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CHAPTER- 3
REVIEW OF RELATED LITERATURE

3.0 Introduction

Review of the related literature is an important precondition to actual planning and then implementation of any research work can be done. The survey of the literature is a crucial aspect of the planning of the study. So the investigator must knowledge of the work done in the past. A review of the related literature is an initial stage in setting a context for any research work.

According to McMillan and Schumacher (1989), a literature review is usually a critique of the status of knowledge on a carefully defined educational topic. The literature review enables a reader to gain further insights from the purpose and the results of a study.

According to Best and Khan (2010), a summary of the writings of recognized authorities and of previous research provides evidence that the researcher is familiar with what is already known and what is still unknown and untested. Because effective research is based on past knowledge, this step helps to eliminate the duplication of what has been done and provides useful hypotheses and helpful suggestions for significant investigation.

So the careful students of research should become familiar with the location and use of the sources of information related to the research. Investigator can’t remove the limitations remaining in previous researches, but can plan his work with care and keeping these limitations in mind. There are many research works done on Reasoning Ability in India and abroad. Some Reasoning Ability tests are developed in Gujarat, and very few tests are developed in the context of
mathematics and Reasoning Ability. So there was a research gap to develop a standardized Reasoning Ability test in the context of mathematics.

3.1 Purpose of the Review

The investigator must be up-to-date with information regarding the research problem and must know the sources are available in the field of his research and how many of them are worthy to be used. According to McMillan and Schumacher (1989), a review of the literature enables a researcher to;

(1) Define and Limit the Problem

Most of the studies add to educational knowledge and investigate only one aspect of the larger topic. The researcher initially becomes familiar with the major works in that topic and the possible breadth of the topic. The research problem is eventually limited to a subtopic within a larger body of previous theory, knowledge or practice, and stated in the appropriate terms.

(2) Place the Study in a Historical and Associational Perspective

To add the knowledge in any subfield, researchers analyze the way their studies will relate to existing knowledge. A researcher can find out the research gap and can add further new knowledge which require.

(3) Avoid Unintentional and Unnecessary Replication

A thorough search of the literature enables the researcher to avoid unintentional replication and to select a different research problem. The researcher however may deliberately replicate a study for verification. A research topic that has been investigated with similar methods that failed to produce significant results.
3.2 Importance of Review

Careful review can help the investigator to avoid duplication of work done earlier. Reviews of past researches serve as the foundation for the present study. If the investigator wants to test the validity of the past studies or tests, in such cases the duplication or replication of previous studies becomes essential. In this situation, careful review helps the investigator in getting acquainted with the number and nature of the studies related to the study whose validity is being assessed at present.

A synthesized collection of prior studies also helps the investigator to identifying the significant overlaps and research gaps among the prior works. Effective and careful review becomes a medium for the investigator in discovering the important variables relevant to the Area of the present study. When significant variables are discovered, the relationship among them can be identified. Subsequently the identified relationship is incorporated into different hypotheses. The relationship between the different variables must be explored by reviewing the related study, so that a good context may be built up for subsequent investigation for conducting a scientific study.

3.3 Review of Previous Researches

Review of previous researches was divided into two parts, first part related to Indian researches’ while, second part related to foreign researches. The following criteria were considered for review of past researches.

(1) Researches must be related to test construction and standardization

Or

(2) Researches must be related to Reasoning Ability.
Researcher has studied the past researches through INFLIBNET, Research Journals, Different libraries of different Universities and National Social Science Documentation Centre.

### 3.3.1 Indian Researches

Researcher has studied the Indian researches in the context of Reasoning Ability and test construction and standardization. Total 17 Indian researches reviewed which related to different type of ability. Two of these researches were on mathematical Reasoning Ability, one on Numerical Reasoning Ability. Seven researches were on Verbal Reasoning Ability Test construction, two were on Abstract Reasoning Test construction while one was on problem solving ability test. Five researches were on primary school level students and 12 researches were on secondary and higher secondary level and one on college level. Now the detail study of these researches is as under in sequence.

**STUDY: 1**

* Researcher : Singh R. N.
* Year and University : 1971, Marathavada University
* Degree : Ph. D. (Psychology)

* Title:

  “Construction and Standardization of a Battery of Tests of Verbal, Abstract and Numerical Reasoning”

* Objectives:

  Main aim of the study was to construct and standardized a battery of tests which can measure the abstract, Verbal and Numerical Reasoning Ability
(Abstract and Verbal test battery) of higher secondary school students and pre-university students for educational guidance and counseling.

The battery of tests which was named as

1. A battery of Verbal, Numerical and Abstract Reasoning Tests (VNART),
2. A test of General Mental Ability consists of Verbal Reasoning Test (VRT), Numerical Reasoning Test (NRT)) and
3. Abstract Reasoning Test (ART).

* Tool:

The battery of tests which named as VNART, VRT, NRT, ART was constructed and standardized.

* Sample:

For piloting, test was given to the 370 students from higher secondary and pre-university classes. The norms for the test were established on a sample of 4500 students of higher secondary school and pre-university classes.

* Findings:

1. Split-half reliability coefficients of the VRT, NRT, ART and VNART were found to be 0.82, 0.92, 0.91 and 0.94.
2. Test-retest reliability coefficients were found to be 0.73, 0.80, 0.70 and 0.80 respectively.
3. Reliability coefficients calculated by KR-formula were found to be 0.82, 0.94, 0.96 and 0.96 for VRT, NRT and ART respectively.
4. Correlation coefficient of the tests and school examination marks were found to be 0.50, 0.37, 0.46 and 0.56 for VRT, NRT, SRT and VNART respectively.
(5) Correlation coefficient of VRT and VNART with Intelligence test was found to be 0.70 and 0.61.

(6) Correlation coefficients of the tests against Raven’s Standard Progressive Matrices were 0.60 for ART and 0.63 for VNART.

(7) Correlation coefficients of the tests against Scholastic Aptitude test were 0.74 for NRT and 0.70 for VNART.

* Norms:

Norms like deviation IQs and T- scores were developed.

STUDY: 2

* Researcher : Giris Bala

* Year and University : 1978, Jamia Milia Islamia University

* Degree : Ph. D.

* Title:

“A Factor Analysis of Reasoning Ability of 13, 14, and 15 Years of Children Studying in Delhi Higher Secondary Schools”

* Objectives:

Main aim of the study was to identify the factors involved in Reasoning Ability in the children of age group of 13, 14, 15 year, according to Guilford’s SI model.

* Tools:

Harper’s item analysis chart was used to read and indicates the item’s difficulty and discrimination index.

* Sample:

The test was administered on 540 children with different age group, 182
children of 13 years age group, 205 children of 14 years age group and 153 children of 15 years age group.

*Findings:*

(1) The cognition of semantic implications (CSI) factor was emerged clearly in age group of 14 and 15.

(2) Reasoning Ability was increased with age of the children.

(3) The following factors were identified by factor analysis,

- General cognition and convergent production, perception of Abstract similarities or convergent production of semantic classes and relations,
- Induction or education of conceptual relations or relation thinking or diffused convergent production and cognition of implications,
- Conceptual foresight or cognition of semantic implications, deduction or general convergent production and apprehension of relations or mixed classification and relation.

(4) The reliability coefficient of the test was above 0.50, than minimum suggested by Guilford, except in case of Sequential Association test for age group of 15 (SAT-0.476) and Associations-IV(0.487) for age group of 13.

**STUDY: 3**

- **Researcher**: Banker, H. R.
- **Year and University**: 1979, Saurastra University, Rajkot.
- **Degree**: Ph. D.
* Title:

“Construction and Standardization of Abstract Reasoning Test for the Students in Grade 8th and 9th of the Secondary Schools of Saurastra”

* Objectives:

To construct and standardize the Abstract Reasoning Test.

* Tools:

Preliminary form of the test was constructed with 192 multiple choice type items. Out of 192 items, 134 items were selected for pilot testing. Finally, 60 items were selected on the basis of item analysis for final testing.

* Sample:

Preliminary test was administered on 111 students of different schools. Pilot test was administered on 370 students. Final test was administered on 5277 students of ninety one different schools of Saurastra, according to Grade, Sex and Area.

* Findings:

(1) Reliability of the test was established by split-half method (0.94), test-retest method (.81), Rulon formula (.94) and KR-20 (0.95). Validity was established by congruent validity (0.84), concurrent validity (0.63) and predictive validity (0.72 to 0.26).

(2) Area difference was not found to be significantly related to Abstract Reasoning of the students.

(3) Significant Sex and Grade difference in Abstract Reasoning were observed.
* Norms:

Grade wise norms for boys and girls were established in the form of PR (percentile rank), T-score, stanine and latter Grades.

STUDY: 4

* Researcher : Bhatt, G. C.

* Year and University : 1980, Saurastra University, Rajkot.

* Degree : Ph. D.

* Title:

“Construction and Standardization of Verbal Reasoning Ability Test for the Students Studying in Grade 8 and 9 of Secondary Schools in Saurastra Area”

* Objectives:

1. To construct and standardize a Verbal Reasoning Ability Test.

2. To study the effect of Sex, Area and Grade on Verbal Reasoning Ability of the students.

* Tools:

Preliminary form of the test was constructed in two form (P and Q form) with 200 multiple choice type items. Out of 192 items, 134 items were selected for pilot testing. Finally, 60 items were selected on the basis of item analysis for final testing.

* Sample:

Preliminary test was administered on 111 students of different schools. Pilot test was administered on 370 students. Total 5449 students were selected from
ninety-six different schools of Saurastra Area. Stratified random sampling method was used for final run of the test.

* Findings:

(1) The mean score of the students studying in 9th class was higher than 8th class.

(2) The mean score of boys was higher than girls’ students.

(3) Area difference was observed only in the case of the 9th class students.

(4) Reliability was established by test-retest method (0.82), split-half (0.93); KR-20 formula (0.91) and KR-21 formula (0.82). Concurrent validity was established by using I.Q test, aptitude tests (Abstract Reasoning, Numerical Ability and Verbal Reasoning Test).

* Norms:

Grade wise norms for boys and girls were established in the form of PR (percentile rank), T-score, stanine, and letter Grades.

STUDY: 5

* Researcher : Keskar P. U.

* Year and University : 1980, Gujarat University, Ahmedabad.

* Degree : Ph. D.

* Title:

“Construction and Standardization of Problem Solving Test for the Students Studying in Class 3rd to 7th in Gujarati Medium”

* Objectives:

(1) To construct and standardize the Problem Solving Test.

(2) To establish reliability and validity of the test.
* **Tools:**

Preliminary form of the test was constructed with 60 multiple choice type items. Out of 60 items, 60 items were selected for pilot testing. Finally, 50 items were selected on the basis of item analysis for final testing.

* **Sample:**

Pre-pilot test was administered on 93 students and pilot test was administered on 370 students. Final test was administered on 1010 students of different Area, class and Sex. Stratified random sampling method was used for the 2nd and final run of the test.

* **Findings:**

1. Significant effect of Grade was found on the mean scores of the test.
2. Reliability of the test was found out by test-retest method (0.30), split-half method (0.93), KR-20 formula (0.72) and Hoyt’s method (0.96). Concurrent validity was found out by using I.Q test (0.82), achievement score (0.25 to 0.95). Construct validity and factorial validity was also established. The factor of IQ was found strong than other factors.

* **Norms:**

Norms like percentile rank and T-scores were established.

**STUDY: 6**

* **Researcher** : Patel R. P
* **Year and University** : 1981, S. P. University, Vallabh Vidyanagar
* **Degree** : Ph. D.
* Title:

“Construction and Standardization of General Mental Ability test for Standard 11 and 12”

* Objectives:

To construct and standardize a General Mental Ability Test for the students of higher secondary schools.

* Tool:

The test was divided into two parts.

Part-1: This part was student’s familiarity with the world around him through his experiences (pre-knowledge). Items were related to various fields like science, social science, community affairs, arts and culture.

Part-2: This part was related to Abstract Reasoning.

* Sample:

The final test was administered on 5725 students of higher secondary schools.

* Findings:

(1) Age and Grade wise differences of mean scores were found significant. This difference was in favor of the higher age group and higher Grade students.

(2) The correlation coefficient of the test score with teacher’s rating was 0.59, with preliminary examination score was 0.52, and correlation with Intelligence test was 0.68. Factor analysis showed that the test was heavily loaded with 9 factors.

* Norms:

Norms were established in the form of PR and deviation IQs.
STUDY: 7

* Researcher : Shah P. C.
* Year and University : 1981, Saurastra University, Rajkot.
* Degree : Ph. D.

* Title:

“Construction and Standardization of a Verbal Reasoning Test for the Students of Standard 6th and 7th in Saurastra”

* Objectives:

To construct and standardize a Verbal Reasoning Test.

* Tools:

Preliminary form of the test was constructed with 220 multiple choice type items. Finally, items were selected on the basis of item analysis for final testing.

* Sample:

Pre-pilot test was administered on 111 students and pilot test was administered on 370 students. Final test was administered on 9382 students of 200 different schools of Saurastra Area.

* Findings:

(1) Significant effect of Sex, Area and class was found on the test scores.

(2) The students of 7th class were excelled than the students of 6th class while boys were excelled than girls and urban students were excelled than rural students in Verbal Reasoning.

(3) Reliability of the test was established by test-retest method (0.88), Split-half method (0.89), Rulon formula (0.86), KR-20 formula (0.92), and
Flanagan formula (0.84). Concurrent validity (0.80 to 0.88), congruent validity (0.72 to 0.52) and predictive validity (0.72 to 0.36) were found.

* Norms:

Norms were established in the form PR, T-score, stanine, and letter Grades.

STUDY: 8

* Researcher : Malhotra K.
* Year and University : 1982, Delhi University, Delhi.
* Degree : Ph. D. (Psychology)

* Title:

“Internal Representations in Reasoning in Children”

* Objectives:

(1) To examine and analyze the internal representations made and used by the children in solving linear syllogistic Reasoning problems and analogical problems.

(2) To draw certain broad generalizations in regard to the strategies employed in the formation of such internal representation and the rate at which these are formed.

* Tools: Two standardized tests were used.

(1) Stanford-Binet test adapted by Kulshrestha in Hindi medium (1971).

(2) Raven’s progressive matrices test.

* Sample:

Total 240 students of 11 to 13 years age group were selected as a sample in which number of boys and girls were equal.
* Findings:

1. The higher ability group of children was required a lesser number of internal representations and less time to solve the problem as compared to the lower-ability group.

2. Interaction between age and SES was observed to be significant in analogical Reasoning tasks and not in deductive Reasoning tasks.

3. The high SES group was found to be significantly superior to the corresponding low SES group in all the response measure.

4. Sex was observed to be significant in interaction with ability, SES and age in deductive Reasoning tasks and not with analogical Reasoning tasks.

Study: 9

* Researcher : Chhikara M. S.

* Year and University : 1985, Jamia Millia Islamia University, Aligadh.

* Degree : Ph. D.

* Title:

   “An Investigation into the Relationship of Reasoning Abilities with Achievement of Concepts in Life Science”

* Objectives:

   To study the relationship of Reasoning Abilities with achievement of concepts in life science.

* Tools:

   1. Battery of Concept Achievement Tests and
   2. Battery of Reasoning Ability Test developed by Girish Bala.
* Sample:

Total of 200 students of different four senior secondary schools were selected as a sample.

* Findings:

(1) A sight modification was made in the hierarchy levels of organization of biological phenomena. When concepts in secondary school life science were identified and concept achievement test was found reliable and valid.

(2) Indian children did not differentiate as clearly as inferred according to the structure of intellect theory.

(3) A definite positive relationship between conceptual achievement in life sciences and Reasoning Ability was found.

(4) Possibility to predict conceptual achievement in life sciences on the basis of the Reasoning Ability test was supported to a large extent by the results of regression analysis.

STUDY: 10

* Researcher              : Ambasana A. D.

* Year and University     : 1988, Saurastra University, Rajkot.

* Degree                  : Ph. D.

* Title:

“Construction and Standardization of an Art Judgment Test”

* Objectives:

(1) To construct and standardize Art Ability Test for the students of standard 8th to 12th.
(2) To study the effect of Sex, Age, Artistic Ability and Art influence (representational and non-representational) on mean score of Art Judgment Ability Test.

(3) To study the relation between Art Judgment Ability and Art-Environment.

* **Tool:**

Primary form of Art Judgment test was constructed with 110 pairs of picture and seven components (Line, Direction, Shape, Size, Texture, Value, and Color). Pre-pilot test was contained 110 pairs of picture and Pilot test was contained 100 pairs of picture and final test was contained 50 pairs of picture. Final pairs of picture were selected according to the difficulty value, facility value and bi-serial correlation. Time for test completion was 30 minute.

* **Sample:**

(1) Pre-pilot test was given to 25 Art masters and drawing teachers.

(2) Pilot test was administered on 561 students.

(3) The final test was administered on 4253 students of different schools by using stratified random cluster sampling method.

* **Findings:**

(1) The effect of Sex, Age, and Artistic Ability on mean score of Art Judgment Ability was found significant, while the effect of Art environment variable was not found significant.

(2) Art Judgment Ability of male was higher than female students.

(3) Mean Art Judgment score of 8th standard students was lowest than the students of 11th standard.
(4) Mean Art Judgment score of 12 year old students was lowest than 15 year old students.

(5) Mean Art Judgment score of art-students was higher than that of non-Art students.

(6) Art environment was not significantly effect on art-Judgment ability of the students.

(7) Reliability of the test was established by test-retest method (0.75), Spearman Brown formula (0.69), KR-20 (0.66).

(8) Construct validity was established by graphical representation for the test.

* Norms:

Norms likes Percentile rank and stanine were established.

STUDY: 11

* Researcher : Solanki M. R.

* Year and University : 1999, S.P. University, Vallabh Vidyanagar.

* Degree : Ph. D.

* Title:

“An Investigation into the Relationship of Reasoning Abilities with Achievement of Concepts in Mathematics of Students of Secondary Schools”

* Objectives:

(1) To construct and standardize the Reasoning Ability Test.

(2) To study the relation of Reasoning Ability of the students with Achievement of Concepts in Mathematics.
(3) To study the relation of Reasoning Ability of the students with Achievement of Concepts in Mathematics in relation to their Area, Sex, I.Q. and Caste.

* Tool:

(1) Primary test was constructed with 127 items and five different components like analogy test, odd-man out test, series, true or false test, prediction test.

(2) Test with 105 items was selected for pilot testing.

(3) After item analysis 90 items were selected for final test.

(4) Time for each sub-test was different.

(5) Separate answer sheet was used.

* Sample:

Forty students of different schools were selected for first tryout. Second tryout was done on 400 students and 370 answer sheets were selected for item analysis. For final run of test, 2000 students were selected by using stratified random sampling method.

* Findings:

(1) Significant effect of Sex, Area, and I.Q. was observed on the relationship of Reasoning Ability of the students with Achievement of Concepts in Mathematics.

(2) Caste was not significantly effect on the Reasoning Ability of the students with achievement of concepts in mathematics.

(3) The high I.Q group was found to be significantly superior to the corresponding low I.Q group in Reasoning Ability.
(4) Urban students were found to be significantly superior to the corresponding rural students in Reasoning Ability, while boys were significantly superior to the corresponding girls in Reasoning Ability.

(5) Only interaction effect of Area x I.Q., Sex x I.Q., and Sex x caste were found significant on the Reasoning Ability of the students.

(6) The reliability of the test was established by test-retest method (0.91), Spearman Brown formula (0.88), KR-20 formula (0.90), and KR-21 formula (0.92). Construct and concurrent validity was established by calculating correlation coefficients of the test with different tests like K.G. Desai’s I.Q. test (0.88), Bhatt group test (0.78), Bhavsar group test (0.77) and Tarulatta Shah Group test (0.62).

STUDY: 12

* Researcher : Patel H. R.
* Year and University : 2001, Gujarat University, Ahmedabad.
* Degree : Ph. D.

* Title:

“Construction and Standardization of the Verbal Reasoning Ability Test for Secondary School Students of Gujarat State”

* Objectives:

(1) To construct and standardize a Verbal Reasoning Test for secondary school students.

(2) To study the effect of Sex, Area and Grade on Verbal Reasoning Ability of the students.
**Tool:**

1. Primary test was constructed with 225 items and five different components like analogy, classification, series, cause and effect type statement, situational test. This test was tested on 15 students.

2. Test with 165 items, 33 of each component was selected for pilot testing.

3. After item analysis 100 items, 20 of each component were selected for final test.

4. Separate answer-sheet was used and time for the test was 45 minutes.

**Sample:**

1. Pre-pilot test was administered on 93 students of different schools and grade.

2. Pilot test was administered on a stratified random sample of 392 students and 370 answer sheets were selected for item analysis.

3. The final test was administered on 5655 students of different schools by using stratified random cluster sampling method.

**Findings:**

1. Sex, area and grade differences of significance were found significant.

2. Reliability of the test was established by test-retest method (0.93), Spearman Brown formula (0.92), Rulon formula (0.96), Flanagan formula (0.94), KR-20 (0.91) and KR-21 (0.89).

3. Concurrent validity was established by correlation with Desai Verbal-Nonverbal Intelligence test (0.70), G.A.T test of M. T. Patel (0.69), marks of preliminary exam (0.61), marks of mathematics (0.66). Factor validity was also established.
Norms likes Percentile rank and T-score were established.

STUDY: 13

* Researcher : Bakarania D. M.

* Year and University : 2002, Gujarat University, Ahmedabad.

* Degree : Ph. D.

* Title:

“Construction and Standardization of Mathematical Reasoning Ability Test (MRAT) for the Pupils of the Colleges of Gujarat State”

* Objectives:

(1) To construct and standardize MRAT for the college pupil of Gujarat state.

(2) To study the effect of Area, Sex, Faculty and class on mean score of MRA.

(3) To set norms for MRAT.

* Tool:

Primary form of MRAT was constructed with 200 items and eight component (Number series, Questions of number, General questions, Signs, metrics, Analogy, Numbers in figure, Paragraph). Pilot test was contained 100 items and final test was contained 50 items. Items were arranged in omnibus form in the final test. Separate answer sheet was prepared.

* Sample:

(1) Fifty students were selected by stratified random sampling technique for first try out. 545 students were selected for second try out. Out of 545
answer sheets, 431 complete answer sheets were selected for item analysis.

(2) By stratified random cluster sampling technique, 2586 students were selected for final run of the test.

* Findings:

(1) The effect of Sex, Faculty, Area and class on mean score of MRAT were found significant.

(2) MRA of male was higher than female students and performance of science student on MRAT was highest while commerce students were at the bottom.

(3) The performance of students of S.Y., T.Y., and F.Y. was in descending order on MRAT.

(4) Reliability of the MRAT was established by test-retest method (0.71), Spearman Brown formula (0.78), and Rulon formula (0.72), Cronbach’s $\alpha$ (0.88), KR-20 (0.87) and KR-21 (0.86).

(5) Concurrent validity was established by correlation with marks of preliminary exam (0.71). Validity was also established by factor analysis.

* Norms:

Norms were established in form of PR score only.

**STUDY: 14**

* Researcher : Patel D. S.

* Year and University : 2002, Saurastra University, Rajkot.

* Degree : Ph. D.
* Title:

“Construction and Standardization of the Verbal Reasoning Ability Test for the Students of Higher Secondary Schools of Gujarat State”

* Objectives:

(1) To construct and standardize a Verbal Reasoning Ability Test for higher secondary school students.

(2) To study the significant effect of Sex, Area and Grade on Verbal Reasoning Ability Test score.

* Test:

Primary form of Verbal Reasoning Test was constructed with 200 items and eight components (Analogy, Classification, Number series, Statement, Cause-relation, Blood-relation, Puzzles, and Coding-decode.). After pre-piloting, 139 items were selected for piloting and finally 80 items were selected for the final test.

* Sample:

Eighty eight students were selected for pre-pilot try out and 370 students from 385 were selected for pilot try out. Total 3524 students were selected for final run of the test by using stratified random sampling method.

* Findings:

(1) The effect of Sex, Stream and Grade on Verbal Reasoning Ability was found significant while effect of Area was not found significant.

(2) Reliability of the test was established by test-retest method (0.88), Spearman Brown formula (0.83), Rulon formula (0.95), Flanagan formula (0.86), KR-20 (0.88) and KR-21 (0.86).
(3) Concurrent validity was established by correlation with Desai Verbal-Nonverbal intelligence test (0.67), G.A.T test of P.P. Patel (0.68), Standard score of marks of preliminary exam (0.31 to 0.49). Factor validity was also established.

* Norms:

Norms were established in form of PR and T-score.

STUDY: 15

* Researcher : Patel V. K.
* Degree : Ph. D.

* Title:

“Construction and Standardization of Mathematical Ability Test for Primary School Children of Standard 5th to 7th”

* Objectives:

(1) To construct the Mathematical Ability Test for primary school students.
(2) To study the effect of Sex, Area, Standard, Type of schools and zone on Mathematical Ability of the students.
(3) To establish reliability and validity of the test.
(4) To establish norms of test.

* Test:

Primary form of Mathematical Ability test was constructed with 170 items and seven components (Pre knowledge of mathematics, Mathematical operations, Mathematical Reasoning, Mathematical Puzzles, Mathematical postulates, Oral calculations and geometric diagrams.). Pre-pilot test was contained 170
items and Pilot test was contained 140 items and final test was contained 100 items. Final items were selected according to the difficulty value, facility value and internal correlation of item with whole items. Selected items were arranged according to omnibus form. Time for test completion was 120 minute.

* Sample:

(1) Pre-pilot test was administered on 100 students of different schools and Grade.

(2) Pilot test was administered on 400 students and 370 answer sheets were selected for item analysis.

(3) The final test was administered on 3600 students of different schools by using stratified random sampling method.

* Findings:

(1) Effect of Sex, Type of School, Standard and Zone on Mathematical Ability Test scores was found significant while Area difference of significance was not found significant.

(2) Mathematical ability of male was higher than female students.

(3) Mathematical Ability of private school’s students was higher than government school’s students.

(4) Mathematical Ability of students of 7th, 6th and 5th standard was observed in descending order.

(5) Reliability of the test was established by test-retest method (0.90), Spearman Brown formula (0.94), Rulon formula (0.98), Flanagan formula (0.98), KR-20 (0.98) and KR-21 (0.97) and Tucker’s modified method (0.98).
(6) Concurrent validity was established by correlation of present test with Numerical Ability test (0.57), Pratiman test (0.61), I.Q. test (0.51), Marks obtained in mathematics in preliminary exam (0.57), marks of mathematics (0.66), teachers’ rating of the students (0.72)

(7) Factor analysis by centroid method shows that the test was heavily loaded with mathematical Ability factors.

* Norms:

Norms were established in form of PR, stanine and T-score.

STUDY: 16

* Researcher: Patel S. R.

* Year and University: 2008, Hemchandracharya North Gujarat University, Patan.

* Degree: Ph. D.

* Title:

“Construction and Standardization of the Verbal Reasoning Ability Test for Primary School Students of Gujarat State”

* Objectives:

(1) To construct and standardize a Verbal Reasoning Test for primary school students.

(2) To study the significant effect of Sex, Area and Grade on Verbal Reasoning test score.

* Tool:

Primary form of Verbal Reasoning test contained 248 items and four components (Analogy, Classification, Series completion, Assertion and
Reason.). Pre-pilot test contained 192 items and Pilot test contained 140 items and final test was contained 80 items which in form of omnibus. Test time was 40 minute.

* Sample:

(1) Pre-pilot test was administered on 103 students of different schools and Grade.

(2) Pilot test was administered on a stratified random sample of 397 students and 370 answer sheets were selected for item analysis.

(3) The final test was administered on 5927 students of different schools by using stratified random cluster sampling method.

* Findings:

(1) Significant effect of Area and Grade on mean scores was found. Reasoning Ability of urban students was higher than rural Area students while the Reasoning Ability of 7th, 6th and 5th Grade students was in descending order.

(2) Effect of Sex on Verbal Reasoning Ability was not found significant.

(3) Reliability of the test was established by test-retest method (0.86), Spearman Brown formula (0.91), Rulon formula (0.97), Flanagan formula (0.91), KR-20 (0.94) and KR-21 (0.93).

(4) Concurrent validity was established by correlation of present test with Verbal group intelligence test of Ajay Pandya (0.74), T-score of percentage obtain in preliminary exam (0.66), and T-score of marks obtain in mathematics in preliminary exam (0.61). Factor validity was also established (first factor loading was 97.34%).
* Norms:

Norms were established in the form of PR and T-score.

STUDY: 17

* Researcher : Thakkar J. S.
* Year and University : 2008, Gujarat University, Ahmedabad.
* Degree : Ph. D.

* Title:

“Construction and Standardization of Emotional Intelligence Test for the Students of the Secondary Schools of Gujarat State”

* Objectives:

(1) To construct and standardize Emotional Intelligence Test for the students of secondary schools of Gujarat state.

(2) To study the effect of Sex, Area, Achievement, Socio economic status level, Social maturity and Intelligence on Emotional Intelligence.

* Tool:

Primary form of Emotional Intelligence test was constructed with 180 items and five components based on Reuven Bar-On and Goleman’s models (Self awareness, Self management, Motivation, Empathy and Social skills.). Pre-pilot test and Pilot test contained 180 items and final test was contained 100 items. Final test items (statements) were selected according to the t-value, and $x^2$-value. There was no time limit for the test.

* Sample:

(1) Total 97 students were selected for first try out and 370 students were selected for second try out.
(2) Total 5146 students out of 49 different schools were selected for final run of the test. Stratified random sampling technique was used and proportion of boys to girls and rural to urban students was maintained as equal.

* Findings:

(1) Significant effect of Area and Standard was observed on Emotional Intelligence.

(2) Sex did not significantly effect on Emotional Intelligence.

(3) The students with high IQ did not necessarily have a high EQ.

(4) Urban students were found to be significantly higher EQ score compared to rural students.

(5) EQ score of 10th Grade students was higher than 9th Grade students. While the EQ score of 8th Grade and 9th Grade students was not significantly different.

(1) Reliability of the test was established by test-retest method (0.739), Spearman Brown formula (0.849), Rulon/Guttmann's formula (0.883), Flanagan formula (0.883).

(6) Concurrent validity was established by calculating correlation of present test with K.G. Desai’s Verbal IQ test (0.51), P.P. Patel’s socio economic status test (0.31), Rashida Diwan’s social maturity test (0.70), T-score of percentage obtain in first term exam (0.51), and Teacher’s rating (0.75).

* Norms:

Norms like PR and T-scores were established.
3.3.2 Foreign Researches

Foreign researches were study in the context of Reasoning Ability and test development, so it gives new viewpoints and can help the researcher to strengthen his work. The details about these researches are as under in sequence.

STUDY: 1

* Researcher : Marilyn A. Morrow
* Year and Country : 1979, Canada
* University/ Institute : Department of Educational Psychology University of Saskatchewan.
* Degree/Project : M.Ed.
* Research Area : Educational Psychology

* Title:

“Educational Achievement of Elementary School Students from two Cultural Groups as Related to Reasoning Ability and Classroom Learning Environment”

* Objectives:

(1) To asses the relationship between thirteen independent variables and academic achievement of Indian and Non-Indian students to make comparisons between the two cultural groups.

* Instruments:

(1) Achievement test having five different subtests of basic skills for measurement of achievement.

(2) Raven’s progressive matrices for measurement of Reasoning Ability.
* Analysis:

A stepwise multiple regression programs were used to analyze the data.

* Variables:

Thirteen independent variables classified into three groups;

1. Personal characteristic (Reasoning Ability),
2. Classroom environment (satisfaction, friction, competitiveness, difficult and cohesiveness),
3. Categorical variables (Sex, Grade, School, Cultural group and interaction between these variables).

* Sample:

The sample included 75 Indian and 95 non-Indian students in Grades 4, 6, and 8 in three schools, one federal school and two provincial (joint) schools.

* Findings:

1. Reasoning Ability was related with achievement of the students.
2. Classroom environment, Grade and school were effective variables on Indian students’ achievement.
3. Average achievement of non-Indian students was significantly higher than the Indian students due to environment and language skills.
4. Non Indian group obtained significantly higher mean achievement test scores than the Indian group.
5. Reasoning Ability was a significant predictor of all achievement test scores for both Indian and non-Indian students.
6. Classroom environment variable was significant predictor of achievement scores.
(7) School and Grade was a significant predictor of Indian students’ achievement.

(8) Sex was a significant predictor of non-Indian students’ achievement.

STUDY: 2

* Researcher               : Cristal Moore, Stephen L. O’keefe and Del Lawhon
* Year and Country       : 1998, Netherlands
* University/ Institute : University of Groningen, West Virginia Graduate College.
* Degree/Project        : Research paper
* Research Area           : Psychology and Education

* Title:

“Concurrent Validity of the Snijders-Oomen Nonverbal Intelligence Test 2½-7-Revised with the Wechsler Preschool and Primary Scale of Intelligence-Revised”

* Objectives:

To study the concurrent validity of the Snijders-Oomen Nonverbal Intelligence Test (SON-R) and Wechsler preschool and primary scale of intelligence revised (WPPSI-R).

* Instrument:

Both tests were standardized tests. Wechsler test has 10 subtests while SON-R has 6 subtests and each test has two parts. The SON-R has items in the form of pictures, squares, colored cards and puzzles and six factors like mosaics, puzzles, patterns (performance), categories, situations and analogies (Reasoning scale).
* Sample:

Sample for final testing was 25 students from age group 4 years’ old, in which 15 boys and 10 girls. Of the subjects 14 from urban area, and 11 from rural areas and 9 from families of lower-middle to middle-class socioeconomic status and 16 from lower-socioeconomic backgrounds.

* Findings:

(1) Correlations of the SON-R with WPPSI-R was 0.87 which significant at 0.01 levels.

(2) There was significant difference found between the mean score of WPPSI-R and SON-R, the mean score of SON-R was lower than WPPSI-R.

(3) The results show that the SON-R has fair concurrent validity with the WPPSI-R and were measuring some similar constructs.

STUDY: 3

* Researcher : Carol R. Aldous

* Year and Country : 2001, Australia

* University/ Institute : Flinders University

* Degree/Project : Research paper based on doctoral research

* Research Area : Educational psychology

* Title:

“Measuring Cognitive and Non-cognitive Systems of Reasoning: Some Preliminary Findings”
* Objectives:

To determine cognitive and non-cognitive forms of Reasoning and described in the novel mathematics problem solving context and whether they can be measured through a self-reporting instrument designed.

* Tool:

Systems of Reasoning Questionnaire (SRQ) which was three points scale developed as an instrument for this study. Primary form of the scale was contained 45 items (statements) with five components (awareness, anxiety, feeling, imagination and intuition). On the basis of factor analysis, 27 items selected in final form of the scale.

* Sample:

(1) Sample for piloting was 114 students of lower secondary and upper primary school from across four metropolitan private schools, in which 56 boys and 58 girls.

(2) The factor analysis was carried out on sample of 400 students of lower secondary and upper primary school.

* Findings:

(1) Factorial validity was found out for the scale. Also factor analysis was performing during item selection in piloting. After factor analysis, expert opinion was taken for identification of the factors. There were five factors like systemic approach to Reasoning, strategic approach to Reasoning, spatial/Verbal approach to Reasoning, free-flowing approach to Reasoning and feeling approach to Reasoning found out.

(2) The reliability for each factor (Kaiser and Caffery) was in between 0.65 to 0.75.
(3) Cognitive and non-cognitive systems of Reasoning was identified, measured and described in novel mathematics problem solving by SRQ.

STUDY: 4

* Researcher : Nora Ricardi and Nuria Cortada de Kohan

* Year and Country : 2004, Argentina

* University/ Institute : Department of psychology,
University Del Salvador (IIPUS), Buenos Aires (UBA), Argentina

* Degree/Project : Research paper

* Research Area : Psychology

* Title:

“Relationship between Reasoning Coherence and Vocabulary in Children”

* Objectives:

(1) To study the relationship between Reasoning Coherence and Vocabulary in Spanish.

(2) To adapt the Reasoning Coherence Test.

(3) To construct the test of vocabulary in Spanish (Buenos Aires Verbal Test for Children).

* Tool:

(1) The Reasoning coherence test was adapted, which designed and developed by Ricardi in 1985, Lopez Alonso in 1988 and 1988. The test have 64 logical items.
(2) Preliminary form of Buenos Aries Verbal Test was constructed with 600 words selected from text books of primary school, in which 50% noun, 30% verbs and 20% adjectives. Initially, three subtests were designed in which, one subtest for 7-8 years old children, second for 9-10 and third for 11-12 years old students. Each subtest has 40 multiple choice type items (total 120 items), with five alternatives. Item analysis was performed by item response theory (IRT). Final form of Buenos Aries Verbal Test has 50 items.

* Sample:

(1) Sample for piloting was 30 students from age group 7 to 12.
(2) Final forms of the both test was administered on 245 students of Buenos Aires (Argentina).

* Findings:

(1) The mean score on the Verbal test was increase with age.
(2) There was no significant difference found between the mean score of boys and girls.
(3) The correlation between the scores on Verbal test and coherence test was 0.50, significant at 0.01 levels.
(3) Verbal test and coherence test discriminate very well between the ages as can be seen in the difference between the means of successive age. The correlation between vocabulary and coherence was found significant.

STUDY: 5

* Researcher : Bottino, R.M., Ferlino, L., Ott, M., and Tavella, M.
* Year and Country : 2006, Italy
* University/ Institute : Consiglio Nazionale Ricerche, Instituto Technology Didattiche, Via De Marini
6, 16149 Genova

* Degree/Project : Pilot project

* Research Area : Technology and cognitive process

* Title:

“Developing Strategic and Reasoning Abilities with Computer Games at Primary School Level”

* Objectives:

(1) To perform a qualitative analysis through direct observation of the cognitive skills involved in playing with the computer games considered to understand whether and to what extent specific features of these products can support the enhancement of such skills.

(2) To perform a quantitative evaluation of children’s performance with the computer games according to a number of different parameters such as the children’s level of achievement, the game’s degree of difficulty and the type of data handled.

* Instruments:

Different type of games like Mastermind, Minefield, Battleship, Chinese checkers and Labyrinths were selected for each ability group according to the level of difficulty.

* Sample:

More than 71000 classes and approximately 1,400,000 students of 2nd Grade to 5th Grade (age group 7 to 11 year) were selected. They were divided in to
three different groups (high, medium and low achiever) according to a general evaluation made by their teachers.

* Findings:

(1) Well structured and long-term activities based on the use of logical games can have a positive impact on pupils’ strategic and logical Reasoning abilities.

(2) Software features can support children’s cognitive processes.

(3) Only high achievers performed well at the difficulty level of almost any game, while low achievers can not perform well and showing clear difficulty.

(4) There were seven software features like direct feedback on the players’ attention, backtracking, support in the detection of the most favorable cases, support anticipation, support for memorization or for performing specific actions, graduation in the level of difficulty, specific tips can support children’s cognitive process.

(5) Numerical Games appear to be more difficult even for high achievers.

STUDY: 6

* Researcher : Charles Randy Duncan

* Year and Country : 2009, Canada

* University/Institute : Department of Educational Psychology and Special Education, University of Saskatchewan, Saskatoon

* Degree/Project : Ph.D.

* Research Area : Educational psychology and special education
* Title:

“The Development and Validation of the Screening Test for the Early Prediction of School Success (STEPSS): A Screen of Cognitive Functioning in Four and Five Year Old Children with Varying Health Conditions”

* Objectives:

To construct and validate the Screening Test for the Early Prediction of School Success (STEPSS) for age group 4:0 to 5:11 years.

* Tool:

Primary form of the scale was constructed with 270 items in which 64 item of memory, 91 items of attention and 115 items of Verbal ability component. There were 61 items in pilot scale, in which 18 of memory, 15 of attention and 19 of Verbal ability and 9 demographic items. Final scale contained 28 items in which 10 items of memory, 11 items of Verbal ability and 7 items of attention. Items selected in final form of the scale were based on factor analysis.

* Sample:

(1) Out of 1670 parents and teachers, 165 have responded to the pilot screening instrument.

(2) Out of 225 content reviewers, 222 professors from 20 Universities in Canada, 17 professors from Universities in United States, 2 professors Universities in Scotland, 1 professor University in Netherlands, 1 professor University in Australia, 1 professor University in New Zealand and 1 child psychiatrist, in Western Canada, 1 child psychologist from a child development centre in Western Canada. All the reviewers were
approached by email and asked to participate as content validity judges. All judges were Ph.D. in different subjects like education, psychology, educational psychology, human development and applied psychology, psychological science and developmental, child psychology and neurophysiology.

(3) For rating the scale items, 165 parents and teachers have responded and Mean Absolute Deviation (MAD) was calculated.

(4) There were 151 parents and teachers, in which 138 were female and 13 were male respondents.

(5) Validity and reliability; the content validity was establish by 225 expert’s opinion and recommendations.

* Findings:

(1) Content validity of the instrument was established by experts of different fields of different universities of world.

(2) Inter rater agreement was found out by the formula of mean absolute deviation (MAD), MAD was small and less than 0.85. So all the rater was interpret equally the items of the instrument.

(3) Exploratory factor analysis, scree test, image analysis by varimax rotation and Thurstone’s simple structure factor analysis were done. After factor analysis, expert’s opinion was taken for identification and interpretation of the factors. Three factors (Memory, Attention and Verbal Ability) were found out by the analysis of the scores. Further factor analysis was performing for memory domain (long term, declarative and short term memory).
(4) The correlations of each item with the all the items was 0.80. Items selected on the basis of factor analysis in final scale.

(5) The valid and reliable STEPSS for the age group 4:0 to 5:11 years was developed with 28 items with three major factors like, memory (three factors), attention and Verbal ability.

3.4 Criticism of the Previous Researches

In the present study there were 23 researches reviewed. These researches are in between 1971 to 2009. The review of these researches is presented in the context of objectives, instrument, sample, analysis and findings.

3.4.1 Criticism According to Objectives

The researches related to Reasoning or test construction or test development and validation were reviewed for the present study. There were 23 researches, in which five researches in between 1971 to 1980, five researches in between 1981 to 1990 and thirteen researches in between 2001 to 2009. The objectives of these researches were classified into five major categories, which are as under.

(1) Construction and standardization of the tool or instrument.

(2) Factor analysis of the Reasoning Ability.

(3) Correlational study of Reasoning Ability with other variables.

(4) Effect of different variables on Reasoning Ability.

(5) To develop Reasoning Ability.

There were fifteen researches related to tool construction and standardization, two researches related to factor analysis, three researches related
to correlational study of Reasoning Ability with other variables, two researches related to effect of different variables on Reasoning Ability and one research on development of Reasoning Ability.

Effect of different variables like Sex, Area, Age, S.E.S., Grade, Classroom environment, School and Cultural group on Reasoning Ability were studied. Also interaction effect between Sex, Age, Grade, Cultural group and School was studied in the context of Reasoning Ability.

In correlational researches, correlation of Reasoning Abilities with achievement and vocabulary was studied. There were fifteen researches related to test construction and standardization, in which nine researches related to Reasoning Ability, in which two researches of mathematical Reasoning Ability test construction for secondary and college level students while one research of Verbal, Abstract and Numerical Reasoning test battery. Out of these nine researches, five researches were related to Verbal Reasoning and one related to Abstract Reasoning Ability, six researches were related to other abilities.

Two researches were of factor analysis of Reasoning Ability in which one research related to the children with age group 13, 14 and 15 years and one research related to cognitive and non cognitive systems of Reasoning of lower secondary and upper primary school students. One research was related to development of strategic and Reasoning Ability by computer games at primary school level.

3.4.2 Criticism According to Sample

There was 25 to 14 lack subjects selected as a sample in 23 reviewed researches. Out of 23 researches, random sampling method applied in four
researches, stratified random sampling method applied in four researches, purposive sampling applied in two researches, and stratified random cluster sampling method applied in two researches.

3.4.3 Criticism According to Instrument

Out of twenty three researches, nine of them were related to tool construction and standardization of Reasoning Ability. Out of nine researches, two of them were related to Mathematical Reasoning Ability and five researches of Verbal Reasoning Ability, one research of Abstract Reasoning Ability and one of Verbal, Abstract and Numerical Reasoning Ability.

Four researches of tool construction and standardization were related to primary school students, in which two researches of Verbal Reasoning Ability Test, one of Problem Solving Ability Test and one of Numerical Ability Test. Six researches of tool construction were related to secondary school students. Out of fifteen tools, nine tools have multiple choice type items. One tool was an objective type tool and other one was a seven point scale.

3.4.4 Criticism According to Analysis

Different statistical techniques were applied to analyze the data of the previous twenty three researches. Out of twenty three researches, data of the fourteen researches was analyzed by t-test, data of four researches by f-test, one research by r and t-test, two researches by factor analysis for factor identification, two researches by f and t-test.
3.4.5 Criticism According to Findings

The research findings of above 23 researches, in seven researches, effect of Sex and Grade on Reasoning Ability was found significant. Reasoning Ability of higher Grade students was found higher than lower Grade students and significant in seven researches.

In four researches, Reasoning Ability of urban area students was higher and significant than rural area students, while this type of result was not found in two researches. In two researches, effect of age was significant and favors higher age group.

In one research, the students having higher S.E.S. have higher Reasoning Ability than lower S.E.S. In two researches, Reasoning Ability of the students of science, commerce and arts were in descending order. In one research, students having higher IQ have higher Reasoning Ability than lower IQ. Significant effect of caste was not found on Reasoning Ability. Reasoning Ability can improve by different mind games.

From above reviews, researcher has not found the instrument or tool which can measure Reasoning Ability of 5th to 7th Grade students of Gujarati medium. So there was a research gap to do this research in the current situation.

3.5 Special Quality of the Present Research

To construct and standardize a Reasoning Ability test in mathematics for primary school students of Gujarati medium was the main aim of the present research. Present research was different from past researches in the following points.
• There were many researches done in the context of Verbal Reasoning Ability of students, but very few researches done in the context of Reasoning Ability related to mathematics. Present research is related to Reasoning Ability in mathematics of the students, in this case it differs from past researches.

• Researcher has not found the standardized Reasoning Ability test related to mathematics for primary school students of Gujarati medium. So, there was almost a research gap to construct and standardize such a test for primary school students. Therefore, present research is differing from past researches in relation to objectives and instrument development.

• In the present research, selection of components for the test were selected by content analysis of the text-books of mathematics of Grade 1 to 4, but previous Reasoning Ability tests were not constructed and developed on the basis of any text-books analysis. So, present research is differing from past researches in relation to components selection.

• In the present research, Reasoning Ability test in Mathematics was validated by exploratory factor analysis and Centroid method of Thurstone. Very few Reasoning Ability tests were validated by factor analysis. In this matter, present research can be differed from past researches.

3.6 Conclusion

Overall, present research is different from past researches related to Reasoning Ability test construction in the context of instrument development, objectives, component selection, Grade and validation.