CHAPTER IX
SUMMARY OF THE WORK

The culmination of any research report is, naturally, an evaluative and panoramic summary of the work done.

EVALUATION OF THE TEST

The need, scope and limitations of the present work are described in the introductory chapter. The productive aspect of guidance activity, its dependence on the tools of guidance and need for ability tests for the use of high school population in Gujarat State are indicated there.

Applicability

Regarding the applicability of the norms evolved in this work, it must be pointed out that they are based on the performance of the students of secondary schools eligible to send their candidates for the S.S.C. Examination conducted by the Gujarat Secondary School Certificate Examination Board. The small rural schools teaching up to tenth standard and post-basic schools, are not included in the survey testing.

Directions for administration

Directions for administration and scoring the test are included in a pamphlet. It does not contain technical details regarding the construction, standardization and evaluation of the test. The summary of findings of a single
test cannot be presented without a danger of over-simplification and over-generalization. Hence a Combined Manual of the three tests is planned to be produced before the tests reach the users.

The pamphlet (appended), however, is expected to serve another purpose also. Suitable literature for general orientation of the school teachers to work as test-administrators and proctors is not yet produced in Gujarati. Hence, efforts are made to provide detailed briefing to the school-teachers at the three stages in using the test.

**Construct**

The hypothetical construct of Numerical Ability adopted for the present work includes Numerical Facility, Numerical Inductive Reasoning and handling of Numerical Concepts stated symbolically and verbally. The Numerical concepts covered by the present test are conventions, decimal conversions, percentage, proportions, square-roots, equations, indices, signed numbers and fractions. The problems stated verbally, also require the ability to handle Numerical concepts and not the Language Ability as such.

**Differential predictivity**

These hypothetical aspects were found to be correlated with achievement in Mathematics on 86 students of the tenth standard in the concurrent validity study. The study was
conducted on a mixed sample of 50 boys and 36 girls. Secondly, the correlations were based on part scores of the spiral omnibus tests. Hence correlations and factor analysis based on total scores on different tests may be considered more reliable for differential predictivity of the tests. This is indicated in table XLIII concerning the Multitrait-Multi-method-Matrix. The present test correlates highest with marks in Mathematics. The validity coefficient of this test is also highest among the three coefficients of the tests employed.

The significance of differential predictivity of the test is not ascertained due to the fact that the validity criteria themselves inter-correlate to the extent of .62, .73 and .77. Hence further studies on homogeneous and larger samples with better criteria are suggested to ascertain the differential predictivity of the three new-born tests.

**Construction of the test.**

The Test and the Manual of Directions are planned keeping in view the population, purpose, setting and level of test-sophistication of the test-users in Gujarat State. The usual procedures of test construction were followed with some additional steps for precision. Ten of such measures are ennumerated in the introductory chapter. Hence, they are not repeated here.
Reliability

The retest and split-half coefficients of reliability of the test were computed on 634 high school pupils of standard eight to eleven. The coefficients for the entire sample of 634 were found to be 0.735 and 0.897 for retest and split-half (whole) respectively. To check up the reliability and compute the standard error of measurement at each grade level, gradewise coefficients of correlations were computed. When they were converted into Fisher's Z, averaged and reconverted into r gave the coefficients 0.68 for retest and .84 for the split-half (whole). The coefficients were not corrected for attenuation, from sample to population.

The answer-sheets of 300 boys of the tenth standard were employed for analysis of variance. The coefficient of reliability by Hoyt's formula was found to be 0.79. Gradewise standard Errors of Measurement are computed from the coefficients of reliability and standard deviations.

Further studies on reliability for optional groups and two sexes are suggested for better precision.

Validity

Factor analysis based on inter-correlations of the part-scores of the present test, employing Hotelling Iterative Procedure was done through the computer. The output for the 300 tenth standard boys indicated the percentage of the
variance accounted for by each of the hypothetical aspects of the test. The general factor Numerical concepts (lower) accounted for 42.54 per cent of the test variance on the sample. Merits of Principal Axis Factor Analysis and limitations of the factor study, conducted, are described in details.

Empirical validity of the test was indicated by group-differences and expectancy tables on a few groups.

The study on congruent validity of the test was carried out on a sample of 429 in the western zone. The coefficient of correlation for the sample was found to be 0.665.

The concurrent validity of the test was cooperatively studied by three test authors on a sample of 86 pupils of tenth standard. The study yielded a 30 x 30 inter-correlation matrix, a Multitrait-Multimethod-Matrix and factor matrix on the sample. The study included factor analysis on inter-correlations of Numerical Ability, verbal(Language) Ability, Pictorial Test of Mechanical comprehension and the good old (Revised) M.P.F.B. (Form B).

The Empirical validity was further studied on percentile ranks of the students of the normative samples. The validity coefficients on eleven classes with marks in Mathematics at the local examinations are reported in full details in table LXI. The correlations are found to be
significant - ten at .01 level and one at .05 level.

The validity coefficients on five groups of the S.S.C. class, one group of the Pre-science class and one group of the F.Y. Diploma in Engineering class with marks in Mathematics, at the external examinations are reported with details in table LXII. Out of the seven, five coefficients are found to be significant at .01 level while two are so at the .05 level. The validity coefficient with the total marks on Pre-science class is not significant at .05 level while it is significant at .05 level on F. Y. Diploma in Engineering class.

The inter-correlations of the six variables on 43 boys at the S.S.C. Examination with technical subjects (table LXIII) indicate that the present test is relatively a better predictor of marks in Algebra-Geometry and total marks for that group. The test is therefore considered to be a useful tool of guidance at the high school stage in Gujarat, for the present.

And that is all about the main purpose of the present work. During the study, some side issues attracted the attention, due to their niceties or practical utility in the field of psychometrics. Their mention at this point may suggest some hypothesis to work upon for future researches.
SIDE-ISSUES ON MEASUREMENT

Most of the issues have the locus on the item indices.

Correction by Horst's formula

The first pilot of the test was run in free-response form to get the plausible distractors from the students themselves. The procedure led to the use of Horst's formula of correction depending on the response-counts of the most popular distractor for each item.

The effect of correction was studied on selected items in the second pilot of the test (table LXIX). When corrected the items appeared more difficult and more discriminating. Similar was the finding on 93 Draftsmen Trainees in standardized administration of the final form of the test. This micro-study lends the hypothesis that Horst's correction magnifies the difficulty as well as the discrimination values of the test items. The hunch may be verified for other tests and other corrections also.

Item indices on standardized administration

After the selection of items for the final form is done, item analysis is rarely attempted. It was, however, carried out in the present work to ascertain the stability of item-indices in standardized administrations on two groups. It is satisfying to note the consistency of average item indices of tenth standard boys (300) with those of Draftsmen trainees (93). The procedure appears to provide
some evidence on item validities of self defining tests.

**Item indices on different grouping.**

The problem regarding the proportional composition of the upper and lower criterion groups is interesting in case of tests being developed for a wide range of grade levels. Item analysis was done to ensure a reasonable range of difficulty and discrimination at each grade level and to check up grade to grade consistency.

The indices derived from general group and cumulated stratified groups correlated significantly on 120 items of the second pilot (table LXXII). The hypothesis is that the cumulated stratified grouping may be considered preferable to the traditional general grouping, as it provides five sets of item indices with almost the same labour of response-counts as that of the general grouping. The procedure is, however, considered as unverified and hence the arrangement of the items in the final form of the test was decided traditionally, on the basis of indices yielded by the general group. The procedure appears to have scope for developing into a (new) method of grouping the sample units for item analysis.

The same procedure, if adopted for the final form of the test, in standardized administration, may yield data on stability of item indices from grade to grade. All these studies on item indices can be considered as validity studies.
at the item level. These studies were possible because of the linearity of scales of indices given by the Harper's chart.

SUGGESTIONS FOR FURTHER RESEARCHES

The rear of a research is the background for many more researches. The work done appears to be insignificant as compared against the vast undone. On the part of the author there is no sense of perfection. At the most there is a feeling of enrichment on some of the finer issues of test development.

One cannot be exhaustive in suggesting new areas and issues for further studies. Only a few regarding the present test are indicated here.

Differential prediction

The essence of ability testing is the differential predictivity of the tools being developed. This test being one of the three tests of special abilities, relevant to educational guidance, should be tried, along with others on samples from multilateral schools, ordinary schools and Pre-degree classes.

Population characteristics

The study should be conducted on well-defined sampling design. In fact there is a need for basic research of
discovering characteristics of the high school population in the State. The statistics available from the Gujarat S.S.C.E. Board are up to date and accurate for a few purposes only. Data on age, grade, optional groups, school sizes and sex are not available even for a district in the State. It is suggested that institutes like the Research unit of the Directorate of Education in the State or the Centre for Advanced Studies in Education, M. S. University, Baroda may undertake such work.

**Validity on trade courses**

The Industrial Training Institutes admit trainees on the basis of selection tests, developed by the Directorate General of Employment and Training. The three new tests may be administered along with the selection tests as an experiment to study the predictive efficiencies of the tests on the samples of various trade courses. The factor analytic study may provide necessary data on the new tests, for the guidance of the school leavers and the applicants for the trade courses.

**Long range validity studies**

The present test was administered for normative data during the year 1968-69. The students tested in 1968-69, while they were in the eighth standard, will appear at the S.S.C. Examination in March, 1972. The test may be validated with marks in Elementary Maths and Algebra-Geometry obtained by the same students. The data will be available with the
Research unit of the S.S.C.E. Board, for all the students in June 1972. Hence this follow-up study may be scheduled in 1972.

The present test is developed, naturally, on the concepts covered by the current syllabus. A new syllabus is coming up, in the high schools of Gujarat State, reaching eleventh standard in 1976. The draft of the new syllabus has some elements of New Mathematics also. The predictive validity of the present test should, therefore, be studied on a large scale in 1976, to check up the consistency of the coefficients reported in the present work.