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The Metacognitive Awareness and Logical-Mathematical Abilities among Children with Visually Impairment and Sight

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

[1]Doctoral Student, Acharya Nagarjuna University, Guntur, AP, India
[2]Professor of Education, English and Foreign Languages University, Hyderabad, India

Abstract: ***This paper presents the relationship between the logical and mathematical abilities of children with respect to their Metacognitive Awareness in mathematics. Metacognition refers to higher order thinking which involves active control over the cognitive processes engaged in learning. Because metacognition plays a critical role in successful learning, hence it is important to study metacognitive activity and development to determine how students can be taught so that they may better apply their cognitive resources in learning mathematics. A study was conducted on students of higher secondary school. Two independent normally distributed populations of visually challenged and sighted children are selected for the study. By random stratified sampling technique the researcher selected total 64 children from IX standard. Out of which 32 children are visually impaired and 32 sighted children for the present study. It is found that in visually impaired and sighted children, awareness and enhancement of once own metacognitive skills improve the mathematical abilities.***

Keywords: metacognitive skills, visually challenged children, logical and mathematical abilities

1. Introduction

Mathematics cultivates thinking and reasoning skills. The mathematical problem solving instruction in the school is to equip the child with skills that enable them to think for themselves and to enhance flexible, independent thinking. It lays the foundation for systematic thinking through the numerical and spatial aspects of the objects[1].

When we think of visual impairment the first question comes in the mind is about their abilities in mathematics. It is found that mathematics skills are poorly developed .This may be because he /she must build up concepts of the world based on other senses and experiences. Even cognitive skills development may be delayed in them because of the absence of the concept of "what happens when", translation of a given concept into other activities and understand the cause and effect relationship [2].

In visually challenged children lack of competence in mathematics results in a harmful effect on the students' further education and training, and thus, it has a deleterious effect on the individual's entire life including, the choice of career paths. As they are unable to demonstrate the fundamental level of mathematics competence necessary for entrance into technical areas are closed to them[3].

Metacognition is an ability which is of concern in development of mathematical skills in children. Metacognition refers to higher order thinking which involves active control over the cognitive processes engaged in learning. Activities such as planning how to approach a given learning task, monitoring comprehension, and evaluating progress toward the completion of a task are metacognitive in nature. Because metacognition plays a critical role in successful learning, it is important to study metacognitive activity and development to determine how students can be taught to better apply their cognitive resources through metacognitive control[4].

According to[5], metacognition is thinking about our thinking and it comprises the following three important aspects: knowledge about our own thought processes, control or self-regulation, and beliefs and intuition. According to [5]metacognition is that students should wisely divide their time among (a) understanding the problem, (b) planning, (c) making decisions on what to do, and (d) executing the decisions for a solution within the time frame. In the process of solving a problem, they should be monitoring and keeping track of the progress to a solution. When the decisions seem not to work, they should try other alternatives or make some adjustment.

Few research work regard metacognitive actions as the 'driving forces' in problem solving, influencing cognitive behaviour in all phases of problem solving [6,7,5]. Some research studies have also reported success in making young children become more aware of their regulation during problem solving [8].

This knowledge about metacognition abilities are to be understood and strategies have to be employed to improve and understand the visually impaired students. Thus, the ability of individuals with visual impairments to regulate their behaviour in order to achieve optimal functioning at school can be achieved.

2. Objective of this Study

To examine the relationship between the metacognive awareness and logical and mathematical abilities of children with visual impairement and sight.

Hypotheses:

1. There is an association between the meta-cognitive awareness and the logical and mathematical abilities of children with visual impairment.
2. There is a significant correlation between the meta-cognitive awareness and the logical and mathematical abilities of children with visually impairment.
3. There is an association between the meta-cognitive awareness and the logical and mathematical abilities of children with sight.
4. There is a significant correlation between the meta-cognitive awareness and the logical and mathematical abilities of children with sight.

Research Procedures:

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, Hydreabad -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.

Tools: Design & Development

For studying the metacognitive abilities of children especially for the visually impaired, the researcher did extensive survey of the research literature and consulted various experts in the field to identify appropriate Metacognitive Activity Inventory (MCAI) and develop a tool to measure logical and mathematical abilities which could be equally suitable to both visually challenged and sighted children. The MCAI was adopted from Delvecchio, F. (2011), Cooper, M., and Sandi-Urena, S. (2009).

The MCAI is administered, as a part of a more comprehensive questionnaire to the visually impaired and sighted children. Visually impaired and sighted children are required to indicate the extent to which each statement in MCAI applies to them. The focus of the tool is to understand the metacognitive abilities of visually challenged children and sighted children. Metacognitive skill is one of the components of metacognition. Schraw and Denison (1994) define metacognition as “the knowledge and regulation of one’s cognition." It has two main components, namely; metacognitive knowledge and metacognitive skilfulness.

The 27 item self-report MCAI instrument assesses students’ metacognitive skilfulness when solving mathematical problems and is used as a diagnostic tool. There are eight items (items 20-27) that were scored inversely to avoid the effects of acquiescence (the tendency of respondents to agree with most of the statements presented to them) (Cooper, M., & Sandi-Urena, 2009). There are eight items (items 20-27) that were coded inversely thus reversely scored to “avoid the effects of acquiescence (the tendency of respondents to agree with most of the statements presented to them)” (Cooper, M., & Sandi-Urena, 2009). The highest possible score that a student could obtain is 135 by adding together the points selected for each item on the MCAI questionnaire. However, before any analysis of the scores, the researcher coded reversely the items that were negatively worded (items 20 – 27).Children select their agreement with the items from a 5 point Likert scale (1, strongly disagree to 5, strongly agree).

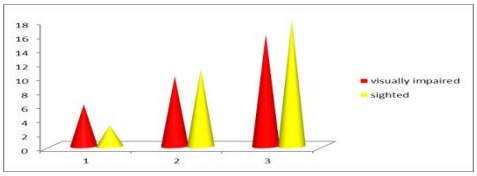
3. Data Analysis and Interpretation

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 hypotheses. Interpretations are drawn on the basis of parametric and non-parametric statistical techniques.

One of the objectives of this research work *is to examine the relationship between the logical and mathematical abilities of children with respect to their Metacognitive abilities* As discussed above relevant tools were administered and the responses of children were collected, analysed and presented below.

Association between Metacognitive Awareness Vs Logical- Mathematical Abilities of the children.

	Logical and Mathematical Abilities					
Children	Meta cognitive Awareness	Poor	Fair	Good	Very Good	Total
Visually Impaired	Low	2	0	4	0	6
	Medium	0	0	10	0	10
	High	0	0	15	1	16
Sighted children	Low	2	1	0	0	3
	medium	1	1	4	5	11
	High	2	0	8	8	18



X- axis – Metacognitive Awareness
Y- axis-. Logical-Mathematical Abilities

From the above table it is clear that majority of visually impaired children's performance in Logical and Mathematical Abilities test is towards higher side of the scale, i.e., they are in good category. Out of 32 sighted children 16 children are found in good and very good category and they are also in high metacognitive awareness. Out of 32 visually impaired children 15 children's performance is good and they found with high metacognitive awareness. To understand the relationship between metacognitive awareness and logical mathematical abilities of children the following null hypotheses has been formulated:

In order to test the hypotheses 1 &2 they were translated into null form and appropriate statistical test Chi square was used to test the association between Metacognitive Awareness and Logical- Mathematical Abilities of the both categories of children. From the statistical results inferences are drawn and presented below.

		Value	df	Asymp.sig(2-sides)
Visually impaired	Pearson Chi-Square	32.473(a)	4	.000
	Likelihood Ratio	15..691	4	.003
	Linear-by-Linear Association	13.952	1	.000
	No of Valid Cases	32		
Sighted Children	Pearson Chi-Square	32.435(a)	4	.000
	Likelihood Ratio	15.339	4	.004
	Linear-by-Linear Association	12.837	1	.000
	No of Valid Cases	32		

In case of visually impaired children the above table indicates that the calculated value of chi-square for visually impaired is 32.473 at 4 degrees freedom and .000 probability value. In other words the calculated value is significant at 0.05 level of significance. And in case of sighted children the above table indicates that the calculated value of chi-square for sighted is 32.435 at 4 degrees freedom and .000 probability value. And this value is significant at 0.05 level of significance.

In order to test the hypotheses 3 &4 they were translated into null form and appropriate statistical test – Pearson Correlation Test was used to test the correlation between Metacognitive Awareness and Logical- Mathematical Abilities of the both categories of children. From the statistical results inferences are drawn and presented below.

		Metacognitive Awareness	Logical-Mathematical Abilities
For visually Impaired children	Metacognitive Awareness	1	0.671
	Logical-Mathematical Abilities	0.671	1
For sighted children		Metacognitive Awareness	Logical-Mathematical Abilities
	Metacognitive Awareness	1	0.677
	Logical-Mathematical Abilities	0.677	1

The statistical findings indicate that there is a high and positive correlation (Pearson correlation is 0.671 at p(.000)< 0.05 between logical mathematical abilities and meta cognitive awareness of visually impaired children. This result indicates that children's Meta cognitive abilities and logical-mathematical awareness are significantly associated. With respect to sighted children it is found that there is a positive correlation between logical mathematical awareness and metacognitive awareness and the correlation value is 0.677 at0.05level of significance. This result indicates that children's metacognitive awareness and logical-mathematical abilities are significantly correlated.

4. Discussion

Metacognition refers to the awareness individual's ability to evaluate and regulate their own thinking. In the above study it was found that both sighted children and visually impaired children show a positive correlation and association between logical-mathematical abilities and metacognitive awareness in mathematical problem solving.

Metacognitive process is considered to be another important factor influencing problem solving performance. It is also observed that the ability to monitor one's own learning increases the effectiveness of problem solving. Good problem solvers tend to show more meta-cognitive knowledge. i.e., an awareness of the processes of learning and solving mathematics [5&9].

Research in the field of mathematics and metacognition has reported that students having difficulties in mathematics do not use a range of cognitive or metacognitive strategies [10&11]. Hence whether in visually impaired or sighted children, awareness and enhancement of once own metacognitive skills can improve the mathematical abilities.

One can adopt many methods and strategies for enhancing matacognitive skills in children. Monitoring of metacognitive awareness in children is a real challenge for teachers. Class room teachers need to scaffold and facilitate children's learning in logical and mathematical subject areas by careful and continuous development of metacognitive abilities. This in turn will transform children as reflective learners with self-confidence and self-efficacy.

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