CHAPTER III
PROBLEM AND HYPOTHESES

Reading is a process which is acquired through formal training where the learner proceeds from a basic level of learning to read and slowly acquires the ability of reading to learn. Scholastic achievement of a child is influenced to a large extent by the ability to read as it forms the basis for instructions and gaining knowledge in all subjects. A number of investigators have reported a positive relationship between reading ability and scholastic achievement (Olson, 1966) and reading ability has been found to be differential among high, moderate and low achievers (Shivananda & Usha, 1985; Srivastava, 1969). With regard to achievement in mathematics a strong relationship has been observed with reading ability. High reading groups have been shown to performance better in mathematics as reading ability and computational ability both play an important role in children’s successful solution of word problems (Muth, 1984). Reading ability also predicts the conceptual understanding of mathematics as students who have good vocabulary and reading comprehension skills, also have good ability to interpret graphs and formulas (Eagle, 1948). This relationship receives further support from the fact that genetic and shared environmental influences have been found to contribute almost equally to the observed covariance between reading and mathematic scores (Light & Defries, 1995).

Even at the cognitive level these abilities appear to share a lot of similarities. The basic form of reading ability constitutes of primary units, i.e. identification of alphabets, words, sentences and the higher
level relates to semantics i.e. assigning meaning to word or sentence. Research in the area of cognitive basis of reading ability has shown that at the structural level phonological processes assumes prime importance while at the semantic level word recognition plays an important role (Chan & Siegel 2001; Parikh, 1979; Porpodas, 1999; Srivastava, 1989).

Similarly, mathematical ability also comprises of basic and higher order components where the basic structural component comprise of numerals, operands and algorithmic procedure (Computation) while the higher order semantic component comprises of concept identification and problem solving strategy (conceptual). Here, proficiency in basic computation and fact retrieval has been identified as important contributors to mathematical skills; Levine, 1987). These basic and higher order processes operate in an interactive manner where processing can be both ways i.e. top down and bottom up (Campbell & Oliphant, 1992; McCloskey & Lindemann, 1992).

However, research implicates the independence of the two components. Investigations of reading and mathematics deficits indicate that the basic component need not be a prerequisite for the higher order processing (Showling, 1987; Shywitz, 1996).

These deficits can be functional or structural in nature. At the functional level an individual may utilize an inappropriate or ineffective strategy, which might have been effective during the initial stage of learning, or was appropriate in a given context, while at the structural level specific neuropsychological deficits may exists. Functional deficits can be attributed to nature of instructions and
societal factors. The role of language in reading implicates early parental influences where a good preschool vocabulary facilitates the decoding process of learning to read. The role of instructions is clearly evident from the differential effect of various teaching methods i.e. whole word and look and say etc. However, the relationship is more explicit in case of mathematical ability where cross cultural comparisons between Asian (Japanese and Korean) and American children reveal the superiority of Asian children at the computational level (Husen, 1977; Song and Ginsburg, 1987). These differences have been attributed to variations in school and home experiences. At the home level parent’s expectations of academic success and their attribution of children’s achievement success to efforts, have been found to differ in Asian and U.S. children. At the school level, proportion of time spent on mathematics is greater in Asian students (Hess, et al., 1986; Mordkowitz & Ginsburg, 1987; Stevenson, et al, 1986). Other than these factors the methods of generating number in Asian numeral number representation (Japanese) reflects the base 10 numerals system and this facilitates the comprehension of place value concepts and addition/subtraction with regrouping.

At the neuropsychological level verbal attention, short term deficits, remote verbal memory, language integration, nonverbal concept formation and upper body motor function have been found to be associated to reading and spelling problems. Mathematical deficits, have been found to be associated with a general attention deficit, visuospatial deficit, long term memory retrieval deficits, and procedural deficits (Gray, 1991; Levine, 1987). Overall neuropsychological scores have been found to predict reading and arithmetical performance and corresponding neuropsychological changes have been found to parallel improvements in reading and
verbal strategies (Delazer, Girelli, Semenza & Denes, 1999). The role of specific brain areas has also been implicated as spelling and writing abilities have been found to be supported by left hemisphere mechanisms (Larsen, Baynes & Swick, 2004). Left hemispheric lesions have been reported to result in problems in reading and writing of numbers, with intact skills in other areas of arithmetical processing (Hecaen, 1962; McCloskey, Caramazza & Basili, 1985). Difficulties in the spatial representation of numerical information is often associated with damage to the posterior regions of the right hemisphere (Benson & Weir, 1972; Cohn, 1961).

Thus, identification of the cognitive and / or neuropsychological correlates of reading and mathematical ability could help in detection of the nature of deficits in these areas thereby making it possible to provide possible remedial measures.

Keeping in view the importance of early detection of these deficits, the present study was planned and the following problem was formulated.

**PROBLEM**

A study of structural, semantic and neuropsychological basis of reading and mathematical ability.

**OBJECTIVES**

The following objectives of the study were delineated:

1. To study the relationship of reading / mathematical ability to academic achievement.

2. To study the structure of reading and mathematical ability.
HYPOTHESES

To achieve the above objectives, the following hypotheses were formulated.

1. Ability (Reading / Mathematical) of high achievers would be significantly higher than that of low achievers

2. Ability (Reading/Mathematical) would be positively related to academic achievement (Hindi and Mathematics respectively).

3. Phonological ability and word recognition would be significant predictors of academic achievement.

4. Reading ability would be positively related to mathematical achievement and ability

5. Neuropsychological basis of reading and mathematical ability would be similar.

The Design and Methodology used for the present investigation has been given in the next chapter.