School Environment and Perceptual Speed in Relation to Achievement in Mathematics of Class IX Students

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Abstract

It is well known that every branch of mathematics has its own unique importance and its applications to different educational and career options. The high levels of students' mathematics performance may not be guaranteed where instructional space such as classrooms, libraries, technical workshops, and laboratories are structurally defective. Also, Perceptual speed is a psychological construct which contributes for maximum learning in mathematics. Hence, the present study is an attempt to investigate how the school environment and perceptual speed of class IX students are related with their achievement in mathematics and to suggest suitable strategies to improve their school environment and perceptual speed. The results revealed that a significant low positive correlation was found between overall Mathematics Achievement and overall and different dimensions of school environment and the Perceptual Speed.

KEYWORDS: mathematics achievement, perceptual speed, school environment

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Introduction

Achievement differences in complex subject areas like mathematics have not been adequately explained. Solving a mathematical problem for example implies the interaction of varied abilities like comprehension of the process implied, inductive and deductive reasoning, and abilities to deal with abstract concepts, spatial and visual perception, and so on. Of the many factors proposed to account for individual variations in mathematics achievement, the present study concentrates on first mental abilities related to perceptual speed and School environment. Perceptual Speed is the speed at which visual stimuli can be compared for similarity or difference. Researchers (Ackerman, Beier, & Boyle, 2002; Ackerman &Cianciolo, 2000; see McGrew, 2005) suggests that Perceptual Speed may be an intermediate stratum ability between narrow and broad defined by four narrow sub abilities viz., Pattern Recognition, i.e. the ability to quickly recognize simple visual patterns; Scanning, i.e. the ability to scan, compare, and look up visual stimuli; Memory, i.e. the ability to perform visual perceptual speed tasks that place significant demands on immediate processing speed; and Complex i.e. the ability to perform visual pattern recognition tasks that impose additional cognitive demands, such as spatial visualization, estimating and interpolating, and heightened memory span loads."Perceptual speed is assessed by the speed of responding (usually on paper-and-pencil tests) with simple content in which everyone would be perfect if there were no time limits. Perceptual speed tasks often involve elementary comparison, search,

and substitution operations, with the test score consisting of the number of items correctly completed in the specified time" Salthouse (2000).

Emphasizing the importance of the school environment to the student's academic performance, Oluchukwu, (2000) asserted school environment is an essential aspect of educational planning. He went further to explain, "Unless schools are well suited, buildings adequately constructed and equipment adequately utilized and maintained, much teaching and learning may not take place. According to Mick Zais (2011), School Environment means the extent to which school settings promote student safety and student health, which may include topics such as the physical plant, the academic environment available, physical and mental health supports and services, and the fairness and adequacy of disciplinary procedures, as supported by relevant research and an assessment of validity.Dorsy (2000) defines, School Environment as involving for key relationships, the relationship of a student to him or herself; a student to his or her peers; a student to his her parents and community; and a student to his or her school workers including teacher, administrator, and all staff. In the present study, the school environment of selected schools are measuredregarding Nurturing enabling environment, Participation of all children and parents, Discipline and participatory management, Curriculum sites and learning resources, Resource of the school and Mathematics teacher related aspects.

Tests involving perception of spatial relations have been used for a long time as qualitative, informal tests of brain damage and even the person's attitude towards the task. Mathematics being a subject which needs more mental operations and logical thinking, span of perception will also influence achievement in mathematics. From the review of related literature, it is noticed that there is not much venture done in this area, which covers the various aspects as aimed in the present study.

Need of the Study

Obioma (2005) states that despite the importance placed on mathematics, researchers had observed that students lack interest in the subject and performpoorly in it. It is unfortunate to note that mathematics in general is disliked by students and is not taught effectively by all teachers of mathematics in a classroom. Majority of pupils feel that mathematics is a difficult subject and it can be understood and followed only by exceptionally intelligent students. Kulp (2004) has established visual perceptual skills have relation with mathematics ability in second through sixth class students. Bowker and Trafton (1981), Battle and George (1985), Doehring and Rosenstein (1985), Gourikuttyamma (1991), Bryce(1994), Davis(1996), Manoranjan Panda (2005) found a significant influence of perceptual speed on academic achievement. Geiger and Litwille (2005) found that poor visual perceptual ability is significantly related to poor achievement in mathematics, even when controlling for verbal cognitive ability both males and females have the same level of perception of mathematics achievement.

Some attempts were also made to predict the factors influencing mathematics achievement in different conditions .Elmore and Ellen (1986), Casey et.al. (2002), Rhode (2008) are some among them. Even though a large number of studies have been conducted in the area of perceptual speed (Shavalier, 2004; Rohde, T.E., &Thompson, L.E. (2005); Tang, 2006; Behzat, 2006; Rohde, 2009), the studies which relate to achievement are very scanty. Akira and Naomi (2001), Zhang (2003), Kathlee (2007) Sewell (2008) studied the effect of perceptual abilities on academic achievement but

Indian studies which relate to mathematics achievement are very few. Some attempts were also made to predict the factors influencing mathematics achievement, Paul (2004), Rhode (2008), Lindson raj (2010) but no such studies were found in the state of AndhraPradesh.

The present study was conducted to investigate how school environment and perceptual speed are correlated with that of mathematics achievement of class IX students of ChittoorDistrict where such studies are not available. Hence, the present problem was selected with the following objectives:

Objectives of the study

1. To study the relationship between Mathematics Achievement and overall and factor-wise perceptual speed of class IX students
2. To explore the relationship between Mathematics Achievement and overall and factor-wise school environment of class IX students
3. To suggest the suitable strategies for the improvement of perceptual speed among students and their school environment.

Hypotheses of the study

In the light of the above objectives, the following hypotheses were formulated for testing:

1. There would not be anysignificant correlation between mathematics achievement and overall school environment and its factors.
2. There would not be anysignificant correlation between mathematics achievement and overall perceptual speed and its factors.

Methodology

Descriptive survey method was employed for the present study. A total of 960 class IX students were selected for the sample by adopting stratified random sampling technique from forty high schools of Chittoor district of Andhra Pradesh. A mathematics achievement test and a school environment scale developed by the investigator and a Perceptual Speed Test (developed by Lidsonraj) were the tools used for collecting data pertaining to high school students. The mathematics achievement test contains 60 items on six dimensions viz., real numbers, polynomials, lines and angles, linear equations, statistics, and surface area, volume and others. The school environment scale contains 60 items on six dimensions viz., nurturing an enabling environment, participation of all children and space for parents and community, discipline and participatory management, curriculum sites and learning resources, physical environment and educational resources, and mathematics teacher related aspects. The Perceptual speed test comprises of 54 items on five factors viz., items related to word comparison, figure comparison, comparison of roman numbers, number/formula comparison and figure identification. Each item in the school environment scale was scored as 1, 2, and 3 to the options low, moderate and high levels of environment whereas, the mathematics achievement and perceptual speed tests were scored as 0 and 1 respectively to the responses such as wrong and right. The summated score of all the items in the tools provided the total score of a student. The reliability co-efficient of the three tools viz., Mathematics Achievement, School environment and Perceptual Speed obtained by using spilt-half method were0.84, 0.79 and 0.82respectively and the intrinsic validity of the tools were 0.92, 0.89 and 0.90 respectively. A personal data sheet to collect the information relating to variables such as sex, locality, management of the school and medium of instruction was used. The data thus collected was analysed using appropriate statistical techniques.

Results and Discussion:

Table: 1. Correlation between School Environment and Mathematics Achievement

Variables correlated with Mathematics Achievement		Value of r	Level of significance
OverallSchool environment		0.073	*
Components of the School Environment	Nurturing an Enabling Environment	0.065	*
	Participation of all children and space for parents and community	0.051	@
	Discipline and Participatory management	0.057	@
	Curriculum sites and learning resources	0.063	@
	Physical environment and educational resources	0.221	**
	Mathematics Teacher related aspects	-0.069	*

Note: * Significant at 0.05 level, ** Significant at 0.01 level and @ Not Significant at 0.05 level

The results from the above table reveal that the value of the coefficient of correlation between overall School Environment and Mathematics achievement is 0.073, which is significant at the 0.05 level. This shows that there is a significant positive correlation between overall School Environment and Mathematics achievement of the students. The above table also reveals that different dimensions of school environment viz., Nurturing an enabling environment, physical environment and resources, and mathematics teacher related components have a significant correlation with Mathematics achievement. The correlation between nurturing an enabling environment and mathematics achievement is 0.065, which is significant at 0.05 level. The correlation between 'physical environment and resources' and Mathematics achievement is 0.221 which is significant at 0.01 level. The correlation between 'Mathematics teacher related aspects of the school environment' and Mathematics achievement is -0.069 which is significant at 0.05 level. From the results, it can be concluded that there is a significant positive relationship between mathematics achievement and overall school environment, and its dimensions viz., Nurturing an Enabling Environment, and Physical environment and educational resources, and Mathematics Teacher related aspects, and negative correlation was found between Mathematics achievement and Mathematics Teacher related aspects. No significant correlation was found between the other dimensions of school environment viz., 'participation of all children and space for parents and community,' 'discipline and participatory management,' 'curriculum sites and learning resources' and mathematics achievement.

Hence, the null hypothesis is rejected with respect to overall school environment and different dimensions of School Environment such as, 'nurturing an enabling environment', 'physical environment and resources', 'mathematics teacher related aspects', but accepted with respect to the other components such as 'participation of all children and space for parents and community', 'discipline and participatory management', 'curriculum sites and learning resources'. Thus, it may be concluded that there is a significant positive correlation between Mathematics achievement of the students and overall School Environment and different dimensions viz., nurturing an enabling environment, physical environment, and educational resources, and a negative correlation with respect to mathematics teacher related aspects only.

Table:-2. Showing the Correlation between Perceptual speed and Mathematics Achievement

Variables correlated with Mathematics Achievement		Value of r	Level of significance
Overall Perceptual speed		0.241	**
Components of the Perceptual speed	Word comparison	0.243	**
	Figure comparison	0.220	@
	Comparison of Roman numerals	0.123	**
	Number/Formula comparison	0.053	@
	Figure Identification	0.052	@

Note: ** Significant at 0.01 level and @ Not Significant at 0.05 level

Table 2 reveals that the coefficient of correlation obtained between overall Perceptual Speed and Mathematics is 0.241. The obtained r-value is significant at 0.01 level. Hence, the obtained correlation is highly significant. Thus, the result shows that there is a significant positive correlation between overall Perceptual Speed and Mathematics achievement of students. Moreover, from table 2 it can also be seen that the components of Perceptual Speed viz., Word Comparison and Comparison of Roman Numerals have a significant correlation with that of mathematics achievement at 0.01 level. No significant correlation was found between the other components of perceptual speed such as figure comparison, Number/Formula Comparison and Figure Identification with that of mathematics achievement.

Hence, the null hypothesis is rejected concerning the overall perceptual speed and components of it viz., Word Comparison and Comparison of Roman Numerals, but accepted with respect to the other components of perceptual speed viz., figure comparison, Number/Formula Comparison, and Figure Identification. Thus, it may be concluded that there is a significant positive relation between overall Perceptual Speed and figure comparison, Number/Formula Comparison and Figure Identification only with that of Mathematics Achievement of students.

Findings of the study

Based on the correlation analysis, the results revealed the following:

- A significant low positive correlation was found between Mathematics Achievement and overall and different dimensions of Perceptual Speed such as word comparison, comparison of roman numerals.
- A significant low positive correlation was found between mathematics achievement and overall and different dimensions of school environment viz., nurturing an enabling environment, physical environment and resources, and mathematics teachers related aspects.

Educational Implications

In the light of the above results, the following are the implications of the study:

In the present study, a significant low positive correlation was found between Mathematics Achievement and overall and different dimensions of Perceptual Speed such as word comparison, comparison of roman numerals. Similarly, a significant low positive correlation was found between mathematics achievement and overall and different dimensions of school environment viz., nurturing an enabling environment, physical environment and resources, and mathematics teachers related aspects. Therefore it is necessary to shift our focus of mathematics education from achieving

‘narrow' goals to ‘higher' goals, engaging every student with a sense of success, while at the same time offering conceptual challenges to the emerging mathematician, changing modes of assessment to examine students' mathematization abilities rather than procedural knowledge, and ,enriching teachers with a variety of mathematical resources. Thus, the need of the hour is to shift our focus from mathematical content to mathematical learning environments and School Environment, where a whole range of processes such as formal problem solving, use of heuristics, estimation, and approximation, optimization, use of patterns, visualization, representation, reasoning and proof, making connections, mathematical communication take precedence.

As suggested by NCF, importance to these processes also helps in removing the fear of mathematics from children’s minds. A crucial implication of such a shift lies in offering a multiplicity of approaches, procedures, solutions. This is crucial for liberating school mathematics from the tyranny of the one right answer, found by applying the one algorithm taught. Such learning environments invite participation, engage children, and offer a sense of success. As suggested by NCF, it is to note that a great deal needs to be done towards preparing teachers for mathematics education. A large treasury of resource material, which teachers can access freely as well as contribute to it, is badly needed.

The government should provide schools with facilities that will develop and sustain student’s mathematical ability as it is a predictor of student’s achievement in mathematics.

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