CHAPTER-8
DISCUSSION, IMPLICATIONS AND RECOMMENDATIONS

8.0 Introduction

Thinking abilities and skills most in demand in the world of work are reasoning, creative thinking, problem solving and decision making. All these abilities are in the root of development of human power. The main aim of mathematics is to develop reasoning power of human being; so mathematics is called a science of logical reasoning. Therefore, mathematics becomes important in our life. Today, for jobs reasoning power, creativity and decision power are parameter to be considered for success. In India and Gujarat, there are many tests available to measure verbal Reasoning Ability of the students; but the test which can measure Reasoning Ability in the context of mathematics of primary level students in Gujarat was not available. So, to fill this research gap, researcher had made effort to develop the RAT. In this chapter, researcher has discussed about summary of test development, hypotheses testing, findings, implications and recommendations for future researches.

8.1 Summary of the Study

The main objective of the study was to construct and standardize a test which can measure Reasoning Ability in mathematics of primary school students of Gujarati medium. To construct a Reasoning Ability test, researcher studied the past researches, literature and text books of mathematics of Grade 1st to 7th. Components for the test was selected by content analysis of mathematics text books of 1st to 4th Grade, study of previous tests related to Reasoning Ability and
competitive examinations’ papers and books. Five different components like Number Series, Analogy, Classification, Number Coding and Mathematical Operations were selected for the test. Based on five components, 150 items were constructed for preliminary test. After experts’ opinions, instructions and some items were modified according to suggestions of experts.

Pre-pilot test was conducted on 108 students of 5th to 7th Grade of four different schools of different Area. After item analysis, some modifications in items and instruction were made; on the basis of distracting power of distracters and facility index of items best 125 items were selected for pilot-test. Pilot test was conducted on 397 students of 5th to 7th Grade of different eight schools of different Area. Incomplete answer sheets were rejected and finally 380 answer sheets were selected for item analysis. After item analysis, total 60 items (12 items from each section) were selected on the base of facility index, discrimination index, distracting power of distracters and reliability index.

All the selected items were arranged according to omnibus method. One more try out was carried out for time setting for the test. Time fixed for the test was fifty minute. Reliability of the test was found out by test-retest method, split-half method, rational equivalence method and standard error of measurement and standard error of correlation coefficient. Validity was found out by content validity by experts’ opinions, criterion validity by correlations coefficients with other standardized tests, construct validity by test homogeneity (internal consistency), developmental change, correlation of present test with other tests and factor analysis, factor validity by exploratory factor analysis and Thurston’s centroid method for factor analysis. All the correlation coefficients were found significant at 0.01 levels.
Finally reliable and valid RAT was constructed. For administration of the final run, 41 primary schools were selected from 18 districts in four zones of the Gujarat state. The four zones are North, South, Middle and Kachchh and Saurastra. Total 4135 students were selected from 5th to 7th Grade by stratified random cluster sampling method. The collected data was classified according to Sex, Area, and Grade variables. Data was analyzed by t-test and F-test. The norms were established in the context of hypotheses rejection. Significant effect of Area and Grade variables was found on the scores of Reasoning Ability of students while effect of Sex was not found significant. Percentile norms and T-scores were established for the test. Hypotheses testing and findings are discussed next.

8.2 Hypotheses Testing

Present study was carried out with twenty one null hypotheses shown in table 8.1.
### Table 8.1

#### Hypotheses Testing

<table>
<thead>
<tr>
<th>Ho No.</th>
<th>Hypothesis</th>
<th>t-value or F-value</th>
<th>Significant level</th>
<th>Ho is rejected or not rejected</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ho1</td>
<td>There is no significant difference between the mean score of Reasoning Ability of boys and girls students.</td>
<td>0.36</td>
<td>Not significant difference</td>
<td>Not rejected</td>
</tr>
<tr>
<td>Ho2</td>
<td>There is no significant difference between the mean score of Reasoning Ability of rural and urban Area students.</td>
<td>15.75</td>
<td>Significant difference at 0.01 level</td>
<td>Rejected</td>
</tr>
<tr>
<td>Ho3</td>
<td>There is no significant difference between the mean score of Reasoning Ability of 5th, 6th and 7th Grade students.</td>
<td>246.91</td>
<td>Significant difference at 0.01 level</td>
<td>Rejected</td>
</tr>
<tr>
<td>Ho4</td>
<td>There is no significant difference between the mean score of Reasoning Ability of rural boys and girls of 5th Grade.</td>
<td>1.38</td>
<td>Not significant difference</td>
<td>Not rejected</td>
</tr>
<tr>
<td>Ho5</td>
<td>There is no significant difference between the mean score of Reasoning Ability of urban boys and girls of 5th Grade.</td>
<td>0.73</td>
<td>Not significant difference</td>
<td>Not rejected</td>
</tr>
<tr>
<td>Ho No.</td>
<td>Hypothesis</td>
<td>t-value or F-value</td>
<td>Significant level</td>
<td>Ho is rejected or not rejected</td>
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<tr>
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</tr>
<tr>
<td>Ho₆</td>
<td>There is no significant difference between the mean score of Reasoning Ability of rural and urban boys of 5th Grade.</td>
<td>7.94</td>
<td>Significant difference at 0.01 level</td>
<td>Rejected</td>
</tr>
<tr>
<td>Ho₇</td>
<td>There is no significant difference between the mean score of Reasoning Ability of rural and urban girls of 5th Grade.</td>
<td>5.69</td>
<td>Significant difference at 0.01 level</td>
<td>Rejected</td>
</tr>
<tr>
<td>Ho₈</td>
<td>There is no significant difference between the mean score of Reasoning Ability of rural and urban students of 5th Grade.</td>
<td>9.68</td>
<td>Significant difference at 0.01 level</td>
<td>Rejected</td>
</tr>
<tr>
<td>Ho₉</td>
<td>There is no significant difference between the mean score of Reasoning Ability of boys and girls of 5th Grade</td>
<td>0.49</td>
<td>Not significant difference</td>
<td>Not rejected</td>
</tr>
<tr>
<td>Ho₁₀</td>
<td>There is no significant difference between the mean score of Reasoning Ability of rural boys and rural girls of 6th Grade.</td>
<td>2.26</td>
<td>Significant difference at 0.05 level</td>
<td>Rejected</td>
</tr>
<tr>
<td>Ho₁₁</td>
<td>There is no significant difference between the mean score of Reasoning Ability of urban boys and urban girls of 6th Grade.</td>
<td>1.54</td>
<td>Not significant difference</td>
<td>Not rejected</td>
</tr>
<tr>
<td>Ho No.</td>
<td>Hypothesis</td>
<td>t-value or F-value</td>
<td>Significant level</td>
<td>Ho is rejected or not rejected</td>
</tr>
<tr>
<td>-------</td>
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</tr>
<tr>
<td>Ho₁₂</td>
<td>There is no significant difference between the mean score of Reasoning Ability of rural boys and urban boys of 6th Grade.</td>
<td>9.25</td>
<td>Significant difference at 0.01 level</td>
<td>Rejected</td>
</tr>
<tr>
<td>Ho₁₃</td>
<td>There is no significant difference between the mean score of Reasoning Ability of rural girls and urban girls of 6th Grade.</td>
<td>4.53</td>
<td>Significant difference at 0.01 level</td>
<td>Rejected</td>
</tr>
<tr>
<td>Ho₁₄</td>
<td>There is no significant difference between the mean score of Reasoning Ability of rural and urban students of 6th Grade.</td>
<td>9.87</td>
<td>Significant difference at 0.01 level</td>
<td>Rejected</td>
</tr>
<tr>
<td>Ho₁₅</td>
<td>There is no significant difference between the mean score of Reasoning Ability of boys and girls of 6th Grade</td>
<td>0.38</td>
<td>Not significant difference</td>
<td>Not rejected</td>
</tr>
<tr>
<td>Ho₁₆</td>
<td>There is no significant difference between the mean score of Reasoning Ability of rural boys and girls of 7th Grade.</td>
<td>0.88</td>
<td>Not significant difference</td>
<td>Not rejected</td>
</tr>
<tr>
<td>Ho₁₇</td>
<td>There is no significant difference between the mean score of Reasoning Ability of urban boys and girls of 7th Grade.</td>
<td>1.76</td>
<td>Not significant difference</td>
<td>Not rejected</td>
</tr>
<tr>
<td>Ho No.</td>
<td>Hypothesis</td>
<td>t-value or F-value</td>
<td>Significant level</td>
<td>Ho is rejected or not rejected</td>
</tr>
<tr>
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</tr>
<tr>
<td>Ho 18</td>
<td>There is no significant difference between the mean score of Reasoning Ability of rural and urban boys of 7th Grade.</td>
<td>8.12</td>
<td>Significant difference at 0.01 level</td>
<td>Rejected</td>
</tr>
<tr>
<td>Ho 19</td>
<td>There is no significant difference between the mean score of Reasoning Ability of rural and urban girls of 7th Grade.</td>
<td>5.08</td>
<td>Significant difference at 0.01 level</td>
<td>Rejected</td>
</tr>
<tr>
<td>Ho 20</td>
<td>There is no significant difference between the mean score of Reasoning Ability of rural and urban students of 7th Grade.</td>
<td>9.40</td>
<td>Significant difference at 0.01 level</td>
<td>Rejected</td>
</tr>
<tr>
<td>Ho 21</td>
<td>There is no significant difference between the mean score of Reasoning Ability of boys and girls of 7th Grade</td>
<td>0.72</td>
<td>Not significant difference</td>
<td>Not rejected</td>
</tr>
</tbody>
</table>

The effect of Sex variable was not found significant on Reasoning Ability of the students. The effect of Area and Grade variable was found significant on Reasoning Ability of the students.

8.3 Findings of the Study

The findings of the present study according to reliability, validity, hypotheses testing and norms of the RAT were as under.
8.3.1 Reliability of the RAT

(1) Test-retest reliability was found 0.72
(2) Split-half reliability was found 0.99
(3) Reliability by Rulon formula was found 0.98
(4) Rational Equivalence method (KR$_{20}$ and KR$_{21}$) was found 0.94
(5) Standard error of measurement of correlation coefficient was found 1.94 to 8.69.
(6) Standard error of correlation coefficient was found 0.001 to 0.046

Above results indicated that the RAT is reliable.

8.3.2 Validity of the RAT

- Criterion validity

The correlation coefficient of the RAT with
(1) Dr. S.R.Patel’s Verbal Reasoning Ability Test was found 0.55
(2) Dr. R.S.Patel’s Numerical Ability Test was found 0.54
(3) Dr. Jyotiben Desai’s I.Q was found 0.60
(4) T-score of mathematics achievement in preliminary exam was found 0.72.

All these correlations were found significant at 0.01 level.

- Factor validity

Factorial validity was found out by exploratory factor analysis and centroid method. Communality, number of factors, eigen values, percentage of variance, cumulative percentage of variance, standard deviation of communality and scree plot , factor scores, factor variance and factor loading indicating validity of the RAT.
• Construct validity

Test homogeneity (internal consistency), developmental change (effect of Grade), correlation coefficient with other standardized tests and factor analysis indicated the validity of the RAT.

8.3.3 Norms of the RAT

Area norms and Grade norms were established for the RAT. Percentile rank norms and T-score norms were established for the test. Findings according to hypotheses testing are as under.

(1) The significant effect of Sex was not found on Reasoning Ability of students. Reasoning Ability of boys and girls were found nearly equal.

(2) The significant effect of Area was found on Reasoning Ability of students. Reasoning Ability of urban Area students were found higher then Rural Area students.

(3) The significant effect of Grade was found on Reasoning Ability of students. Reasoning Ability of 7th, 6th and 5th Grade students were found in descending order.

(4) The significant effect of Sex was not found on Reasoning Ability of Rural Area students in 5th and 7th Grade. Reasoning Ability of rural boys and girls in 5th and 7th Grade students were found nearly equal.

(5) The significant effect of Sex was found on Reasoning Ability of Rural Area students in 6th Grade. Reasoning Ability of rural girls was found higher than rural boys.
(6) The significant effect of Sex was not found on Reasoning Ability of urban Area students in 5th, 6th and 7th Grade. Reasoning Ability of urban boys and girls in 5th, 6th and 7th Grade students were found nearly equal.

(7) The significant effect of Area was found on Reasoning Ability in 5th, 6th and 7th Grade boys. Reasoning Ability of urban boys was higher than rural boys in 5th, 6th and 7th Grade.

(8) The significant effect of Area was found on Reasoning Ability in 5th, 6th and 7th Grade girls. Reasoning Ability of urban girls was higher than rural girls in 5th, 6th and 7th Grade.

(9) The significant effect of Area was found on Reasoning Ability in 5th, 6th and 7th Grade students. Reasoning Ability of rural students was lower than urban students in 5th, 6th and 7th Grade.

(10) The significant effect of Sex was not found on Reasoning Ability in 5th, 6th and 7th Grade students. Reasoning Ability of boys and girls in 5th, 6th and 7th Grade students were found nearly equal.

8.4 Implications of the Study

The implications based on the findings of the study were as under.

(1) The Reasoning Ability of urban Area students was higher than rural Area students. So, the special care of rural Area students should be taken by the teachers during teaching mathematics in the context of reasoning. Also special classes for rural Area students should be arranged at school level. Some mind games can enhance the reasoning power of the students, therefore the schools and parents can arrange a library of mind games at
school level in rural Area. The rural Area students can use these mind games.

(2) The Reasoning Ability of 5th, 6th and 7th Grade students were in ascending order. Reasoning Ability of 7th Grade students was higher than 5th and 6th Grade students. So that teachers should give more emphasis to increase reasoning power of 5th and 6th Grade students during teaching mathematics.

(3) In class room, time should be given for practicing and teaching reasoning in mathematics for the students having lower reasoning power.

(4) Schools should use the tests and materials related to reasoning, for the students having lower reasoning power in mathematics.

(5) Government should encourage the research projects to enhance Reasoning Ability of rural Area students.

8.5 Recommendations for Future Researches

Any research can become a seed for future researches, so researcher has made some recommendations for the future researches as highlighted below.

(1) Present test has been standardized on 5th to 7th Grade students of Gujarati medium, the same test can be constructed and standardized on trainees of B.Ed. and P.T.C level.

(2) This type of test can be constructed and standardized in other languages.

(3) A study of the non-cognitive systems of reasoning of 5th to 7th Grade students can be undertaken.

(4) A study of factor analysis of Reasoning Ability in mathematics can be undertaken.
(5) A study to enhance the Reasoning Ability in mathematics by mind games can be undertaken.

(6) A study of relationship of creativity and Reasoning Ability of students can be undertaken. Same study can be done for teachers.