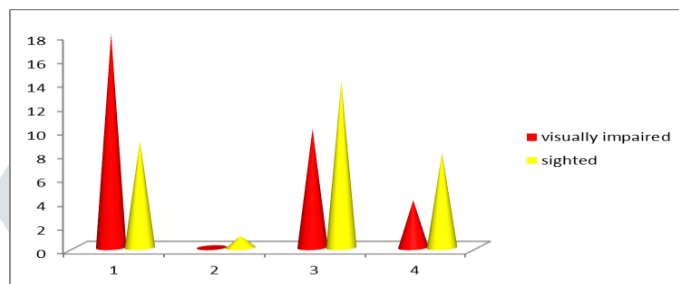
5.1.0. Objective I: To explore the Logical mathematical abilities of children with visual impairment and normal sight and to compare these abilities with respect to their gender background.

Proportional thinking is the establishment of relations of one part to another or of a whole with respect to magnitude, quantity or degree. This may refer to the understanding of such numerical relationships or of algebraic relationships of two variables.

One of the objectives of this research work is *to explore the Proportionality thinking of children with visual impairment and normal sight and to compare these abilities with respect to their gender background* by administering the appropriate tools and the responses of the children is collected and analysed. The data is presented below.

Table 5.1.0. Distribution of children with respect to the ability of “Proportionality thinking

sample	gender	ability of proportionality thinking				total
		Poor	fair	good	very good	
visually impaired	boys	8 50%	0 0%	6 7.5%	2 12.5%	16 100%
	girls	10 62.25%	0 0%	4 25%	2 12.5%	16 100%
sighted	boys	4 25%	0 0%	7 43.75%	5 31.25%	16 100%
total		27 2.18%	1 1.56%	24 37.5%	12 18.72%	64 100%



X- axis -Sample distribution.Y- axis- Proportionality thinking

From the above table it is clear that majority of visually impaired children’s performance is towards lower side of the scale, i.e., they are in poor categories. Out of 32 sighted children 14 children performance is good category. Further it is observed that the performance of boys and girls across the samples, by and large, is same.

However, for the purpose of finding statistical differences between the visually impaired and sighted Children the following three null hypotheses have been formulated:

1. There is no significant difference between the visually impaired and sighted children with respect to their “proportionality thinking”.
2. There is no significant difference between the boys and girls belonging to visually impaired with respect to their “proportionality thinking”.
3. There is no significant difference between the sighted boys and sighted girls with respect to their “proportionality thinking”.

5.1.1. In order to test the above null hypotheses the statistical test, “t-test”, has been adopted and the results are presented below:

	mean		s.d		t- value	signifi cance
	visually impaired	sighted	visually impaired	sighted		
hypothesis-1	2.433	3.733	1.278	0.4497	5.255	0.000
hypothesis-2	visually impaired boys 3.7333	visually impaired girls 3.7333	visually impaired boys .45774	visually impaired girls .45774	.807	.427
hypothesis-3	sighted boys 3.6667	sighted girls 3.8000	sighted boys .48795	sighted girls .41404	.807	.426

Visually impaired children vs. sighted Children: proportionality thinking:

The above table indicates that the mean and standard deviation values of visually impaired and sighted children are 2.433, 1.278 and 3.733, 0.4497. The obtained T-value is 5.255 (two-tailed) and $p(.000) < 0.05$ level of significance. This result indicates that children belong to the visually impaired and sighted categories differ significantly with respect to their proportionality thinking. Hence, the null hypothesis-1 is rejected.

Visually impaired boys vs. visually impaired girls: proportionality thinking:

The above table indicate that the mean and standard deviation values of visually impaired boys and visually impaired girls are 3.7333, 0.45774 and 3.7333, .45774. The calculated t-value is 1.387 (two-tailed) and $p(.427) > 0.05$ level of significance. This result indicates that the boys and girls belonging to visually impaired group do not differ significantly with respect to their proportionality thinking. Hence, the null hypothesis-2 is accepted.

Sighted boys vs. sighted girls: proportionality thinking:

The above table indicates that the mean and standard deviation values of sighted boys and sighted girls are 3.6667, 0.48795 and 3.8000, 0.41404. The obtained T-value is 0.807 (two-tailed) and $p(.426) > 0.05$ level of significance. This result indicates that sighted boys and sighted girls do not differ significantly with respect to their proportionality thinking. Hence, the null hypothesis-3 is accepted.

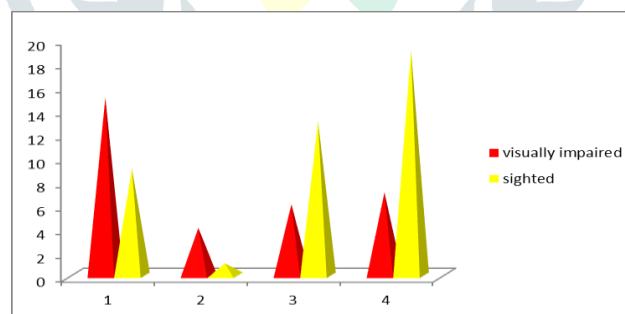
5.2.0. Objective IX: To explore the ability of Probability thinking of children with visual impairment and normal sight and to compare these abilities with respect to their gender background.

Probability thinking is the establishment of a logical relation statement such that evidence conforming to one conforms to the other to some degree. The extent to which an event is likely to occur, measured by the ratio of the favourable cases to the whole number of cases possible.

One of the objectives of this research work is to explore the ability of Probability thinking of children with visual impairment and normal sight and to compare these abilities with respect to their gender background by administering the appropriate tools and the responses of the children is collected and analysed. The data is presented below.

Table 5.2.0. Distribution of children with respect to the ability of “Probability thinking”

sample	gender	ability of probability thinking				total
		poor	fair	good	very good	
visually impaired	boys	8 50%	2 12.5%	3 18.75%	3 18.75%	16 100.0%
	girls	7 43.75%	2 12.5%	3 18.75%	4 2%	16 100.0%
sighted	boys	4 25%	1 6.25%	1 6.25%	10 62.5%	16 100.0%
	girls	5 31.25%	0 0%	2 12.5%	9 56.25%	16 100.0%
total		24 37.5%	5 7.8%	9 0.92%	26 40.62%	64 100.0%



X- axis -Sample distribution. Y- axis- Probability thinking.

From the above table it is clear that majority of visually impaired children’s performance is towards lower side of the scale, i.e., they are in poor and fair categories. Out of 32 sighted children 9 children’s performance is poor. Further it is observed that the performance of boys and girls across the samples, by and large, is same. However, for the purpose finding statistical differences between the visually impaired and sighted children the following three null hypotheses have been formulated:

1. There is no significant difference between the visually impaired and sighted children with respect to their “probability thinking”.
2. There is no significant difference between the boys and girls belonging to visually impaired with respect to their “probability thinking”.
3. There is no significant difference between the sighted boys and sighted girls with respect to their “probability thinking”.

5.2.1. In order to test the above null hypotheses the statistical test, “t-test”, has been adopted and the results are presented below:

	mean		s.d		t-value	significance
	visually impaired	sighted	visually impaired	sighted		
hypothesis-1	1.033	2.133	0.1825	0.3457	15.409	0.000
hypothesis-2	2.2000	2.0667	.41404	.25820	1.058	.299
hypothesis-3	2.2000	2.0667	.41404	.25820	1.058	.299

Visually impaired children vs. sighted Children: Probability thinking:

The above table indicates that the mean and standard deviation values of visually impaired and sighted children are 1.033, .1825 and 2.133, 0.3457. The obtained T-value is 15.409 (two-tailed) and $p(0.000) < 0.05$ level of significance. This result indicates that visually impaired and sighted categories differ significantly with respect to their probability thinking. Hence, the null hypothesis-1 is rejected.

Visually impaired boys vs. visually impaired girls: probability thinking:

The above table indicates that the mean and standard deviation values of visually impaired boys and girls are 2.2000, .41404 and 2.0667, .25820. The calculated T-value is 1.058 (two-tailed) and $p(.299) > 0.05$ level of significance. This result indicates that the boys and girls belonging to visually impaired group do not differ significantly with respect to their probability thinking. Hence, the null hypothesis-2 is accepted.

Sighted boys vs. sighted girls : Probability thinking:

The above table indicates that the mean and standard deviation values of sighted boys and girls are 2.2000, .41404 and 2.0667, .25820. The obtained t-value is 1.058 (two-tailed) and $p(.299) > 0.05$ level of significance. This result indicates that sighted boys and sighted girls do not differ significantly with respect to their probability thinking. Hence, the null hypothesis-3 is accepted.

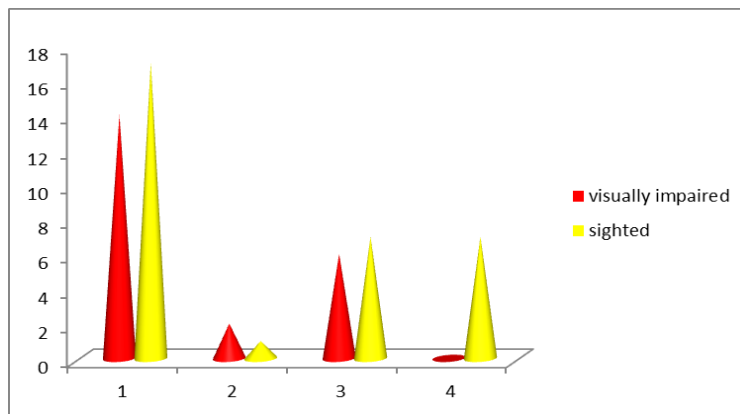
5.3.0. Objective X: To explore the Correlation thinking of children with visual impairment and normal sight and to compare these abilities with respect to their gender background.

Correlation thinking is the establishment of correlation or causal relationship. It may also refer to the presentation or setting forth so as to show relationships. The process of establishing a relationship or connection between two or more things.

One of the objectives of this research work is to explore the Correlation thinking of children with visual impairment and normal sight and to compare these abilities with respect to their gender background by administering the appropriate tools and the responses of the children is collected and analysed. The data is presented below.

Table 5.3.0. Distribution of children with respect to the ability of “Correlation thinking”

sample	gender	ability of correlation abilities				total
		poor	fair	good	very good	
visually impaired	boys	14 87.5%	0 0%	2 12.5%	0 0%	16 100%
	girls	10 62.25%	2 0%	4 25%	0 0%	16 100%
sighted	boys	9 56.25%	0 0%	4 25%	3 18.75%	16 100%
	girls	8 50%	1 6.25%	3 18.75%	4 25%	16 100%
total		41 64.0%	3 4.68%	13 20.31%	7 10.9%	64 100%



X- axis -Sample distribution's- axis- Correlation abilities.

From the above table it is clear that majority of visually impaired children’s performance is towards lower side of the scale, i.e., they are in poor and fair categories. Outof 32 sighted children 22children’s performance is poor. while the performance of sighted children is towards higher side of scale i.e., they are in good and very good categories. However, for the purpose finding statistical differences between the visually impaired and sighted children the following three null hypotheses have been formulated:

1. There is no significant difference between the visually impaired and sighted children with respect to their “correlation thinking”.
2. There is no significant difference between the boys and girls belonging to visually impaired with respect to their “correlation thinking”.
3. There is no significant difference between the sighted boys and sighted girls with respect to their “correlation thinking”.

5.3.2. In order to test the above null hypotheses the statistical test, “t-test”, has been adopted and the results are presented below:

	mean		s.d		t-value	Significance
	visually impaired	sighted	visually impaired	sighted		
Hypo thesis-1	1.1333	3.6666	0.4341	0.4794	21.452	.000
Hypo thesis-2	visually impaired boys	visually impaired girls	visually impaired boys	visually impaired girls	.756	.456
	3.7333	3.6000	.45774	.50709		
Hypo thesis-3	sighted boys	sighted girls	sighted boys	sighted girls	.756	.456
	3.7333	.45774	3.6000	.50709		

Visually impaired children vs. sighted Children: correlation:

The above table indicates that the mean and standard deviation values of visually impaired and sighted children are 1.1333, .4341 and 3.6666, 0.4794 .The obtained t-value is 21.452 (two-tailed) and $p(.000) < 0.05$ level of significance. This result indicates that children belonging to the visually impaired and sighted categories differ significantly with respect to their correlation thinking. Hence, the null hypothesis-1 is rejected.

Visually impaired boys vs. visually impaired girls: correlation:

The above table indicates that the mean and standard deviation values of visually impaired boys and visually impaired girls are 3.7333,0.45774 and 3.6000, 0.50709.The calculated t-value is .756 (two-tailed) and $p(.456) > 0.05$ level of significance. This result indicates that the boys and girls belonging to visually impaired group do not differ significantly with respect to their correlation thinking. Hence, the null hypothesis-2 is accepted.

Sighted boys vs. sighted girls: correlation:

The above table indicates that the mean and standard deviation values of sighted boys and sighted girls are 3.6000, 0.50709 and 3.7333, 0.45774.The obtained T-value is .756 (two-tailed) and $p(.456) > 0.05$ level of significance. This result indicates that sighted boys and sighted girls do not differ significantly with respect to their correlation thinking. Hence, the null hypothesis-3is accepted.

6. Discussion

The above study is also supported by many researches on the cognitive abilities of males and females; it was observed that from birth to maturity, the claim that men have greater intrinsic aptitude for mathematics is proved to be false. Male and female infants do not differ in the cognitive abilities at the foundations of mathematical thinking and they have common abilities to represent and learn about objects, numbers, language, and space. Male and female children harness these abilities in the same ways, at the same times, to master the concepts and operations of elementary mathematics. These findings are consistent with those of Heron and Simmons son (1969) which found no significant difference in the conservation performance between male and female children.

The better performance in proportionality thinking, probability thinking and correlation thinking tasks by sighted children than visually impaired children may be due to development of the ability to think about abstract concept skills such as logical thought, deductive reasoning, and systematic planning is early developed. In case of visually impaired children, the ability to think about abstract concepts rely solely on previous experiences and present demands. They also lack the ability to consider many different solutions to a problem before acting. Because their representations are limited to the tangible, touchable and concrete, their appreciation of the consequences of events is similarly limited, local and concrete in scope. This is also supported by Salkind, 2004, according to him, "In the formal operational stage, actual (concrete) objects are no longer required and mental operations can be undertaken 'in the head' using abstract terms". But in case of visually impaired, children are often developmentally delayed in the motor skills and perception which badly effect the cognitive skill of child and significantly impact on their higher level of mathematical skills.

7. References

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