Chapter – 3

REVIEW OF RELATED LITERATURE

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3.1 **Introduction:**

This is an attempt to give a brief sketch of related studies done in the field of testing and measurement as well as mathematics education. The studies have been taken from 1970 to 2006.


Both Indian Studies and foreign studies are given separately. Brief analysis of these studies is mentioned as summary and implication for the study.

3.2 **Importance of review of related literature:**

It is important to review literature related to the study in order to learn more about the study, determine the context in which the study might have been researched previously and obtain guidance that will help in putting the research efforts more swiftly.

Review of literature serves several purposes in research. Knowledge from related literature is used in stating the significance of the problem, developing the research design, relating the results of the study to previous knowledge and suggestions for further research. It enables the researcher to define and limit the problem and helps in placing the problem in a historical
and associational perspective. A thorough search of the related literature enables the researcher to avoid unintentional and unnecessary replication. Previous investigations provide a rationale and insight for the research design. Review of related literature helps in relating the findings to previous knowledge and suggest for further research.

Keeping in mind the importance of review of related literature, investigator reviewed various primary sources of information and secondary sources of information. They are listed below.

### 3.3 Indian Studies:

1. Bhavsar S.J. (1970) constructed and standardized Numerical Aptitude test for the students of STD IX, X and XI of secondary schools of Saurashtra area.\(^{(1)}\)

   The test included fourteen subtests, which were further classified under three categories, viz. (1) computation ability in four fundamental processes on integers, fractions, decimals and numbers with units. (2) Computation ability with reasoning in percentage, ratio and proportion. Square, Square roots, cube, cube roots, averages (3) understanding of important concepts and processes as given in problems like transformation of fractional to decimals, transformation of one unit to another, place value, HCF, LCM number series completion etc.

   The final form of the test contained 50 items. The reliability coefficients have been calculated using test-retest, split-half, K-R formula
K-R formula reliability co-efficient ranged from .84 to .94. Validity co-efficient ranged from .43 to .75. The other findings were (1) performance of boys was significantly superior to the performance of girls (2) The city students and urban students didn’t differ significantly in their scores (3) Rural boys showed a better performance than the city boys on the test.

2. Shah R.P. (1971) Constructed and standardized a Numerical ability test for High school students. The test items were first coined and tried out in the free response form. The distractors were drawn from the actual incorrect responses of a representative sample of pupils. Five aspects were selected viz numerical facility, number series, numerical concepts, lower and higher numerical reasoning. Final version of the test has ten items in each aspect. The test was administered on 3,743 boys and 3,249 girls of Std. VIII to Std.XI of Gujarat State. Stratified cluster samples were drawn. The test was also administered on students of pre degree commerce, pre degree science, First year engineering, IIT’s and polytechnic.

Percentile grade norms were computed for boys and girls, opting elementary mathematics, as well as for those opting algebra and geometry at their respective grade levels. Percentile norms for technical groups were also computed. The test-retest reliability coefficients ranged from 0.523 to
.880 with a median value of .661 and split-half reliability coefficient ranged from .755 to .934 with median value of .835 for the students of grades VIII, IX, X and XI.

3. Singh R.N. (1971) constructed and standardized a battery of test of verbal, abstract and numerical reasoning. (3)

A battery of test of verbal, Numerical and abstract reasoning (VNART) was named as "A test of General Mental Ability" consisting of verbal reasoning test (VRT), numerical reasoning test (NRT), abstract reasoning test (ART). The subtest included in the battery were word classification, word analogy, number series, arithmetic problems, figure analogy and figure series. The battery was standardized on a sample of 4500 students of higher secondary school and pre university classes (covering the age range of 13 years to 20 years). The co-efficient of split-half reliability for VRT, NRT, ART and VNART was found to be 0.82, 0.92, 0.91 and 0.94. Co-efficient of reliability by test-retest method was found to be 0.73, 0.80, 0.70 and 0.80. Validity against school examination marks of each was found to be 0.50, 0.37, 0.46 and 0.56 respectively. The VRT and VNART had a co-efficient of validity of 0.70 and 0.61 against verbal intelligence test. The Raven’s standard progressive matrix was 0.60 for ART and 0.63 for VNART. The Co-efficient of validity against
scholastic aptitude test was 0.74 for NRT and 0.70 for VNART. Standard scores and deviation IQ’s were also developed.


It was hypothesized that success in technical courses were related to (1) Verbal ability, language usage (2) Mechanical knowledge and comprehension, perceptual ability, spatial ability. (3) School achievement, School examination marks in mother tongue, mathematics and science. Total of 253 students studying in grade IX of technical higher secondary schools constituted the sample. Pearson’s product moment correlation and multiple regression analysis were used for analysis of data.

The odd-even reliability for the verbal ability test was 0.816, for language usage test was 0.837, for numerical ability test was 0.851, for general information test was 0.876.

The Numerical ability test had significant relationship with all the criteria. Its predictive value for the total was 0.486.

5. Dubey V.K. (1987) studied the factorial nature of Numerical aptitude and it bearing on mathematical learning.\(^{(5)}\)

The main objectives of the study were (1) to find out the number and nature in terms of psychological constructs of basic factors underlying
constructs of basic factors underlying numerical aptitude (2) to study the contributions of these factors in the achievement of algebra, geometry and arithmetic. (3) To study the contribution of these factors in the overall achievement in mathematics.

The study was conducted on class X and intermediate college students of Varansi. The sample comprised of 300 students. Tools, used for data collection were numerical aptitude test (N. A.T) and achievement test in mathematics (A.T.M.) N.A.T. comprised of 12 sub-tests and each subtest contained 10 homogenous test items. The reliability Co-efficient of this test is 0.97. A.T.M. was comprised of three subtest namely arithmetic, algebra and geometry. Reliability coefficient of the test was 0.89.

The major findings were:

- All the subtest of NAT were significantly correlated with one another.
- The factor analysis of 12 subtest of N.A.T. resulted in the emergence of three common factors namely ‘Numerical Reasoning’, Numerical facility’ and ‘visualization of numerical patterns’.
- The first factor ‘numerical reasoning’ was best represented by four subtest of numerical aptitude namely arithmetic operational sequence, number relations, number correlates and group member identification all based on more or less the ability to find relationships and correspondence in the numerical situations.
• The second factor 'Numerical facility' was characterized largely by the subtest number operations, which was purely a computations test based on four fundamental operations. The subtest Number Group property also gave a significant loading in this factor.

• The third factor 'Visualization of numerical patterns' was characterized by sub test problem solving was based on recognizing implicit numerical systems or patterns.

• The results of multiple regression analysis of arithmetic achievement, algebraic achievement and geometry achievement on the factor scores was carried out. The results indicated that arithmetic achievement was best predicated by numerical facility and visualizations of numerical reasoning and Numerical facility. Geometry achievement was best predicted by Numerical reasoning.

• The multiple regression analysis of the combined scores of A.T.M. on the factor scores of N.A.T. showed that Numerical facility and Numerical reasoning were found to be the best predictors of achievement in mathematics.
6. Kasat B.S. (1991) attempted to identify the causes of the large failures in mathematics at S.S.C. examination of Marathi medium high school students in Palghar, Tahsil.\(^6\)

The main objectives of the study were (1) To find out whether low intelligence and poor numerical ability are the reasons for failure in mathematics. (2) To find out the student related, teacher related, subject-related, parents related and school – related reasons for the failure in mathematics.

The sample of the study comprised of 200 students (100 Boys & 100 Girls) of 25 Marathi in mathematics between October'88 and October'89. Standardized test of numerical ability and a self made questionnaire for teachers were used to collect the data.

Low intelligence, poor numerical ability, poor comprehension and recall ability, poor study habits and no interest in mathematics were the major causes for the failure in mathematics. Parents being illiterate couldn't help the children in their studies at home. Due to financial problems, School didn't have audio-video facilities, which also affected the achievements.
7. Nagailiankin Caroline (1991) conducted a research to identify variables associated with achievement in mathematics.\(^{(7)}\)

The sample consisted of class X students studying in central Schools located in the states of Nagaland, Meghalaya and Manipur. The sample comprised of 303 students. The tools used were Achievement Test in mathematics, Attitude scale to measure attitude towards mathematics, educational aspirational scale by Sharma and Gupta, occupational aspirational scale by Grewal, DAT and Cattell’s 14 PF for high school Students. It was found that there was significant association between achievement in mathematics and:

(1) Attitude towards mathematics
(2) Educational aspiration
(3) Numerical ability
(4) Abstract reasoning

8. Rajyaguru Mahesh S (1991) did the comparative study of over and underachievers in mathematics in context of personal characteristics and environmental characteristics.\(^{(8)}\)

The sample of 1093 was selected by stratified, proportionate and cluster sampling. The total number of over achiever was 133 and underachiever was 114. The tools used were Desai-Bhatt Group Test of intelligence, Bhavsar numerical aptitude Test, Mathematics achievement
Test developed by researcher. Mathematics anxiety scale by Patel T.Z.,
study habit inventory by Patel B.V., mathematics aptitude scale by Desai
H.G., interview schedule and Rotter's Locus of control Scale adopted by
Bhogayata (in Gujarati).

(1) It was found that there was a positive and significant correlation
between
• Intelligence and achievement in mathematics,
• Achievement in mathematics and numerical aptitude
• Intelligence and numerical aptitude

(2) Overachievers and underachievers did not differ in (a) intelligence
(b) numerical aptitude (c) Locus of control.

(3) Over achievers had better study habit, less anxiety and more
positive attitude towards mathematics.

test for students of std VIII to X of Gujarat State. (9)

The test items were first coined and after that the item analysis was
carried out. On the basis of difficulty value and discriminating value the
final version of the test was prepared. Final version of the test comprised of
30 items. They were of multiple-choice items having four options. Total
time period for the test was finalized of 25 minutes. Stratified cluster
random sampling technique was used for the final run of the test. One
school each from 24 districts of Gujarat State was selected at random. The total sample comprised of 4350 students among which 2520 were boys and 1830 were girls. The reliability coefficient was calculated using test-retest method, split half method, KR Formula 20 and KR formula 21. Reliability co-efficient ranged from 0.70 to 0.84 and validity co-efficient ranged from 0.73 to 0.90. After the administration of the test, T-test was calculated to observe the significant difference between the mean scores of variables. It was observed that

1. Boys of std. VIII urban area were superior to girls.
2. Boys of std. IX of urban and semi urban area were superior to girls.

3.4 Foreign Studies:

1. Kalamaros (1991) tried to study instructional method and decreased student errors on math worksheets. (10)

The purpose of this study was to explore the effect that instructional methods have on student performance on math worksheets. A multiple baseline single organism study was completed with 11 third grade subjects. The subjects were referred for participation by their classroom teacher based on the teacher’s belief that the student had “difficulty following written directions.” Teachers need to be aware of the potential relationship between reading ability and math performance. When teachers are interested in determining student’s skills in math, the effects of reading
must be taken into account. Teachers must evaluate the types of errors students made and take the time to show student explicitly how to correct those errors. Without this effort, errors are likely to be repeated. Teachers should always consider the impact that attitudes and beliefs about math ability have on student performance. Controlling for these influences increases the likelihood that students will demonstrate their true math skills.

2. Lee (1999) studied why Asian students fall behind in maths.\(^{(11)}\)

Asian students having strong achievement in mathematics has long been recognized. However, not all Asian children excel at math. The present study examines Chinese second – grade high-math achievers (HMAs) and low math achievers (LMAs) who are at risk of developing mathematical learning disabilities (MLD). Both groups have average of above-average intelligence, normal sensory functioning and no emotional disorders. This study aims to identify why LMAs are poor in math. The results show that, when compared to HMAs, LMAs, showed a wide range of weakness in the areas of short-term memory, working memory and long-term memory, LMAs were slower to solve number facts than HMAs in addition, they tended to use less mature and less efficient strategies to solve these problems (e.g. they use “counting all” or “counting on”), and their place value concepts were also less mature and complete. LMAs had more difficulty solving 3-digit as opposed to 2-digit problems, which may result
from their less mature understanding or place value and weak as compared to HMAs. A high frequency of LMAs errors in the multi-digit problems involved trading procedures such as increasing or reducing place value. Over the school year, although LMAs made progress on fact retrieval automaticity and place-value tasks, their achievement remained poorer than that of HMAs. An analysis of errors and better understanding the underlying cognitive processes involved in arithmetic competence can provide valuable insights for us to design programs tailored to each child’s individual needs.

3. Duncan (2000) studied the relationship between math preparation in high school and mathematics skills of college entering students.\(^{(12)}\)

The sample consisted of college extras. The study found that most students in remedial mathematics were exposed to the mathematics content in high school but they never learn the material sufficiently enough to acquire math skills for college. It indicates that increasing the mathematics requirements in high school does not ensure students that they will have sufficient mathematics skills necessary to readily enter college.
3.5 Summary and implication for the study:

After reviewing studies from surveys and dissertation abstract international, new view points new research methodologies, new areas of research emerged. Review of literature helped the investigator to channelize the thoughts.

Kasat (1991) Nagailiankim (1991), Rajyaguru (1991) clearly stated the importance of numerical ability. They also directed towards positive and significant correlations between numerical ability and achievement in mathematics. Studies reflected that lack of numerical ability was one of the major causes for failure in mathematics.

Studies of Bhavsar (1970), Shah (1971) Dubey (1987) Talati (2006) gave idea about the components of numerical ability. It also helped the investigator in acquiring the knowledge about standardization procedure. They also emphasized that numerical facility and numerical reasoning were the best predictors of achievement in mathematics.

Lee (1999) tried to identify factors for low achievement in mathematics by low-math-achievers and high-math-achievers. The study found low-math-achievers very slow in solving number facts and they used less efficient strategies and had less mature concepts of place values, Such studies tell us about the cognitive processors involved in arithmetic competence, which should be addressed rather than more drill.
Duncan (2006) tried to find out the relationship between math preparation in high school and mathematics skills of college entering students. This study brought to light the fact that though mathematics content was increased, students entering college did not have sufficient mathematics skills. So instead of increasing the syllabi, need was to ensure the acquisition of mathematical concepts and skills.

Studies such as these helped the investigator to understand that there are many factors affecting achievement of mathematics and numerical ability is one of them. Today when competitive exams have replace scholastics achievement, it is felt that classroom needs monitoring of remedial process, effective teaching learning process instead of volumised text books and better representation of content is expected. To address these needs foremost step is to have a well constructed and standardized tool, which can lay reliable results in front of us.

Numerical ability tests are constructed in other states. Bhavsar (1970) and Shah (1971) constructed numerical ability test, but these are very old and we can use only after revalidating them. Talati (2006) constructed and standardized numerical ability test but it was for students studying in Gujarati medium school. With flourishing English medium schools, it was today's need to develop a tool through which English medium school students can be advantage.
Huge contribution of numerical ability in mathematics, leads to an urge to construct and standardize numerical ability test for English medium students of Gujarat, where no such study has been reported.
CHAPTER REFERENCE


