APTITUDE TEST DEVELOPMENT

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SYED AHMED

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DEVELOPING A GROUP TEST OF APTITUDE FOR USE WITH THE STUDENTS OF CLASS NINE IN BANGLADESH

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ABSTRACT

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Statement of the Problem

The problem of the study was to develop a group test of aptitudes suitable for use with the students who would be selecting their course of study at the secondary school certificate level in Bangladesh; and more specifically, to investigate if the test would differentiate the students of such groups as Humanities, Science, Commerce, Industrial Arts and Home Economics of some secondary schools of Dacca, Bangladesh.

Methods of Study

A test comprising three sub-tests, namely Verbal Reasoning, Numerical Ability and Abstract Reasoning was developed and tried out for selecting items for the final test. It was a multiple choice objective test.

The test manual was prepared in Bengali and it contained methods of administration and scoring and other necessary instructions.

The final test was administered to 1292 students of classes VIII, IX and X of seven randomly selected schools in Dacca, Bangladesh. Each class included both boys and girls.

There were 425 students from class VIII, 456 from class IX and 411 from class X. The boys of classes IX and X belonged to four groups, namely Humanities, Science, Commerce and Industrial Arts while the girls of classes IX and X belonged to three groups, namely Humanities, Science and Home Economics. Thus the students were considered to belong to sixteen groups.

Each sub-test was validated against five external and an internal criteria. The external criteria were the scores obtained by the students in the preceding First terminal/Half-yearly examination conducted by the respective schools on Bengali, Mathematics, Bengali plus Mathematics, Elective subjects and all school subjects together. The internal criterion was the score on the test under study.

Reliability coefficient of each sub-test was obtained by split-half method and was corrected by Spearman-Brown Prophecy formula. The reliability coefficients for a sub-total and the total test were obtained by averaging the corresponding reliability coefficients by z-transformation method.

The differential ability of the tests were obtained using the F-test and the t-test. As a prerequisite for the use of F-test and t-test, the group variances were tested for homogeneity using Bartlett's test.

Students in each group were categorized on the basis of four aptitude criteria and two achievement criteria to see the extent of misplacement in different groups.

The difficulty index of each item was obtained by averaging the percentages of correct response of the higher and the lower groups. The discriminating index of each item was read from the Table of r-bis.

The 0.05 level of significance was chosen for the study.

Findings

Significant validity coefficients indicated that the test or some of the tests were valid for each of the external criteria for each of the sixteen groups except that for IXBC and XBH.

Validity coefficients against the internal criterion were all significantly greater than zero with the only exception for NA for IXBC indicating that each sub-test was a valid instrument in almost all cases.

Coefficients of correlation between any two sub-tests for most of the groups were low in magnitude. It was also found, as expected, that as large as seventy-seven per cent of the coefficients of inter-sub-test correlation were less than 0.50 in magnitude. This substantiated the assumption of low inter-sub-test correlation to an extent.

Sixty-eight per cent of the reported reliability coefficients were significantly greater than 0.60. For the total group of 1292 students each of the tests was found to be reliable.

The results of the F-test and the t-test indicated that the tests discriminated the groups significantly.

Percentage distribution of students as per category indicated, the students of class IX and X in the sample were mostly misplaced into different groups.

Items retained in the final form of the test were thirty-two in VR, forty in NA and twenty-eight in AR. The range of difficulty indexes of the three sub-tests were 0.76 to 0.26, 0.72 to 0.23 and 0.78 to 0.22 respectively and the corresponding range of discriminating indexes were 0.76 to 0.20, 0.69 to 0.20 and 0.58 to 0.16 respectively.

Conclusions

The following conclusions were made:

1. The tests, were substantially valid and reliable. So the tests could be used for measurement of scholastic aptitude.
2. The tests discriminated the groups as well as sexes efficiently. This also indicated that the test was valid.
3. Low inter-sub-test correlation indicated that the sub-

sub-tests contributed satisfactorily to the validity of the test.

4. The test is differential in nature and can be used to classify students at the secondary school certificate level.

Recommendations

It was recommended:

1. That for obtaining more rigorous measures of relationships between the test scores and the criteria for validation, the latter has to be more reliable and valid. Further and more rigorous study may be conducted to obtain more valid and reliable criterion measures.
2. That Nation-wide validation and standardization be made for practical use of the test.

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CHAPTER I

INTRODUCTION

Manpower is one of the vital resources in Bangladesh and education is the best means to ensure the use of this resource. But the system of education which has been inherited from the past regime has proved unsuitable to tap it. With the achievement of freedom and sovereignty it has become the obligation of each and every conscious citizen to work with utmost zeal and sincerity in his field of specialization for the realization of this goal. It is the responsibility of the educationists to construct and to adopt valid instruments for measuring aptitude and interests of pupils to ensure the best utilization of the manpower.

Developed countries of the world have already made commendable contribution to the matter of objective assessment of human traits like aptitude, intelligence, interests etc. But unfortunately for Bangladesh it was not before the 1950's that planners and educationists of the then Pakistan (now Bangladesh) could comprehend the idea of objective and standardized tests to be used for proper evaluation. The planners of the First Five-Year Plan (48, p. 1.) realized that some steps should be taken to reorganize the existing education system. Their awakening is observed in the

following words:

> . . . it is proposed that at least one university in each Wing establish, within its department of education, an Institute for Educational Research. . . . The chief functions of the Institute would be . . . to train specialists in . . . testing, (48, p. 563.).

The proposals in the First Five-Year Plan were a reflection of the public opinion for some definite change in the then system of education. Consequently, government had to set up a Commission on National Education on the 30th December, 1958.(47, p. 1.). The Commission in its report put much emphasis on the construction and use of objective tests. Two observations of the Commission in connection with higher education and in connection with guidance in the educa-tion system are worth mentioning. Regarding examination in higher education the Commission said:

> A task of the proposed Institutes of Education would be to explore the possibilities of new types of testing, and to devise and standardise ones which are suitable for our candidates, bearing in mind the use of tests in selection, student guidance, and graduate assessment . (47, p. 25.)

The observation of the Commission in connection with guidance in the education system reads:

> We recommend, therefore, that: The Ministry of Educa-tion should establish a bureau with such branches as may be necessary to undertake the construction of tests and other evaluative instruments required in a compre-hensive national programme of counseling and guidance. (47, p. 256.).

At the beginning of the Second Five-Year Plan the

proposed Institute of Education and Research was established as an integral part of the University of Dacca. From the very inception of the Institute the students therein started using objective tests that were imported from the United States of America. Some doctoral students from Bangladesh (the then East Pakistan) undertook research project in devel-oping tests suitable for this country while some worked on the feasibility of using American tests in this culture but the zeal supporting the start could not maintain its original progress, perhaps due to less emphasis by the Government or due to political unrest in the country. It may be recalled that in the Second Five-Year Plan (49, p. 345.) the planners, in connection with teacher education only, called for re-search to develop "tests of aptitude and intelligence".

As in the First Five-Year Plan the Third Five-Year Plan similarly stressed the need for research and the devel-opment of objective tests. In connection with teacher edu-cation the Plan reads:

> In research high priority is to be accorded to the development and standardization of objective tests, such as those of intelligence, and scholastic achievement in various subjects, stratified for different age and grade level children, besides batteries of aptitude tests. (50, p. 197.).

The trends and issues depicted in the foregoing paragraphs inspired the researcher to undertake this study:

Statement of the Problem

The problem of the study was to develop a group test of aptitudes suitable for use with the students who would be selecting their course of study at the secondary school certi-ficate level in Bangladesh; and more specifically, to investigate if the test would differentiate the students of such groups as Humanities, Science, Commerce, Industrial Arts and Home Economics of some secondary schools of Dacca, Bangladesh.

An attempt was made in this study to explore the feasibility of the use of the test by obtaining measures of reliability and validity of the test and of the sub-tests comprising the test.

In this study an attempt was made to carry out item analysis to select the most effective items. The item analysis provided difficulty and discriminating indexes for each item.

Significance of the Problem

The rationale for this study can be realized from the deep concern expressed by the Government of the Peoples Republic of Bangladesh (46, p. 1.) in the statement that "Vocational and technical training at different levels will be given greater emphasis . . . . Higher education will be made highly selective; . . .". (46, p. 448.)

Regarding vocational planning Lindquist says:

> Jobs within these broad families demand similar patterns of ability, achievement, aptitude, personality, and interests. The measurement of these behavioral elements, therefore, can lead to rough predictions of the job families in which greater or lesser success and satisfaction may be expected. (25, p. 75.)

The Government of the Peoples Republic of Bangladesh emphasizes highly selective higher education which implies that the selection will be made on some sound basis. With this end in view the Commission on National Education (45, p. 259.) proposed the establishment of a Guidance and Testing Institute. The concept of selective education implies proper educational placement. Regarding educational placement Lindquist points out the role of valid tests in the following words: "Educators have rapidly come to realize that tests offer unique help in many problems of counseling, guidance, and, particularly, of placement". (25, p. 85.)

Besides the emphasis laid in the Third Five-Year Plan (50, p. 1.) and the Fourth Five-Year Plan (51, p. 1.), Ali has made an observation of the limitations of the educational evaluation in the then Pakistan (now Bangladesh). He points out that:

> Teachers of Pakistan seem to use subjective type of tests exclusively. This type of teacher-made-tests cannot bring about overall improvement in the educational system because (1) many teachers pay little attention to the objectives and content of instruction, (2) many teachers do not possess the knowledge and techniques needed for valid test construction, and (3) many teachers

lack statistical knowledge to tabulate and analyse test scores. (53, pp. 11-12.)

The area of psychological testing is deeply concerned with the measurement of aptitude, a correct assessment of which can be an asset to the individual, the educator and the employer.

Bennet, Seashore and Wesman have described the trend in aptitude testing in the following words:

> Since the 1920's, there has been a growing recognition of the need for measures of many aspects of mental ability. The research and theories of Thorndike, Kelley, Spearman, Thomson, Thurstone, and others have made us increasingly aware that so called intelligence is not a unitary trait — it is composed of many abilities, which are present in different individuals in varying amounts. A student may have excellent verbal facility, yet lack numerical or mechanical aptitude. (3, p. 1.)

But no published record reveals that any formal attempt has so far been made to construct an objective test for the classification and placement of the students when they step to pursue one of the many diversified courses offered at the secondary level in the educational system of Bangladesh. The purpose of this study, therefore, was to develop an aptitude test to meet the need of the time.

Need for the Study

If Bangladesh is to offer selective education beginning from the secondary school level she must start developing some aptitude tests together with other psychological

tests. Aptitude tests purport to measure one's capacity or ability to perform in a specific area. It is, therefore, the need of the day to make aptitude as well as other psychological tests available so that they may be used freely and frequently for diagnosis and prognosis of the individual's behaviour in a variety of settings.

To derive maximum benefit from diversified courses at the secondary level in Bangladesh, tests of intelligence, aptitude and achievement should be used in conjunction with other significant information for the purpose of proper identification and classification of the students. The need for the development of such tests was felt during the past period. The Commission on National Education has, therefore, observed:

> Some reasonably effective tests of this type have been developed and used in other countries. Even though tests, like traditions, are not profitably exported, the principles and procedures involved in test construction are fairly universal. We would suggest, therefore, that as soon as possible the appropriate agency undertake the designing of standardized tests that may be used in conjunction with other pertinent criteria in this nation-wide search for talent. (47, p. 249.)

That the recommendation of the Commission could not be implemented to achieve the aspired goals and that the need for developing psychological tests for practical use still persists in Bangladesh have been reflected in the proposed Report of the Commission on National Education. This

Commission provided a definite plan of work proposing the establishment of an Institute and delineating some specific functions of the proposed Institute. Regarding the establishment of an Institute and its functions, the Report reads (paraphrased):

> As a preparation for the initiation of a comprehensive programme of guidance and counseling an Institute for Testing and Guidance should be established . . . . This Institute shall be responsible for the construction of psychological tests of intelligence, interest, aptitude and achievement for use at different stages . . . will provide training for specialists in Testing and Guidance. (45, p. 258.)

Rationale for the Test

Efforts were made to develop the test on the basis of operational definition of aptitude. Such a definition has been quoted by the specialists who developed The Differential Aptitude Test Battery. The quotation is:

> A set of characteristics regarded as symptomatic of an individual's ability to acquire with training (usually specified) knowledge, skill, or set of responses such as the ability to speak a language, to produce music . . . .(3, p. 2.)

Questions may be raised whether this definition is a scientific one or not. A scientific definition of aptitude should provide for specificity, unitary composition, and the facilitation of learning of some activity or type of activity. In the present need and condition of the country it was not considered wise to wait for a scientific definition of apti-

tude for the purpose of developing an aptitude test. In this connection Super and Crites say:

> In our present state of knowledge and with current techniques, it seems wiser to be satisfied if the aptitudes measured are relatively distinct and have some validity, than to devote much time to obtaining pure traits. (35, p. 72.)

Another implicit assumption in aptitude testing is that aptitude cannot be measured directly. Aptitude is infer-red from one's level of performance on aptitude test. An aptitude test measures what an individual can learn better, it does not measure inter-person superiority; rather it measures intra-person superiority of ability. Thus aptitude measures provide index to facilitate the placement of individuals in academic courses or vocations.

Another assumption, which was implicit in the construction of this test, was that at least three components of ability that are required for the scholastic success in various diversified courses should be used for the assessment of those three abilities. These abilities are — Verbal Reasoning, Numerical Ability and Abstract Reasoning. All the three components of the test were paper-pencil type of test usable both to a group, or to individuals. Classification of the students for grouping into various courses is a general problem and as such the test will usually be administered to groups but in special cases it may be used to individuals too.

Like most of the objective tests the principles underlying the construction and standardization of aptitude tests are fairly universal. Experience of others in the field of intelligence and aptitude test construction was therefore utilized in the development of this test for use in Bangladesh. The materials and media used were derived from the local background. Development of a test was preferable to translation or adaptation of a foreign test, it was also imperative that in the process of construction of this test only those principles and methods which were suitable for the purpose, be utilized. Therefore some principles underlying the construction of widely used tests, such as Differential Aptitude Tests (DAT), Flanagan Aptitude Classification Tests, Academic Promise Tests and General Aptitude Tests Battery were used with necessary modification. The DAT was specially considered in this connection. The principles that were utilized for the construction of the test were: (1) Each of the three sub-tests should be an independent test so as to facilitate the use of a sub-test if and when necessary; (2) the test as a whole should measure power instead of speed; (3) the test materials should be practical; (4) the test should be easy to administer and (5) the test battery should yield a profile.

Objectives of the Test

Each of the three sub-tests comprising the test was expected to measure a single phase of aptitude and the general objective of the test was to provide a measure of academic promise. These sub-tests were: (1) Verbal Reasoning (VR), (2) Numerical Ability (NA), and (3) Abstract Reasoning (AR). Each sub-test was expected to contribute to the measurement of one phase of aptitude of the testees. The specific objectives of each are listed below:

I. The VR is a measure of abilities to provide 'structural descriptions' and 'semantic readings'. The first of these abilities refers to the grammatical competence which includes abilities to (a) distinguish structurally well formed utterances, (b) note when and in what ways an utterance is susceptible to more than one structural interpretation, and (c) relate sentences or words to each other by virtue of their structural similarity or difference. While the second refers to (a) semantic anomally, (b) note when and in what ways an utterance may be semantically ambiguous, and (c) note paraphrases and synonymy relations among utterances.

2. The NA is a measure of the ability to think in and work with numbers.

3. The AR is a measure of the ability to perceive relationships in abstract patterns — generalization and [illegible] of principles.

deduction of principles from nonlanguage designs.

Delimitations of the Study

This study was delimited to:

1. Obtaining measures of reliability and validity of the test and the sub-tests comprising the test.
2. Obtaining item analysis data, mainly difficulty and discriminating indexes.
3. Establishing the discriminating abilities of the sub-tests and the test as a whole between the high achievers and the low achievers as identified by the school record.
4. Validating the test and the sub-tests against criterion scores on Bengali, Mathematics, Bengali plus Mathematics, Elective Subjects and Aggregate Scores on all subjects obtained by the students in the preceding examination conducted by the respective schools.
5. Using sample of students of classes eight, nine and ten enrolled in some selected schools of Dacca.
6. Using the class or classes as a whole of each selected school.
7. Using Bengali as the language of the test and that of the instructions.

Hypotheses for the Study

The general and logical hypotheses for the study were the following:

1. The test would yield valid and reliable measure of scholastic aptitude.
2. The test and the sub-tests would discriminate between the high achievers and the low achievers.
3. The items would be effective and suitable for the sub-tests.
4. The sub-tests would be effective for the test.

The above mentioned hypotheses were translated into corresponding and appropriate statistical hypotheses and they were tested for significance.

Definition of Terms

School. — An educational institution having students in classes eight, nine and ten.

Students. — Boys or girls belonging to either of the classes eight, nine or ten.

Class. — An academic grade in schools of Bangladesh.

Group. — A constituent part of the total sample — being different from other parts in respect of sex, class or course of study.

Humanities group. — A group that selects and studies any

four elective subjects from among the languages and social science subjects.

Science group. — A group that selects and studies physics, chemistry and mathematics as main elective subjects.

Commerce group. — A group that selects and studies book-keeping and accountancy as main elective subjects.

Industrial Arts group. — A group that selects and studies technical drawing, metal work and/or wood work as main elective subjects.

Home Economics group. — A group that selects and studies Home economics, cooking and sewing as main elective subjects.

Secondary School Certificate Level. — Classes nine and ten in Bangladesh is termed as secondary school certificate level.

Tests. — The three sub-tests (VR, NA and AR) and two of their combinations, namely VR+NA(ST) and ST+AR(TT), were together termed as tests.

Test. — The combination of three sub-tests was termed as test.

Abbreviations Used

VR. — Verbal Reasoning

NA. — Numerical Ability

AR. — Abstract Reasoning

ST. — VR + NA

TT. — ST + AR

TS. — Total sample of 1292 students

TB. — Boys in the total sample

TG. — Girls in the total sample

STB. — Boys of classes nine and ten included in the total sample.

STG. — Girls of classes nine and ten included in the total sample.

VIII. — Class eight

VIIIB. — Boys of class eight

VIIIG. — Girls of class eight

IX. — Class nine

IXB. — Boys of class nine

IXBH. — Boys of class nine Humanities

IXBS. — Boys of class nine Science

IXBC. — Boys of class nine Commerce

IXBIA. — Boys of class nine Industrial Arts

IXG. — Girls of class nine

IXGH. — Girls of class nine Humanities

IXGS. — Girls of class nine Science

IXGHE. — Girls of class nine Home Economics

X. — Class ten

XB. — Boys of class ten

XBH. – Boys ofcclass ten Humanities

XBS. – Boys of class ten Science

XBC. – Boys of class ten Commerce

XBIA. – Boys of class ten Industrial Arts

XG. – Girls of class ten

XGH. – Girls of class ten Humanities

XGS. – Girls of class ten Science

XGHE. – Girls of class ten Home Economics

z_r. – z-value corresponding to an r (validity or reliability coefficient)

Reference

Whenever any of the bibliographical entries was cited in the body or text of the dissertation, it was referred to by number. The number was enclosed within parentheses, together with the page number from which the quoted material was taken.

CHAPTER II

A REVIEW OF RELATED RESEARCH

The principal problem of this study was the construc-tion of a group test of aptitudes to be used for the purpose of selecting students of class nine for different courses that are offered at this level of education in Bangladesh. Most of the aptitude tests that are available in Bangladesh were constructed and studied in American situation. Locally made aptitude tests are needed for use in Bangladesh.

The main purpose of the review of related research is to present a picture of the trend of research studies on testing in Bangladesh. It also serves as a summary of what has occured during the last few years in the area of testing in the country. The research studies in Bangladesh and elsewhere were reviewed with the purpose of knowing what had been done before and what needed to be done.

Since July 1, 1960, when the recommendations of the Commission on National Education (47, p. 1.) were put into effect in Pakistan, a few studies have been conducted using the Differential Aptitude Tests - either in their entirety or in parts. In East Pakistan, (now Bangladesh) most of the studies with these tests had been conducted under the auspices of the Institute of Education and Research, University of Dacca. A review of such research studies is presented below:

Studies and Reports During 1960-1961

The very first report on research in psychological testing at the Institute of Education and Research, University of Dacca, was a study (60, p. ii.) with the graduate students in education.

The basic problem of the above mentioned study was to attempt to measure cultural differences and to evaluate the significance of these differences when well-standardized tests of another culture were used in the then Pakistan to explore the usability of such tests.

The experimental group consisted of graduate students in education working toward a master of education degree during the academic year 1960-1961 at the Institute of Education and Research, University of Dacca.

The psychological instruments used were as follows: (1) Differential Aptitude Tests (DAT) (3, p. 1.), (2) Co-operative School and College Ability Tests (SCAT) (9, p. 1.), (3) Study of Values (SV) (1, p. 1.), (4) Minnesota Teacher Attitude Inventory (MTAI) (8, p. 1.), and (5) Edwards Personal Preference Schedule (EPPS) (11, p. 1.).

The VR scores and the NA scores of the DAT and the V scores and the Q scores of the SCAT were used as those measuring academic aptitude. The SV, MTAI and EPPS were used to measure attitudes and other personality variables. This

exploratory research encouraged and strengthened the need for continued research in this area.

In her study with Class X girls Anwar (69, p. v.) concluded that there was a statistically significant relation-ship between scholastic achievement scores and scores on the VR and the NA sub-tests of the DAT.

Working with students studying for a bachelor of education degree, Khatoon (84, pp. iv-v), using all the sub-tests of the DAT, found that the VR was positively related while the NA was negatively related when correlated with the admission tests of the institution.

Khatun (86, p. iv.) using all the sub-tests of the DAT, Form A, and working with the second-year college women students of Dacca, studied the concurrent validity of the sub-tests of the DAT by correlating scores obtained on the sub-tests with some of the courses the students were taking. She found that the VR and NA sub-tests may be used as predictors of scholastic success.

Sadruddin (88, p. v.) worked with the second-year college men students of Dacca. He used all the sub-tests of the DAT. From the data available no substantial correlation was found between scholastic achievement and DAT performance (except Numerical Ability and Mathematics) for this group.

Saifullah (98, pp. iv-v.) studied the Class X boys

and administered all the sub-tests of the DAT to them. He attempted to obtain concurrent validity coefficients for each of the sub-tests of the DAT by correlational methods. He also constructed a local percentile norm and a stanine norm.

Studies and Reports During 1961-1962

Ahmed (64, p. iv.), using Form A of the VR and NA of the DAT with class X boys of Dacca, constructed a local percentile norm.

Baroya (73, p. iii.) processed all tests data on graduate students in education collected during the academic years 1960-1961 and 1961-1962 at the Institute of Education and Research. He constructed percentile and stanine norms for forty-eight separate groups for whom six standardized tests were in use at the graduate level.

Biswas (75, p. iv.) attempted to establish local norms on Form A of the VR and the NA of the DAT for the first-year college men students of Dacca. He constructed a local percentile norm, and compared the performance of the Arts and the Science groups.

Gani (77, p. iv.) attempted to establish local norms on Form A of the VR and the NA of the DAT for class X boys of Dacca and constructed percentile norms for the group.

Haque (79, pp. iv-v.) used Form A of the VR and the

NA sub-tests of the DAT which he administered to 113 first-year college Science men students and forty-nine first-year college Arts men students. He attempted to construct percentile norms and found that the achievement scores were positively correlated with the aptitude scores.

Ibrahim (81, p. v.), by studying the accuracy with which the Intermediate examinations can predict success in B.A., B.Sc., B.Com., Medicine and B.Sc. Preliminary Engineering Examinations, found that the Intermediate Examinations as a whole has little value as a predictor of success in the later examinations.

Using Form A of the VR and the NA sub-tests of the DAT, Khan (82, p. v.) constructed a percentile norm in his study with the Class X boys.

Khatun (85, p. iv.), using Form A of the VR and the NA sub-tests of the DAT to study the first-year college men students of Dacca, constructed a percentile norm for the group. She also attempted to establish concurrent validity of these sub-tests and found positive relationship between the sub-tests used and the courses taken by the students.

Naqvi (92, p. iv.), using Form A of the VR and the NA sub-tests of the DAT, conducted a study with the Class X girls of Dacca. This study was conducted to obtain normative data. She constructed a percentile norm for the group.

Tasneem (101, p. v.) used form A of the VR and the NA sub-tests of the DAT to study the 61 master of education full-time students at the Institute of Education and Research, University of Dacca. In addition to constructing a local per-centile norm, she found that the scores on the sub-tests and the grade-point average (G.P.A.) for the first two terms of the academic year 1961-1962 were positively related.

In a 1962 report, Husain (61, p. iii.) attempted to validate the VR and the NA sub-tests of the DAT against the grade point average (G.P.A.) of the first two terms of the academic year 1961-1962 at the Institute of Education and Research, University of Dacca and found them positively related.

Khan (62, p. iii.) attempted to construct norms for the second-year college Arts men students using Form A of the VR and the NA sub-tests of the DAT. The report was based on a sample of fifty-one students.

Muslimuddin (63, p. iv.) administered the SCAT on twenty-two students of the first-year B. Sc. class, fourteen students of the second-year B.A. class and two students of the first-year B. A. class. In addition to constructing local norms on this small sample, he found that the achievement scores and the SCAT scores were positively related.

Studies and Reports During 1962-1963

Ahmed (66, p. iv.) conducted a study to ascertain the predictive validity of Form A of the VR and the NA sub-tests of the DAT for college men and found them positively related with achievement scores.

Ahmed (65, p. iv.) conducted a study in which he attempted to ascertain the predictive validity of Form A of the VR and the NA sub-tests of the DAT using Class X boys and found them positively related with achievement scores.

Akhtar (68, p. iii.) in her study, attempted to ascertain the predictive validity of a Bengali translated and adapted version with the first-year college men students. The findings were: (1) The Numerical Ability Test proved to be the more effective predictor of scholastic achievement; (2) The relationship between scholastic achievement and the performance on the Verbal Reasoning and Numerical Ability test were not significant.

Hamid (72, p. iv.) conducted a study to ascertain the predictive validity of the Bengali translated and adapted version of Form A of the VR and the NA sub-tests of the DAT and concluded that while the NA seemed to have some predictive validity, the predictive validity of the VR seemed doubtful.

Matinuddin (89, p. viii.) conducted a study to ascer-tain the predictive validity of three versions of the VR and

the NA sub-tests of the DAT with the second-year college men students in Arts, Science and Commerce groups. The study found that the Adaptation or Translation forms of the tests are no better instruments than the original tests for the local use until these are reconstructed and carefully developed.

Saeed (96, p. v.) conducted a study to ascertain the predictive validity of Form A of the VR and the NA sub-tests of the DAT for the second-year college men students and found that VR was a valid predictor of academic success in Chemistry, Mathematics, and Method of Business while NA was in Biology.

Studies and Reports During 1963-1964

Azizullah (71, p. v.) developed a new Bengali translated version of the VR sub-tests of the DAT based on the combined items of Forms A and B. This test comprises seventy-five items distributed in two booklets. He found that the number of items that could be retained were thirty-nine, forty, forty and forty-two for classes VIII, IX, X and for the total sample. Of these thirty-one items were common retainable items for all groups.

Monsur (90, p. v.) constructed a scholastic readiness test for the pre-school and the early school children of East Pakistan. This test provides three indices of scho-

scholastic readiness.

In a study with the DAT, Form A, and the SCAT, Begum (74, p. iv.) compared the validities of the VR and the NA sub-tests of the DAT with those of the V and the Q sub-tests of the SCAT and found no difference.

The study undertaken by Gomes (78, p. v.) investigated into the effects of administration time on validity of Form A of the VR sub-tests of the DAT and found that mean difference was significant. Thus the prescribed time was not adequate for the students to do their best.

The EPPS was translated into Bengali by Khanum (83, p. vii.) in an effort to make an instrument of personality measurement available for use among Bengali-speaking people. She found significant differences in the personality traits of boys and girls in the area of CHANGE, DOMINANCE and HETEROSEXUALITY.

The reliability of the SCAT was studied by Khatun (87, p. vi.) who reported that the obtained reliability coefficients were significant when used among the graduate students in education.

Mustafa (91, p. v.) and Noor (93, p. iv.) marked the trends of research on testing at the Institute of Education and Research, University of Dacca and launched out to construct new tests of verbal reasoning and scholastic ability.

The tests were statistically valid and reliable.

Siddiqui (100, p. iv.) made an adaptation of the VR sub-tests of the DAT after an item analysis.

Sarwatara (97, p. v.) attempted to recast the VR sub-test of the DAT from its original analogy type of format to a multiple-choice type of format where only five choices were used for each item. The test so developed was neither valid nor reliable.

Studies and Reports During 1966-1979

Fatema (76, p. 50.) and others studied the validity of the ULS Test of Mental Ability (English and Bengali Form) for boys and girls of Classes VI, VII and VIII of East Pakistan. The test was administered to a sample of 1464 students. They concluded that though the results were significant at 0.05 level, the reliability coefficients were not very high. It can, therefore, be concluded that the hypotheses were accepted with some reservation.

Rehman (95, p. vi.) studied the predictive validity of the VR sub-test, Form F of the DAT. Subjects for the study were selected from St. Gregory School and Holy Cross School of Dacca. Findings indicated that tests were valid predictors of academic success.

Shikder (99, pp. iv-v.) constructed and validated an Achievement test in Mathematics for class VIII. He

reported validity, reliability and the results of item analysis.

Arju (70, p. iv.) constructed a test of General Knowledge. The subjects for the study were selected from three schools of Dacca. Mean, standard deviation, percentile ranks and the significance of the differences in mean were reported.

Ahmed (67, p. v.) constructed an objective type achievement test in elective chemistry for the students of secondary school certificate level in Bangladesh. It was administered to 497 students of class X in the city of Dacca. Mean, variance, standard deviation, validity and reliability were reported. The test was reported to be valid and reliable.

Huque (80, p. iv.) investigated into the reliability of the achievement test in elective chemistry (67, p. v.). He found that the test was reliable.

Doctoral Studies

In his study, Aijaz (52, pp. v-ix.) compared the predictive validity of the original English, the translated and the adapted versions of the VR and the NA sub-tests of the DAT. The English, the translated and the adapted versions were administered to 106, 107 and 82 subjects respectively. The scores obtained from these three versions were

correlated with the measures of school achievement as reflected in the most recent school grades. He found that both the translated and adapted versions of VR and NA were better predictors than the original English version.

In his doctoral study, Alvi (54, pp. 2775-2776.) studied the traditional and "culture fair" aptitude test performance of college students from different academic and cultural backgrounds.

Using other instruments besides the DAT, he attempted to study the traditional and "culture fair" aptitude test performance of college students. His findings indicated that the Cattell, Otis and the DAT gave strong support to the notion that these tests transcend the "culture barrier" in their applicability.

It is interesting to note that Aijaz was not as categorical in his conclusions as Alvi in his study with the DAT.

Ali (53, pp. v-x.) studied the feasibility of Forms L and M and adapted forms of an achievement test of mathematics in East Pakistan. His study was concerned with the students of classes VIII, IX, and X in certain schools of Dacca. It obtained measures of reliability and validity, item difficulty and discrimination, sex difference in mean achievement and of discriminating ability of the translated and the adapted versions of three of the Cooperative Mathe-

matics Tests (1962 edition). He found that attempting adaptations along with translation of a standardized mathematics test without empirical evidence is not as productive as straight translation.

Haque (58, pp. vi-ix.) constructed an objective English Spelling Test for use in East Pakistan Secondary Schools. Specifically, the study examined the feasibility of standardizing an objective type English Spelling Test for Bengali speaking students of classes VI, VII and VIII. Two forms of the test were developed and were found valid.

Baroya (55, pp. iv-viii.) studied reliability, validity, and comparability of Forms L and M of the VR and the NA sub-tests of the DAT for use among the boys and girls of classes VIII, IX and X of the English-medium high schools of East Pakistan. He found that the tests were valid, reliable and comparable for the boys of classes VIII, IX and X but not so for the girls.

Haque (57, pp. iv-vii.) developed an individual performance scale of intelligence suitable for use with children of East Pakistan. It was an attempt to investigate whether the developed scale was suitable for children of kindergarten to class six, corresponding to the age group of five to eleven years of some schools in Dacca, East Pakistan. He found that the scale as a whole was more valid and reliable than any combination of the sub-tests.

Begum (56, pp. iv-v.) constructed objective achievement tests in Arithmetic for classes I through V in the Bengali medium schools in Dacca, East Pakistan. The tests were administered to 344 students for tryout and on 1913 students for establishing the validity and reliability. All five tests were found to be valid and reliable.

Sabir (59, pp. iv-vii.) developed an objective achievement test in Urdu for the assessment of the achievement level in Urdu of class IX students of the Urdu medium school of Dacca city and to provide basic data for the stand-ardization of the test. His findings were that the test was valid and reliable.

An Evaluation

During the first, second and the third years of its inception, researchers at the Institute of Education and Research, University of Dacca, were interested in determining predictive validity, establishing local norms and the translation of the DAT.

During the fourth year in addition to the translation of tests, a completely new test was developed in the area of scholastic readiness.

The fifth year brought a new crop of researchers. Work on determining the validity of tests was undertaken in the field of scholastic aptitude. A personality schedule

was translated into Bengali, a scholastic aptitude test has been translated into Urdu and a verbal reasoning test was constructed in English. A scholastic ability test was also constructed in Bengali. This was followed by a study intended to investigate into the problems of reliability, validity and comparability of Forms L and M of the VR and the NA subtests of the DAT.

Beginning from the year 1966 the trend was towards development of new achievement tests and intelligence tests.

Thus far no attempt has been made to develop an aptitude test for the purpose of aiding selection of students for different groups from class nine onwards. The present study intends to develop a group test of aptitudes comprising three sub-tests, namely VR, NA, and AR for the selection of students for different groups in class nine in Bangladesh.

CHAPTER III

METHODS OF STUDY

The purpose of this study was to develop a group test of aptitudes suitable for use with students who would be selecting their course of study at the secondary school certificate level in Bangladesh; and more specifically, to inves-tigate if the test so developed would differentiate the students of different groups belonging to Science, Humanities, Commerce, Industrial Arts and Home Economics of some selected secondary schools of Dacca, Bangladesh. In order to achieve the purpose this study was systematically organised and a number of sequential steps were followed.

Description of the Sub-tests

Verbal Reasoning (VR)

The VR aimed at the evaluation of students' ability to abstract or generalize and to think constructively. The analogies form of test-items were considered to be appropriate for the measurement of reasoning ability. This type of items were proved to be versatile and reliable.(3, p. 6.) There were sixty-four items for try out and the suitable thirty-two from them were included in the final test. The items were not restricted to any subject area. It was a power test. The time for taking the test was generous at the try out

stage but for the final test time limit was ascertained on the basis of the observation made at the try out stage. Ten minutes were devoted to detail the instructions of the sub-test while twenty-five minutes were allowed to take this sub-test.

Numerical Ability (NA)

Numerical ability is manifested through the ability to think in and to work with numbers. These abilities could be measured in terms of ability in arithmetic computation. There were eighty items for the try out and the suitable forty from them were included in the final test. Short computational problems from arithmetic were developed for this purpose. As in the case of VR, the time for taking this sub-test was generous at the try out stage but for the final test time limit was ascertained on the basis of the observations made at the try out stage. Ten minutes were devoted to detail the instructions while thirty minutes were allowed to take this sub-test.

Abstract Reasoning (AR)

The AR was included in the test both as a check for the verbal reasoning and as a sub-test. It was purely a non-verbal test. The testees were required to perceive the next sequence in a series of thought or action. Thirty-five items depicting sequence of thought or action were included in this

sub-test for try out. The suitable twenty-eight items were included in the final test. Time for taking this sub-test was determined from the observations made during try out. Ten minutes were devoted to detail the instructions while twenty minutes were allowed to take this sub-test.

Scores

The three sub-tests yielded five scores for each student. Three of these scores were obtained from the sub-tests. And the rest two were derived from the sub-total of VR+NA(ST) and the grand total of ST+AR(TT) respectively. Thus the obtained scores were on TT, ST, VR, NA and AR.

Procedure for the Study

Selection of Schools

Secondary schools in the city of Dacca were located and coded. A random sample of fourteen schools were drawn. For the purpose of the study only fifty per cent of the selected sample were used. The reason for drawing a larger sample was that some schools might not agree to participate in the testing programme of the study. In such an instance an element of the sample could easily be substituted by another already selected for the purpose.

The participating schools were: (1) Polytechnique High School, (2) Intermediate Technical College, (3) Nazneen

High School, (4) Motijheel Government Girls High School, (5) Dhanmondi Government Girls High School, (6) Khilgaon Government Boys High School and (7) Azimpur Girls High School. Besides, three schools were selected arbitrarily for the purpose of try out of the sub-tests. These schools were: (1) Dhanmondi Government Boys High School, (2) Lake Circus Girls High School and (3) University Laboratory School.

Selection of Students

Students of VIII, IX and X of a selected school were required to take the test.

Criterion measures for each student were collected for the purpose of the study. Students, for whom criterion measures were not available, were not included in the study.

Each class had both boys and girls. The boys of IX and X belonged to four groups, namely Humanities, Science, Commerce and Industrial Arts. The girls of IX and X belonged to three groups, namely Humanities, Science and Home Economics. Students of VIII did not belong to such groups because there was no such grouping in this class. Thus the total sample consisted of sixteen groups.

Administration of the Test

The total test comprising all the three sub-tests was administered to 1292 students of seven selected schools

by the researcher.

A manual for administration and scoring of the test was prepared. It contained a detailed description of the test materials and the methods of administering and scoring. The testing of the total sample for this study was performed during the period between seventeenth July and thirty-first August, 1978.

Criterion Measure

For the validation of the tests five external criterion measures were used. These measures were scores on: (1) Bengali, (2) Mathematics, (3) Bengali plus Mathematics, (4) Elective Subjects and (5) all school subjects, obtained by the students in the preceding Half yearly/First terminal examination conducted by the respective schools.

For validation of the sub-tests and the items in each sub-test, two internal criterion measures were used. These were: (1) scores on the total test and (2) scores on each sub-test respectively.

Assuming that the total test was a valid measure of scholastic aptitude, the score on it was used as a criterion for validation of the sub-tests. By a similar argument, the score on a sub-test was used as a criterion measure for validation of the items in it. (44, p. 83.)

It was assumed for this study that the tests were

valid only to the extent that the criteria themselves were valid.

Measures of Validity

Measures of validity of the tests were obtained for each group and for the total group. The coefficients of correlation between each criterion measure and each of the tests were treated as validity coefficients. The correlation coefficients were computed by the Pearson Product-Moment method. The coefficient of correlation between each of the criterion measures and each of the scores on the tests for each group was obtained.

The hypothesis that rho was equal to zero, was tested to determine the significance of each validity coefficient. This was done by t-test.

To estimate the validity coefficient of a sub-test or the test for the total group, weighted average of the validity coefficients of the sixteen groups was computed. The average validity coefficients could be relied upon, as measures of validity for the total group, if it could be demonstrated that the bivariate sub-groups, for which the validity coefficients were computed would be drawn from a common bivariate population. Chi-square test (10, p. 83.) was carried out to investigate into this in the cases of each pair of variables.

Further, the validity coefficients, as were obtained, could be relied upon as true measures of validity if the relationships involved were linear. To investigate into this, the test of no departures from linearity (23, p. 126.) was carried out in the cases of each pair of variables.

Investigation was also made to find out whether the difference between the validity coefficients obtained against each criterion measures was significant. This was expected to provide information as to which of the criterion can be efficiently predicted by which of the tests.

Measures of Reliability

Measures of reliability of the sub-tests were obtained for each group and the total group. For this purpose, the split-half method was used in the case of each sub-test. Reliability of TT and ST were obtained by Fisher's z-transformation method. (4, p. 462.) The coefficients of correlation were computed by the Pearson Product-Moment method. To obtain the reliability coefficient of a sub-test, the Spearman-Brown Prophecy formula (25, p. 580.) was applied. The significance of each reliability coefficient was tested by the t-test.

Although an absolute minimum for the reliability of a measurement procedure cannot be set, the level of reliability that was required to achieve a specified level of

accuracy in describing an individual or a group could be indicated. Accordingly, a reliability coefficient of 0.90 was said to be satisfactory for distinguishing individual performance and a reliability coefficient of 0.60 was said to be satisfactory for distinguishing group performance. (15, p. 35) Hence 0.60 was chosen as the value of rho for testing the significance of the reliability coefficients of the tests for each group and for the total group.

The hypothesis that rho was equal to 0.60, against the alternative that rho was greater than 0.60 was tested to determine the significance of the reliability coefficients of the tests, for each group and for the total group.

Comparison of Group Differences

The mean values of scores on the tests for the groups were compared to investigate whether the tests discriminate the groups compared and if the mean value of scores for any of the compared group was greater than that of the other group.

The significance of the overall differences among the mean values of scores was tested by the application of the F-test. The hypothesis that the overall differences among the mean values of scores were significant, against the alternative that the differences in mean values were nonsignificant, was tested.

The sample units for this investigation were assumed to have been drawn from a hypothetical parent population. Hence, the samples might be regarded a s independent random samples from that population.(24, p. 51.)

When the forms of the distribution of the scores on the test were examined, it was found that these approached normality. Aptitude, as measured by a test similar to that under study, tended to be distributed normally. (15, p. 95.) It was assumed that the population distribution of the scores was normal.

Bartlett's Test (42, p. 95.) of homogeneity of variances was performed to examine whether variances of the scores on the tests for the groups were equal. This particular test was planned because no attempt was made to have group samples equal in number.

The reason given above justified the use of the t-test for comparison of mean values of scores on the tests. It might, however, be mentioned that non-normality of distri-bution or heterogeneity of the variances of scores did not rule out the legitimacy of the use of the t-test. (24, p.78.)

Scholastic Aptitude Grouping

The steps undertaken to investigate into the capacity of the aptitude test for classification of the students of the sample groups were as follows:

1. The sub-test scores were transformed into corresponding standard scores with mean and standard deviation of fifty and ten respectively.
2. On the basis of the aptitude test scores students were classified to belong to the category: (a) the thirty-fifth percentile or above, (b) below thirty-fifth percentile, (c) VR less than or equal to NA, and (d) VR greater than NA.
3. On the basis of the scores on AS students were classified to belong to the catetory: (x) above mean and (y) mean or below.
4. Those satisfying (a), (c) and (x) were termed as properly placed Science students while those satisfying (a), (c) and (y) were termed as under-achieving Science students. Those satisfying (a), (d) and (x) were termed as properly placed Humanities students while those satisfying (a), (d) and (y) were termed as under-achieving Humanities students. All the remaining students were termed as 'others'.
5. Utilizing this classification scheme students in each of the sixteen groups were categorized and the corresponding percentage distributions were formed.

6. Using VIIIB and VIIIG as the reference groups, each of the other corresponding groups was compared in respect of the percentage distribution. The corresponding differences were tested for significance using the chi-square test.

It was expected that the analysis would reveal the extent of mis-placement of students of IX and X in the respec-tive groups.

Item Analysis

Item analysis was carried out to determine two characteristics of each item. One was the difficulty index and the other was the discriminating index of the items. These indexes were found for each item for the total try out group.

To determine the difficulty and discriminating indexes a statistical approach was followed. The following were the details of the procedure:

1. Test papers were arranged in order of size of test scores putting the paper with the highest score on top.
2. Top twenty-seven per cent of the papers were treated as higher group while twenty-seven per cent of the papers at the bottom were treated as the lower group.

3. Each group of papers was scored for each item. The scores of each group were converted into percentages.
4. Difficulty index of an item was determined by averaging the percentages in the higher group and in the lower group.
5. Biserial r for an item was read from the Table (15, p. 366.) of normalized biserial coefficients of correlation. The biserial r for an item was treated as the discriminating index.

Item discriminating index of 0.10 or more was used as one criterion for item acceptance. "As a general rule, items with validity indices of 0.20 or more are regarded as satisfactory; but items with lower indices will often serve if the test is long". (15, p.368.)

Items with difficulty indexes of 0.20 to 0.80 were considered to have met the second criterion of acceptance. The possible values of the difficulty indexes of items fell between zero and one. For the sharpest discrimination among examinees, items should be around 50% in difficulty.(15,p.364.) This choice, therefore, appeared to be sufficient for a possible talent range covered by the three classes of students.

Further, the items, which might fall beyond the chosen limits of the difficulty indexes, would be eigher extremely easy or difficult. The larger the variance of an

item, the higher would be its validity. (15, p. 363.) The variance of extremely easy or difficult items would be negligible. (29, p. 146.)

Choice of Level of Significance

The level of significance for this study was 0.05. The choice of a level of significance was an arbitrary and subjective one. The 0.05 level is one of the most commonly judged suitable values. (4, p. 281.) In dealing with uncertainties and unknown a judicious choice of level of significance was necessary.

The validity and reliability of the tests and also those of the criterion measures, were unknown. The need for such a test was great, but this need could not be satisfied by any wastage of resources, unless the test was worthy. Considering these implications, the 0.05 level of significance seemed to be justified.

Data Processing

Item analysis was done with the aid of an electronic calculator while for the final test data an IBM 1620 computer was used.

CHAPTER IV

PRESENTATION AND ANALYSIS OF DATA

Summarized Test Results

The test was administered to a total number of 1292 students belonging to VIII, IX and X. Each class had both boys and girls. The boys of IX and X belonged to four groups, namely Humanities, Science, Commerce and Industrial Arts. The girls of IX and X belonged to three groups, namely Humanities, Science and Home Economics. Students of VIII did not belong to such groups because there was no such grouping in this class. Thus the total sample consisted of sixteen groups.

The three sub-tests yielded five scores for each student. Three of these scores were obtained from the VR, NA and AR. The rest were derived from the sub-total of VR+NA(ST) and the grand total of ST+AR(TT) respectively.

Intervals between the lowest score (Ls) and the highest score (Hs), mean value and standard deviation for each group as well as for the TS were obtained and placed in Appendix A. Besides this, for eleven other kinds of groupings the mean values were obtained.

Mean values of scores on the tests are presented in Table 1.

The mean values ranged from 29.88 to 53.67 for TT, 19.39 to 36.96 for ST, 11.04 to 16.33 for VR, 6.18 to 21.05

TABLE 1

MEAN VALUES OF SCORES ON THE TESTS

Group	N	Test				
		TT	ST	VR	NA	AR
VIIIB	223	37.53	26.59	13.01	13.67	10.96
VIIIG	202	32.30	22.45	11.95	10.51	9.86
IXBH	15	33.07	22.67	11.13	11.53	10.40
IXBS	84	53.54	36.96	16.43	20.54	16.60
IXBC	9	42.11	28.89	12.56	16.33	13.22
IXBIA	76	45.22	30.37	13.37	17.00	14.86
IXGH	102	33.94	23.18	11.52	11.66	10.76
IXGS	109	46.08	31.06	13.98	17.08	14.93
IXGHE	61	30.89	20.38	12.70	7.67	10.51
XBH	26	36.58	25.08	11.04	14.04	11.50
XBS	69	49.93	33.38	14.38	19.00	16.61
XBC	21	53.67	35.43	14.67	20.76	18.24
XBIA	85	46.86	31.44	13.99	17.46	15.44
XGH	82	33.30	22.10	11.39	10.71	11.21
XGS	95	51.41	35.62	14.63	21.05	15.93
XGHE	33	29.88	19.39	13.21	6.18	10.48
VIII	425	35.04	24.62	12.50	12.17	10.44
IX	456	42.06	28.52	13.49	15.04	13.52
IXB	184	47.29	31.70	13.81	17.89	15.62
IXG	272	38.12	25.71	12.77	12.94	12.38

TABLE 1 (continued)

Group	N	Test				
		TT	ST	VR	NA	AR
X	411	44.06	29.70	13.47	16.25	14.40
XB	201	47.88	32.68	14.54	18.14	15.21
XG	210	40.96	27.97	13.14	14.68	13.23
TB	608	43.89	30.12	13.74	16.42	13.79
STB	385	47.57	32.17	14.16	18.01	15.42
TG	684	37.27	25.38	12.64	12.76	11.89
STG	482	39.36	26.62	12.93	13.70	12.75
TS	1292	40.39	27.61	13.16	14.48	12.78

for NA and 9.86 to 16.61 for AR.

Validation of the Tests

Each of the tests was validated against external criteria. The external criteria were scores on Bengali (B), Mathematics (M), Bengali plus Mathematics (BM), Elective Subjects (ES) and all school subjects (AS).

Thus for each of the fourteen groups of students belonging to IX and X twenty-five coefficients of correlation were computed against the external criteria. For each of the two sex groups of students of VIII the number of coefficients of correlation were twenty because for this class there was

no elective subject. The coefficients of correlation were computed by the Product-Moment method.

Further, each of the three sub-tests was validated against an internal criterion. The internal criterion was the score on the test (TT). The coefficients of correlation against the internal criterion were computed separately for each of the sixteen groups of students.

In each case of a coefficient of correlation related statistics e.g., t, ^{2} and F along with corresponding degrees of freedom for F were computed and tabulated for analysis. These coefficients of correlation were used in this study as validity coefficients.

The hypothesis that rho was equal to zero, against the alternative that rho was greater than zero, was tested to determine the significance of each of the obtained validity coefficients.

The validity coefficients could be relied upon if the relationships between the criterion scores and the scores on the tests were linear. To investigate into this, the hypothesis that there was no departure from linearity was tested for each of the validity coefficients.

F-ratio related to each validity coefficient was nonsignificant at the 0.05 level indicating that the relation-ship between the combination pair of variables was linear in each case.

The detailed computational output in connection with the determination of validity coefficients of the tests appears in Appendix B.

Validity coefficients against external criteria and results of testing significance for the boys of class eight (VIIIB) are furnished in Table 2.

TABLE 2

VALIDITY COEFFICIENTS FOR VIIIB

Criterion	Test				
	TT	ST	VR	NA	AR
B	0.31	0.31	0.15	0.34	0.17
M	0.28	0.30	0.13*	0.32	0.12*
BM	0.33	0.35	0.15	0.38	0.16
AS	0.36	0.36	0.16	0.40	0.17

*Nonsignificant at the 0.05 level.

The eighteen out of twenty validity coefficients, ranging from 0.15 to 0.40, were found significant at the 0.05 level. Thus the hypothesis was rejected in each of the eighteen cases.

Significant validity coefficients indicated that for VIIIB the degree of success can be predicted in each of B, BM and AS by each of the tests; and in M by each of TT, ST and NA.

Validity coefficients against external criteria and results of testing significance for the girls of class eight (VIIIG) are presented in Table 3.

TABLE 3

VALIDITY COEFFICIENTS FOR VIIIG

Criterion	Test				
	TT	ST	VR	NA	AR
B	0.57	0.60	0.46	0.58	0.16
M	0.51	0.53	0.43	0.49	0.14
BM	0.59	0.62	0.49	0.58	0.17
AS	0.56	0.62	0.49	0.58	0.11*

*Nonsignificant at the 0.05 level.

The twenty validity coefficients ranged from 0.11 to 0.62. Each of them, excepting the smallest one, was significant at the 0.05 level. Thus the hypothesis was rejected in each of the nineteen cases.

Significant validity coefficients indicated that for VIIIG the degree of success can be predicted in each of B, M, BM and AS by each of TT, ST, VR and NA; and in each of B, M and BM by AR.

Validity coefficients against external criteria and results of testing significance for the boys of class nine Humanities (IXBH) are presented in Table 4.

TABLE 4

VALIDITY COEFFICIENTS FOR IXBH

Criterion	Test				
	TT	ST	VR	NA	AR
B	0.58	0.60	0.53	0.60	0.38*
M	0.39*	0.41*	0.40*	0.39*	0.25*
BM	0.61	0.63	0.57	0.63	0.40*
ES	0.49*	0.53	0.55	0.47*	0.30*
AS	0.56	0.60	0.59	0.56	0.34*

*Nonsignificant at the 0.05 level.

The fourteen out of twenty-five validity coefficients, ranging from 0.53 to 0.63, were found significant at the 0.05 level. Thus the hypothesis was rejected in each of the fourteen cases.

Significant validity coefficients indicated that for IXBH the degree of success can be predicted in each of B, BM and AS by TT; in each of B, BM, ES and AS by each of ST and VR and in each of B, BM and AS by NA. AR cannot be used to predict either of the criteria.

Validity coefficients against external criteria and results of testing significance for the boys of class nine Science (IXBS) are furnished in Table 5.

The nineteen out of twenty-five validity coeffi-

TABLE 5

VALIDITY COEFFICIENTS FOR IXBS

Criterion	Test				
	TT	ST	VR	NA	AR
B	0.41	0.37	0.43	0.24	0.37
M	0.15*	0.21*	0.11*	0.25	0.00
BM	0.36	0.38	0.34	0.32	0.23
ES	0.24	0.27	0.26	0.22	0.12*
AS	0.34	0.37	0.36	0.28	0.21*

*Nonsignificant at the 0.05 level.

cients, ranging from 0.22 to 0.43, were found significant at the 0.05 level. Thus the hypothesis was rejected in each of the nineteen cases.

Significant validity coefficient indicated that for IXBS the degree of success can be predicted in each of B, BM, ES and AS by each of TT and VR; in each of B, M, BM, ES and AS by each of ST and NA and in each of B and BM by AR.

Validity coefficients against external criteria and results of testing significance for the boys of class nine Commerce (IXBC) are presented in Table 6.

The twenty-five validity coefficients, ranging from -0.54 to 0.40, were each nonsignificant at the 0.05 level. Thus the hypothesis was retained in each of the cases.

TABLE 6

VALIDITY COEFFICIENTS FOR IXBC

Criterion	Test				
	TT	ST	VR	NA	AR
B	0.22	0.29	-0.05	0.40	0.02
M	-0.52	-0.54	-0.34	-0.34	-0.34
BM	-0.27	-0.24	-0.27	-0.09	-0.23
ES	-0.27	-0.09	-0.32	-0.14	-0.48
AS	-0.09	0.03	-0.27	0.25	-0.27

Validity coefficients indicated that for IXBC neither of the tests can be used as a valid measure to predict the degree of success in any of the criteria.

Validity coefficients against external criteria and results of testing significance for the boys of class nine Industrial Arts (IXBIA) are furnished in Table 7.

The thirteen out of twenty-five validity coefficients, ranging from 0.27 to 0.54, were found significant at the 0.05 level. Thus the hypothesis was rejected in each of the thirteen cases.

Significant validity coefficients indicated that for IXBIA the degree of success can be predicted in each of M and AS by each of TT, ST and NA; in BM by each of ST and NA; and in ES by each of the tests.

TABLE 7

VALIDITY COEFFICIENTS FOR IXBIA

Criterion	Test				
	TT	ST	VR	NA	AR
B	-0.07*	0.07*	-0.09*	0.17*	-0.25*
M	0.45	0.49	0.22*	0.54	0.22*
BM	0.21*	0.33	0.06*	0.43	-0.05*
ES	0.49	0.49	0.27	0.50	0.32
AS	0.39	0.46	0.14*	0.54	0.15*

*Nonsignificant at the 0.05 level.

Validity coefficients against external criteria and results of testing significance for the girls of class nine Humanities (IXGH) are presented in Table 8.

TABLE 8

VALIDITY COEFFICIENTS FOR IXGH

Criterion	TT	ST	VR	NA	AR
B	0.18	0.19	0.21*	0.11	0.11
M	0.21*	0.20*	0.14	0.18	0.15
BM	0.23*	0.22*	0.20*	0.16	0.15
ES	0.17	0.16	0.13	0.14	0.12
AS	0.31*	0.30*	0.26*	0.24*	0.20*

*Significant at the 0.05 level.

The eleven out of twenty-five validity coefficients, ranging from 0.20 to 0.31, were found significant at the 0.05 level. Thus the hypothesis was rejected in each of the eleven cases.

Significant validity coefficients indicated that for IXGH the degree of success can be predicted in B by VR; in M by each of TT and ST; in BM by each of TT, ST and VR; and in AS by each of the tests.

Validity coefficients against external criteria and results of testing significance for the girls of class nine Science (IXGS) are furnished in Table 9.

TABLE 9

VALIDITY COEFFICIENTS FOR IXGS

Criterion	Test				
	TT	ST	VR	NA	AR
B	0.48	0.51	0.49	0.39	0.30
M	0.55	0.56	0.45	0.50	0.40
BM	0.58	0.60	0.53	0.51	0.40
ES	0.59	0.64	0.55	0.56	0.36
AS	0.57	0.60	0.52	0.52	0.37

The twenty-five validity coefficients, ranging from 0.30 to 0.60, were each found significant at the 0.05 level. Thus the hypothesis was rejected in each case.

Significant validity coefficients indicated that for IXGS the degree of success can be predicted in each of the criteria by each of the tests.

Validity coefficients against external criteria and the results of testing significance for the girls of class nine Home Economics (IXGHE) are presented in Table 10.

TABLE 10

VALIDITY COEFFICIENTS FOR IXGHE

Criterion	Test				
	TT	ST	VR	NA	AR
B	0.37	0.34	0.27	0.23*	0.23*
M	0.17*	0.25*	0.08*	0.33	-0.02*
BM	0.33	0.37	0.21*	0.35	0.12*
ES	0.33	0.26	0.12*	0.29	0.26
AS	0.38	0.34	0.20*	0.33	0.26

*Nonsignificant at the 0.05 level.

The fifteen out of twenty-five validity coefficients, ranging from 0.26 to 0.38, were found significant at the 0.05 level. Thus the hypothesis was rejected in each of the fifteen cases.

Significant validity coefficients indicated that for IXGME the degree of success can be predicted in B by each of TT, ST, and VR; in M by NA; in BM by each of TT, ST and

NA; and in each of ES and AS by each of TT, ST, NA and AR.

Validity coefficients against external criteria and results of testing significance for the boys of class ten Humanities (XBH) are furnished in Table 11.

TABLE 11

VALIDITY COEFFICIENTS FOR XBH

Criterion	Test				
	TT	ST	VR	NA	AR
B	-0.11	-0.13	-0.12	-0.09	-0.04
M	-0.42	-0.40	-0.20	-0.37	-0.36
BM	-0.31	-0.32	-0.18	-0.28	-0.23
ES	-0.16	-0.18	-0.05	-0.20	-0.10
AS	-0.17	-0.18	-0.08	-0.18	-0.11

The twenty-five validity coefficients, ranging from -0.42 to -0.04, were each nonsignificant at the 0.05 level. Thus the hypothesis was retained in each case.

Validity coefficients indicated that for XBH neither of the tests can be used as a valid measure to predict the degree of success in any of the criterion scores.

Validity coefficients against external criteria and results of testing significance for the boys of class ten Science (XBS) are presented in Table 12.

TABLE 12

VALIDITY COEFFICIENTS FOR XBS

Criterion	Test				
	TT	ST	VR	NA	AR
B	0.32	0.38	0.29	0.32	0.11*
M	0.28	0.30	0.19*	0.29	0.10*
BM	0.37	0.41	0.29	0.37	0.14*
ES	0.37	0.39	0.21*	0.40	0.19*
AS	0.43	0.47	0.28	0.47	0.17*

*Nonsignificant at the 0.05 level.

The eighteen out of twenty-five validity coefficients, ranging from 0.28 to 0.47, were found significant at the 0.05 level. Thus the hypothesis was rejected in each of the eighteen cases.

Significant validity coefficients indicated that for XBS the degree of success can be predicted in each of B, BM and AS by each of TT, ST, VR and NA; and in each of M and ES by each of TT, ST and NA.

Validity coefficients against external criteria and results of testing significance for the boys of class ten Commerce (XBC) are furnished in Table 13.

The twenty-five validity coefficients were from -0.21 to 0.47. Each of them, excepting the largest one, was

TABLE 13

VALIDITY COEFFICIENTS FOR XBC

Criterion	Test				
	TT	ST	VR	NA	AR
B	0.43	0.47*	0.37	0.40	0.11
M	0.09	0.19	0.17	0.15	-0.21
BM	0.29	0.38	0.31	0.31	-0.09
ES	0.35	0.34	0.41	0.19	0.19
AS	0.31	0.34	0.34	0.24	0.08

*Significant at the 0.05 level.

nonsignificant at the 0.05 level. Thus the hypothesis was rejected in one case only.

Significant validity coefficient indicated that for XBC the degree of success in B can be predicted by ST.

Validity coefficients against external criteria and results of testing significance for the boys of class ten Industrial Arts (XBIA) are presented in Table 14.

The eighteen out of twenty-five validity coefficients, ranging from 0.24 to 0.39, were found significant at the 0.05 level. Thus the hypothesis was rejected in each of the eighteen cases.

Significant validity coefficients indicated that for the boys of class ten Industrial Arts the degree of success can be predicted in B by each of ST, VR and NA; in M

TABLE 14

VALIDITY COEFFICIENTS FOR XBIA

Criterion	Test				
	TT	ST	VR	NA	AR
B	0.20*	0.35	0.37	0.24	-0.07*
M	0.25	0.30	0.18*	0.33	0.09*
BM	0.28	0.39	0.33	0.35	0.02*
ES	0.26	0.36	0.33	0.30	0.04*
AS	0.27	0.37	0.34	0.31	0.04*

*Nonsignificant at the 0.05 level.

by each of TT, ST and NA; and in each of BM, ES and AS by each of TT, ST, VR and NA.

Validity coefficients against external criteria and results of testing significance for the girls of class ten Humanities (XGH) are furnished in Table 15.

TABLE 15

VALIDITY COEFFICIENTS FOR XGH

Criterion	Test				
	TT	ST	VR	NA	AR
B	0.40	0.44	0.31	0.37	0.21*
M	0.21*	0.10*	-0.01*	0.15*	0.30
BM	0.36	0.33	0.18*	0.31	0.30
ES	0.26	0.29	0.28	0.18*	0.13*
AS	0.33	0.31	0.21*	0.27	0.25

*Nonsignificant at the 0.05 level.

The sixteen out of twenty-five validity coefficients, ranging from 0.25 to 0.44, were found significant at the 0.05 level. Thus the hypothesis was rejected in each of the sixteen cases.

Significant validity coefficients indicated that for XGH the degree of success can be predicted in B by each of TT, ST, VR and NA; in M by AR; in each of BM and AS by each of TT, ST, NA and AR; and in ES by each of TT, ST and VR.

Validity coefficients against external criteria and results of testing significance for the girls of class ten Science (XGS) are presented in Table 16.

TABLE 16

VALIDITY COEFFICIENTS FOR XGS

Criterion	Test				
	TT	ST	VR	NA	AR
B	0.48	0.52	0.44	0.43	0.29
M	0.59	0.60	0.31	0.64	0.41
BM	0.62	0.65	0.42	0.63	0.41
ES	0.55	0.58	0.40	0.55	0.33
AS	0.62	0.65	0.46	0.60	0.40

The twenty-five validity coefficients, ranging from 0.29 to 0.65, were each found significant at the 0.05 level. Thus the hypothesis was rejected in each case.

Significant validity coefficients indicated that for XGS the degree of success in each of the criteria can be predicted by each of the tests.

Validity coefficients against external criteria and results of testing significance for the girls of class ten Home Economics (XGHE) are furnished in Table 17.

TABLE 17

VALIDITY COEFFICIENTS FOR XGHE

Criterion	Test				
	TT	ST	VR	NA	AR
B	0.14	0.28	0.31	0.09	-0.07
M	-0.03	0.01	-0.16	0.19	-0.07
BM	0.08	0.19	0.12	0.16	-0.08
ES	0.16	0.35*	0.19	0.33	-0.12
AS	0.09	0.27	0.15	0.26	-0.15

*Significant at the 0.05 level.

The twenty-five validity coefficients ranged from -0.16 to 0.35. Each of them, excepting the largest one, was nonsignificant at the 0.05 level. Thus the hypothesis was rejected in one case only.

Significant validity coefficient indicated that for XGHE the degree of success in ES can be predicted by ST.

Determining an Efficient Predictor

To determine the efficient predictor(s) for each criterion, differences for ten possible pairs of validity coefficients in terms of z-values for each criterion were tabulated and tested for significance. If one or both of the validity coefficients of a treated pair were nonsignificant then the difference was not reported. The same procedures were repeated for all criteria for each of the sixteen groups of students.

The z-value corresponding to each significant validity coefficient was taken from Table C. (15, p. 460.)

Differences of the validity coefficients in terms of z_r and the results of testing significance for VIIIB are presented in Table 18.

Of the thirty-three reported differences twelve were greater than 0.18 and each of these twelve differences was significant at the 0.05 level.

Thus for B, NA can be considered a better predictor than VR; for BM, each of TT, ST and NA can be considered a better predictor than VR, NA is also a better predictor than AR; and for AS, each of TT, ST and NA can be considered a better predictor than VR or AR.

Differences of the validity coefficients in terms of z_r and the results of testing significance for VIIIG are

TABLE 18

DIFFERENCES OF THE VALIDITY COEFFICIENTS FOR VIIIB

Tests	Criterion			
	B	M	BM	AS
TT and ST	0.00	0.02	0.03	0.01
TT and VR	0.17	-	0.19*	0.21*
TT and NA	0.03	0.04	0.06	0.05
TT and AR	0.15	-	0.18	0.20*
ST and VR	0.17	-	0.22*	0.22*
ST and NA	0.03	0.02	0.03	0.04
ST and AR	0.15	-	0.21*	0.21*
VR and NA	0.20*	-	0.25*	0.26*
VR and AR	0.02	-	0.01	0.01
NA and AR	0.15	-	0.24*	0.25*

*Significant at the 0.05 level.

presented in Table 19.

Of the thirty-six reported differences eleven were greater than 0.31 and each of these eleven differences was significant at the 0.05 level.

Thus for each of B and M each of TT, ST, VR and NA can be considered a better predictor than AR; and for BM each of TT, VR and NA can be considered a better predictor than AR.

Differences of the validity coefficients in terms of

TABLE 19

DIFFERENCES OF THE VALIDITY COEFFICIENTS FOR VIIIG

Tests	Criterion			
	B	M	BM	AS
TT and ST	0.04	0.03	0.05	0.10
TT and VR	0.15	0.10	0.14	0.09
TT and NA	0.01	0.02	0.02	0.03
TT and AR	0.49*	0.42*	0.51*	-
ST and VR	0.19	0.13	0.19	0.19
ST and NA	0.03	0.05	0.07	0.07
ST and AR	0.53*	0.45*	0.56	-
VR and NA	0.16	0.08	0.12	0.12
VR and AR	0.34*	0.32*	0.37*	-
NA and AR	0.50*	0.40*	0.49*	-

*Significant at the 0.05 level.

z_r and the results of testing significance for IXBH are presented in Table 20.

Of the fifty reported differences four were greater than 0.26 and each of these four differences was significant at the 0.05 level.

Thus for each of BM and AS, ST can be considered a better predictor than AR; and for ES each of TT and ST can be considered a better predictor than AR.

Differences of the validity coefficients in terms of

TABLE 20

DIFFERENCES OF THE VALIDITY COEFFICIENTS FOR IXGS

Tests	Criterion				
	B	M	BM	ES	AS
TT and ST	0.04	0.01	0.03	0.08	0.04
TT and VR	0.02	0.14	0.07	0.06	0.07
TT and NA	0.11	0.07	0.10	0.05	0.07
TT and AR	0.21	0.20	0.24	0.30*	0.26
ST and VR	0.02	0.15	0.10	0.14	0.21
ST and NA	0.15	0.08	0.13	0.13	0.11
ST and AR	0.25	0.21	0.27*	0.38*	0.30*
VR and NA	0.13	0.07	0.03	0.01	0.00
NA and AR	0.10	0.13	0.14	0.25	0.19

*Significant at the 0.05 level.

z_r and the results of testing significance for XGS are furnished in Table 21.

Of the fifty reported differences twelve were greater than 0.28 and each of these twelve differences was significant at the 0.05 level.

Thus for M each of TT, ST and NA can be considered a better predictor than VR and NA is also a better predictor than AR; for BM each of TT, ST and NA can be considered a better predictor than AR and each of ST and NA is a better predictor than VR; for ES, ST can be considered a better

TABLE 21

DIFFERENCES OF THE VALIDITY COEFFICIENTS FOR XGS

Tests	Criterion				
	B	M	BM	ES	AS
TT and ST	0.06	0.01	0.05	0.04	0.05
TT and VR	0.05	0.36*	0.28	0.20	0.23
TT and NA	0.06	0.08	0.01	0.00	0.04
TT and AR	0.22	0.24	0.29*	0.28	0.31*
ST and VR	0.11	0.37*	0.33*	0.24	0.28
ST and NA	0.12	0.07	0.04	0.04	0.09
ST and AR	0.28	0.25	0.34*	0.32*	0.36*
VR and NA	0.01	0.44*	0.29*	0.20	0.19
VR and AR	0.17	0.12	0.01	0.08	0.08
NA and AR	0.16	0.32*	0.30*	0.28	0.27

*Significant at the 0.05 level.

predictor than AR; and for AS each of TT and ST can be considered a better predictor than AR.

For two groups each of the validity coefficients was nonsignificant and these groups were IXBC and XBH. For two groups only one validity coefficient each was significant and these groups were XBC and XGHE. For these groups neither the predictors were compared nor the differences of their validity coefficients were reported.

For the remaining eight groups, each of the differ-

ences between the plausible combinations was nonsignificant and thus no comparison could be made between the plausible pairs of predictors. These eight groups were IXBH, IXBS, IXBIA, IXGH, IXGHE, XBS, XBIA and XGH. The z-value for each of the significant validity coefficients for these eight groups are placed in Appendix C.

Validity coefficients against internal criterion (TT) and results of testing significance for the students of all the sixteen groups are presented in Table 22.

The validity coefficients ranged from 0.54 to 0.86 for VR, 0.45 to 0.95 for NA, and 0.58 to 0.86 for AR.

Each of the validity coefficients excepting that for NA for IXBC was significant at the 0.05 level. Thus the hypothesis was rejected in each case excepting that for NA for IXBC. It was, therefore, indicated that each sub-test was a valid instrument in almost all cases.

Inter-test Correlation

It was expected that, as measures of differential aptitudes, the VR and NA would measure separate and distinct aspects of scholastic aptitude. The AR was expected to operate both as a check to verbal reasoning and numerical ability and as a different sub-test for measurement of scholastic aptitude. As measures of differential scholastic aptitudes, these sub- tests were expected to measure differ-

TABLE 22

VALIDITY COEFFICIENTS AGAINST TT

Group	VR	NA	AR
VIIIB	0.69	0.79	0.70
VIIIG	0.79	0.76	0.58
IXBH	0.88	0.95	0.83
IXBS	0.78	0.88	0.83
IXBC	0.68	0.63*	0.80
IXBIA	0.68	0.79	0.77
IXGH	0.75	0.74	0.75
IXGS	0.79	0.80	0.84
IXGHE	0.77	0.45	0.72
XBH	0.56	0.82	0.86
XBC	0.69	0.83	0.62
XBIA	0.72	0.82	0.79
XGH	0.54	0.84	0.79
XGS	0.68	0.87	0.84
XGHE	0.56	0.72	0.80

*Nonsignificant at the 0.05 level.

ent aspects of scholastic ability in the same direction. It was, therefore, assumed that the inter-sub-test correlation would be positive but low in magnitude. To investigate into

this assumption coefficients of inter-sub-test correlation were computed by the Product-Moment method.

The hypothesis that rho was equal to zero against the alternative that rho was greater than zero was tested to investigate into the significance of each of the obtained coefficients.

In Table 23, the first column stands for the group of students for whom coefficients of correlation were computed, N in the second column stands for the number of students in the corresponding group while the coefficients of correlation are reported in the remaining three columns.

The coefficients of inter-test correlation between VR and NA, between VR and AR and between NA and AR appear in Table 23.

The inter-test coefficients of correlation were non-significant at the 0.05 level between VR and NA for each of IXBC, IXGHE, XBH, XBC, XGH and XGHE; between VR and AR for each of IXBC, XBH, XBS, XBC, XGH and XGHE; and between NA and AR for each of VIIIG, IXBC, IXGHE and XBC. Thus the hypothesis was retained in each of these sixteen cases.

In general the significant coefficients of correlation were obtained for the groups of comparatively brighter students. Such groups were VIIIB, IXBH, IXBS, IXBIA, IXGH, XBIA and XGS. This is, perhaps, due to the fact that brighter ones are bright in most respects.

TABLE 23

COEFFICIENTS OF INTER-TEST CORRELATION

Group	N	VR and NA	VR and AR	NA and AR
VIIIB	223	0.29	0.31	0.32
VIIIG	202	0.50	0.18	0.07*
IXBH	15	0.81	0.57	0.67
IXBS	84	0.52	0.46	0.64
IXBC	9	-0.04*	0.59*	0.21*
IXBIA	76	0.33	0.35	0.37
IXGH	102	0.33	0.41	0.27
IXGS	109	0.47	0.53	0.49
IXGHE	61	0.08*	0.33	-0.01*
XBH	26	0.14*	0.32*	0.57
XBS	69	0.35	0.21*	0.42
XBC	21	0.30*	0.34*	0.25*
XBIA	85	0.52	0.28	0.43
XGH	82	0.19*	0.13*	0.55
XGS	95	0.36	0.36	0.68
XGHE	33	0.09*	0.10*	0.46

*Nonsignificant at the 0.05 level.

It was also found, as expected, that as large as seventy-seven per cent of the coefficients of inter-sub-test correlation were less than 0.50 in magnitude. This sub-

stantiated the assumption of low inter-sub-test correlation to an extent.

Average Validity Coefficients

The feasibility of the use of the average validity coefficients, for the total group, depended on the assumption that the groups, for which the validity coefficients were separately estimated, were drawn from common bivariate popula-tions. To investigate into this, the hypothesis that the groups for which the validity coefficients were obtained, were drawn from common bivariate populations was tested for significance. The chi-square test was used for this purpose.

Each of the chi-square values excepting those between AR and each of AS and VR was significant at the 0.05 level. Thus the hypothesis was rejected in each of the twenty-nine out of thirty-one cases. The findings did not support the hypothesis in twenty-nine out of thirty-one cases that the groups for validation of the tests against the criteria used were drawn from a common bivariate population excepting for those between AR and each of AS and VR.

The results of the chi-square test, involving the relationships between the scores on each of the tests and each of the criteria for all the sixteen groups are placed in Appendix D.

Reliability of the Tests

The three sub-tests comprising the test yielded five scores. These scores were on TT, ST, VR, NA and AR. Reliability of each sub-test was established by the split-half method and was corrected by the Spearman-Brown-Prophecy formula. Reliability coefficient for each of TT and ST was obtained by Fisher's z-transformation method. Reliability coefficients for each of the tests was tested for significance.

Eta-square and F-ratio were computed with a view to testing the linearity of the relationship between the two halves of each sub-test. For this purpose the hypothesis that there was no departure from linearity was tested for each sub-test. Each of the F-ratios was nonsignificant at the 0.05 level. This indicated that the relationship between two halves of each sub-test was linear which in turn indicated that the split in each case was a rational one.

The hypothesis that rho was equal to 0.60, against the alternative that rho was greater than 0.60 was tested to determine the significance of reliability coefficients.

The coefficients of correlation were treated as reliability coefficients. The correlation coefficients were computed by the Pearson Product-Moment method.

The procedures of the foregoing paragraphs were

repeated for each of the sixteen groups and the TS.

The detailed computational output in connection with the determination of reliability coefficients of the sub-tests appears in Appendix E.

Reliability coefficients of the tests and results of testing significance are furnished in Table 24.

Reliability coefficients of TT, ST, VR, NA and AR ranged from 0.73 to 0.92 for TS, 0.74 to 0.89 for VIIIB, 0.80 to 0.92 for VIIIG, 0.56 to 0.91 for IXBH, 0.84 to 0.94 for IXBS, 0.26 to 0.68 for IXBC, 0.57 to 0.89 for IXBIA, 0.65 to 0.86 for IXGH, 0.79 to 0.88 for IXGS, 0.51 to 0.57 for IXGHE, 0.31 to 0.95 for XBH, 0.61 to 0.87 for XBS, 0.69 to 0.89 for XBC, 0.67 to 0.88 for XBIA, 0.53 to 0.89 for XGH, 0.80 to 0.89 for XGS, and 0.52 to 0.79 for XGHE.

At the 0.05 level each of the reliability coefficients was significant for TT excepting those for each of IXBH, IXBC, IXGHE, XBC and XGHE; for ST excepting those for each of IXBH, IXBC, IXGHE and XGHE; for NA excepting those for each of IXBC and IXGHE; and for AR excepting those for each of IXBH, IXBC, IXGHE, XBC and XGH but for VR only six reliability coefficients were significant and they were for TS, VIIIB, VIIIG, IXBS, IXGS and XGS.

TABLE 24

RELIABILITY COEFFICIENTS

Group	TT	ST	VR	NA	AR
TS	0.85	0.85	0.73	0.92	0.85
VIIIB	0.80	0.74	0.74	0.89	0.74
VIIIG	0.88	0.87	0.80	0.92	0.88
IXBH	0.79*	0.79*	0.56*	0.91	0.79*
IXBS	0.88	0.90	0.84	0.94	0.84
IXBC	0.49*	0.50*	0.26*	0.68*	0.48*
IXBIA	0.76	0.77	0.57*	0.89	0.74
IXGH	0.78	0.77	0.65*	0.86	0.79
IXGS	0.85	0.84	0.79	0.88	0.85
IXGHE	0.54*	0.53*	0.51*	0.55*	0.57*
XBH	0.84	0.75	0.31*	0.93	0.95
XBS	0.81	0.77	0.61*	0.87	0.87
XBC	0.79*	0.83	0.74*	0.89	0.69*
XBIA	0.80	0.74	0.67*	0.80	0.88
XGH	0.73	0.77	0.53*	0.89	0.65*
XGS	0.85	0.85	0.80	0.89	0.84
XGHE	0.72*	0.68*	0.52*	0.79	0.78

*Nonsignificant at the 0.05 level.

Comparison of Group Differences

As one of the prerequisites for testing the signifi-

cance of the differences among the means of scores Bartlett's Test for homogeneity of variances was applied. The hypothesis that the population variances of the scores on each of the tests for each kind of grouping were homogeneous, against the alternative that these variances were heterogeneous, was tested.

The results of homogeneity of variance test are presented in Table 25.

The test for homogeneity of variances was applied to thirteen kinds of grouping for each of the tests. Thus sixty -five chi-square values were reported. Each of the chi-square values was significant at the 0.05 level and the values ranged from 7.08 to 5570.42. The results, therefore, indicated that the variances for the tests were heterogeneous.

Analysis of Variance

Analysis of variance for over all comparison of mean values of scores was carried out. This was done for each of the tests in each of the thirteen kinds of groupings of the students.

The hypothesis that the population mean values were equal against the alternative that the mean values were not equal was tested at the 0.05 level.

The results of analysis of variance are presented in Table 26.

TABLE 25

HOMOGENEITY OF VARIANCE TEST IN TERMS OF CHI-SQUARE

Group	df	TT	ST	VR	NA	AR
TB and TG	1	11.98	11.04	7.13	12.40	9.20
STB and STG	1	12.17	10.56	13.62	19.15	12.16
VIIIB and VIIIG	1	12.42	16.19	25.49	10.01	35.28
VIII and IX	1	5023.13	4848.91	5166.58	5570.42	4148.96
VIII and X	1	4569.41	4429.50	4822.23	5019.01	3679.42
IX and X	1	12.37	10.92	12.28	14.08	10.51
IXB and XB	1	18.45	21.97	16.18	13.42	11.16
IXG and XG	1	23.62	27.12	7.08	52.67	8.30
VIII, IX and X	2	181.97	86.72	36.10	121.21	156.55
IXGH, IXGS and IXGHE	2	114.87	97.03	37.09	107.09	69.94
XGH, XGS and XGHE	2	38.02	34.14	23.60	44.25	42.17
IXBH, IXBS, IXBC and IXBIA	3	78.01	75.76	73.02	48.17	44.73
XBH, XBS, XBC and XBIA	3	53.37	53.96	25.26	53.87	19.94

TABLE 26

ANALYSIS OF VARIANCE IN TERMS OF F-RATIO

Group	df_1/df_2	TT	ST	VR	NA	AR
TB and TG	1/1290	77.90	78.72	17.91	97.85	37.43
STB and STG	1/865	72.95	67.12	14.07	83.31	46.58
VIIIB and VIIIG	1/423	30.19	29.08	6.56	39.04	7.50
VIII and IX	1/879	1.53*	1.60*	2.29*	0.89*	1.01*
VIII and X	1/834	1.10*	1.18*	2.07*	0.60*	0.55*
IX and X	1/865	4.04	2.85*	0.00*	6.12	4.87
IXB and XB	1/383	0.16*	0.95*	2.08*	0.14	0.47*
IXG and XG	1/480	4.84	5.27	0.76*	6.96	2.79*
VIII, IX and X	2/1289	53.44	32.22	6.24	41.43	63.37
IXGH, IXGS and IXGHE	2/269	46.08	44.07	7.90	74.32	22.83
XGH, XGS and XGHE	2/207	69.26	82.29	11.83	116.92	24.46
IXBH, IXBS, IXBC and IXBIA	3/180	12.06	12.34	8.02	10.31	6.20
XBH, XBS, XBC and XBIA	3/197	9.28	7.15	3.90	6.19	6.19

*Nonsignificant at the 0.05 level.

The eighteen out of sixty-five F-ratios reported were nonsignificant at the 0.05 level. These F-ratios were in terms of each of the tests for three combinations; each of ST and VR for one combination; and each of VR and AR for one combination. The combinations were VIII and IX, VIII and X, IXB and XB, IX and X, and IXG and XG respectively.

The results, therefore, indicated that in forty-seven out of sixty-five cases the population mean values were unequal.

Group difference in terms of mean values of scores on the tests between groups, was tested for significance by the t-test. This was accomplished by testing the hypothesis that the population mean values of scores for combination pairs of groups were equal, against the alternative that the mean values were not equal.

Group difference in terms of mean values and the results of testing for significance of the differences appear in Table 27.

The thirty-four out of 115 reported differences in mean values were nonsignificant at the 0.05 level. These differences were in terms of each of the tests for three combinations; each of TT, ST, VR and AR for one combination; each of TT, VR and AR for one combination; each of TT, ST, and AR for one combination; each of ST and VR for one combination; each of VR and AR for one combination; AR for one

TABLE 27

DIFFERENCES IN MEAN VALUES OF SCORES ON THE TESTS

Group	TT	ST	VR	NA	AR
TB and TG	6.62	4.74	1.10	3.66	1.90
STB and STG	8.21	5.55	1.23	4.31	2.67
VIIIB and VIIIG	5.23	4.14	1.06	3.16	1.10
IX and X	2.00	1.18*	0.02*	1.21	0.88
IXG and XG	2.84	2.26	0.37*	1.74	0.85*
IXBH and IXBS	20.47	14.29	5.30	9.01	6.20
IXBH and IXBC	9.04*	6.22*	1.43*	4.80	2.82*
IXBH and IXBIA	12.15	7.70	2.24*	5.47	4.46
IXBS and IXBC	11.43	8.07	3.87	4.21	3.38*
IXBS and IXBIA	8.32	6.59	3.06	3.54	1.74
IXBC and IXBIA	3.11*	1.48*	0.81*	0.67*	1.64*
IXGH and IXGS	12.14	7.88	2.46	5.42	4.17
IXGH and IXGHE	3.05*	2.80	1.18*	3.99	0.25*
IXGS and IXGHE	15.19	10.68	1.28*	9.41	4.42
XBH and XBS	13.35	8.30	3.34	4.96	5.11
XBH and XBC	17.09	10.35	3.63	6.72	6.74
XBH and XBIA	10.28	6.36	2.95	3.42	3.94
XBS and XBC	3.74*	2.05*	0.29*	1.76*	1.63*
XBS and XBIA	3.07*	1.94*	0.39*	1.54*	1.17*
XBC and XBIA	6.81	3.99	0.68*	3.30	2.80
XGH and XGS	18.11	13.52	3.24	10.34	4.72
XGH and XGHE	3.42*	2.71*	1.82	4.53	0.73*
XGS and XGHE	21.53	16.23	1.42*	13.87	5.45

*Nonsignificant at the 0.05 level.

combination; and VR for four combinations. The combinations were IXBC and IXBIA, XBS and XBC, XBS and XBIA, IXBH and IXBC, IXGH and IXGHE, XGH and XGHE, IX and X, IXG and XG, IXBS and IXBC, IXBH and IXBIA, IXGS and IXGHE, XBC and XBIA, and XGS and XGHE respectively.

The results, therefore, indicated that in eighty-one out of 115 cases the differences in mean values were significant. Thus excepting three combination pairs, namely IXBC and IXBIA, XBS and XBC, and XBS and XBIA, for each of the remaining twenty pairs, the test or at least some sub-test(s) were/was differential in nature.

Scholastic Aptitude Grouping

The steps undertaken to investigate into the capacity of the aptitude test for classification of the tudents of the sample groups were as follows:

1. The sub-test scores were transformed into corresponding standard scores with mean and standard deviation of fifty and ten respectively.
2. On the basis of the aptitude test scores students were classified to belong to the category: (a) the thirty-fifth percentile or above, (b) below thirty-fifth percentile, (c) VR less than or equal to NA, and (d) VR greater than NA.

3. On the basis of the scores on AS students were classified to belong to the category; (x) above mean and (y) mean or below.
4. Those satisfying (a), (c) and (x) were termed as properly placed Science students while those satisfying (a), (c) and (y) were termed as under-achieving Science students. Those satisfying (a), (d) and (x) were termed as properly placed Humanities students while those satisfying (a), (d) and (y) were termed as under-achieving Humanities students. All the remaining students were termed as 'others'.
5. Utilizing this classification scheme students in each of the sixteen groups were categorized and the corresponding percentage distributions were formed.

Percentage distribution of students into the categories appears in Table 28.

With the only exception of IXBC each group contains all the category in the similar manner as in VIIIB and VIIIG. This indicated that the placement of students into different groups had no proper basis.

Using VIIIB and VIIIG as the reference group, each of the other corresponding groups was compared in respect of the percentage distribution. The corresponding differences

TABLE 28

PERCENTAGE DISTRIBUTION OF STUDENTS PER CATEGORY

Group	Properly placed	Under-achieving	Properly placed	Under-achieving	'others'
VIIIB	12	8	14	13	53
IXBH	27	13	13	13	34
IXBS	20	7	12	10	51
IXBC	0	0	22	11	67
IXBIA	20	8	9	8	55
XBH	11	11	8	8	62
XBS	17	13	9	9	52
XBC	19	19	5	5	52
XBIA	14	12	12	6	56
VIIIG	14	9	10	5	62
IXGH	13	14	14	10	49
IXGS	16	12	14	8	50
IXGHE	16	8	13	10	53
XGH	15	7	11	11	56
XGS	15	9	12	5	59
XGHE	9	12	9	3	67

were tested for significance using the chi-square test.

The chi-square values and the results of testing significance appear in Table 29.

TABLE 29

CHI-SQUARE VALUE FOR GROUP DIFFERENCE IN TERMS OF CATEGORY

Reference Group	Compared Group with chi-square value							
VIIIB	IXBH	IXBS	IXBC	IXBIA	XBH	XBS	XBC	XBIA
	11.13*	2.64	23.89*	4.34	4.04	3.87	13.89*	3.86
VIIIG	IXGH	IXGS	IXGHE	XGH	XGS	XGHE		
	5.01	3.19	3.05	2.89	0.29	2.26		

*Significant at the 0.05 level.

Three out of fourteen comparisons reported were significant at the 0.05 level for four degrees of freedom. These three combinations were VIIIB with each of IXBH, IXBC and XBC. The results, therefore, indicated that for each of the remaining eleven groups there exists no significant difference in terms of the category considered.

The findings indicate that the students of IX and X were mostly mis-placed in the in the respective groups.

Item Analysis

Item analysis data were obtained for each item for the group tested with each test. To determine the difficulty and discriminating indexes a statistical approach was followed. The detailed procedures were as the following:

1. Test papers were arranged in order of size test scores putting the paper with the highest score on top.
2. Top twenty-seven per cent of the papers were treated as higher group while twenty-seven per cent of the papers at the bottom were treated as the lower group.
3. Both higher and lower group of papers were scored for each item. The scores of each group were converted into percentages.
4. Difficulty index of an item was determined by averaging the percentages in the higher group and in the lower group.
5. The biserial r for an item was read from the table of normalized biserial coefficient of correlation. Biserial r for an item was treated as the discriminating index. Item for which the higher group score was less than that of the lower group or for an item with zero score in either of the groups the biserial r was not reported.

The items with discriminating index of 0.10 or more and difficulty index from 0.20 to 0.80 were accepted as effec-tive ones. Of course, all the effective items were not

retained in the final test. Effort was made to retain a minimum number of items in the final test with a maximum possible reliability coefficient.

The difficulty indexes of the items were also used to rearrange the items in the final test.

Detailed item analysis data for each sub-test were placed in Appendix F.

Item analysis results for the retained items in the final test of each sub-test were furnished in the Tables 30 to 32. The first column in these tables read serial number of items as they appeared in the final test while the last column contained serial number of items as they were in the try out test.

Item analysis results for the retained items of VR were given in Table 30.

Difficulty indexes of the thirty-two retained items ranged from 0.26 to 0.76 and their discriminating indexes ranged from 0.20 to 0.76. Items were arranged in ascending order of difficulty.

Item analysis results for the retained item of NA are presented in Table 31.

Difficulty indexes of the forty retained items ranged from 0.23 to 0.72 and the discriminating indexes ranged from 0.20 to 0.69. Items were arranged in ascending

TABLE 30

ITEM ANALYSIS RESULTS FOR VR

Item number (Final test)	Difficulty Index	Discriminating Index	Item number (Try out test	Item number (Final test)	Difficulty Index	Discriminating Index	Item number (Try out test)
1	0.76	0.65	10	17	0.50	0.34	2
2	0.74	0.36	7	18	0.50	0.40	39
3	0.70	0.45	1	19	0.50	0.45	23
4	0.70	0.63	51	20	0.50	0.45	31
5	0.65	0.34	6	21	0.48	0.20	41
6	0.64	0.47	11	22	0.48	0.56	36
7	0.64	0.28	25	23	0.45	0.36	30
8	0.63	0.28	33	24	0.45	0.46	55
9	0.62	0.32	24	25	0.44	0.29	20
10	0.60	0.48	38	26	0.44	0.61	56
11	0.60	0.63	17	27	0.40	0.27	13
12	0.60	0.68	14	28	0.40	0.48	62
13	0.57	0.26	3	29	0.36	0.23	64
14	0.57	0.76	57	30	0.34	0.43	46
15	0.54	0.49	15	31	0.33	0.57	28
16	0.54	0.53	60	32	0.26	0.34	61

TABLE 31

ITEM ANALYSIS RESULTS FOR NA

Item number (Final test)	Difficulty Index	Discriminating Index	Item number (Try out test)	Item number (Final test)	Difficulty Index	Discriminating Index	Item number (Try out test)
1	0.39	0.45	4	21	0.68	0.51	44
2	0.37	0.36	6	22	0.67	0.45	42
3	0.57	0.36	19	23	0.64	0.56	52
4	0.53	0.43	20	24	0.61	0.43	41
5	0.51	0.34	23	25	0.50	0.36	55
6	0.28	0.46	22	26	0.49	0.28	43
7	0.67	0.24	24	27	0.41	0.24	54
8	0.52	0.38	26	28	0.41	0.26	53
9	0.42	0.44	27	29	0.42	0.21	61
10	0.23	0.40	28	30	0.37	0.27	62
11	0.65	0.33	31	31	0.39	0.46	59
12	0.61	0.45	32	32	0.39	0.56	60
13	0.52	0.21	34	33	0.64	0.69	67
14	0.50	0.20	30	34	0.64	0.63	68
15	0.33	0.49	35	35	0.39	0.52	70
16	0.33	0.38	36	36	0.39	0.53	71
17	0.44	0.41	39	37	0.42	0.50	72
18	0.38	0.44	38	38	0.42	0.50	73
19	0.72	0.45	15	39	0.28	0.56	75
20	0.27	0.27	40	40	0.30	0.69	77

order of difficulty within each type of problems.

Item analysis results for the retained items of AR are presented in Table 32.

TABLE 32

ITEM ANALYSIS RESULTS FOR AR

Item number (Final test)	Difficulty Index	Discriminating Index	Item number (Try out test)	Item number (Final test)	Difficulty Index	Discriminating Index	Item number (Try out test)
1	0.78	0.36	10	15	0.42	0.54	25
2	0.73	0.49	15	16	0.40	0.32	3
3	0.70	0.17	1	17	0.40	0.37	7
4	0.66	0.30	2	18	0.39	0.29	14
5	0.64	0.49	8	19	0.38	0.58	5
6	0.60	0.45	22	20	0.37	0.49	20
7	0.59	0.33	17	21	0.35	0.28	13
8	0.56	0.39	11	22	0.33	0.31	31
9	0.55	0.23	4	23	0.33	0.38	29
10	0.53	0.42	16	24	0.32	0.23	35
11	0.52	0.46	9	25	0.30	0.57	32
12	0.51	0.42	6	26	0.24	0.19	19
13	0.47	0.16	12	27	0.23	0.19	27
14	0.46	0.21	24	28	0.22	0.32	33

Difficulty indexes of the twenty-eight retained items ranged from 0.78 to 0.22 and the discriminating indexes ranged from 0.58 to 0.16. Items were arranged in ascending order of difficulty.

CHAPTER V

SUMMARY, CONCLUSION AND RECOMMENDATIONS

Summary

The government of the Peoples Republic of Bangladesh has expressed its deep concern, as was expressed in the Five-Year Plan and the Report of the Commission on National Education, for the development of objective tests of various types suitable for use in measuring academic achievement, scholastic aptitude and intelligence. In view of the need of the country this study was undertaken to develop a group test of aptitudes suitable for use with the students who would be selecting their course of study at the secondary school certificate level in Bangladesh.

The Test

The test comprising VR, NA and AR was developed. There were sixty-four analogies form of test-items in VR at the try out stage and these were four choice objective items. Thirty-two items were retained in the final test. The NA had eighty five choice objective items at the try out stage and forty of them were retained in the final test. The AR had thirty-five non-verbal items at the try out stage, and twenty-eight of them were retained in the final test.

Time for taking each sub-test was generous at the

try out stage. But for the final test time limit was ascertained and the time was 110 minutes. This time was distributed in the following manner: five minutes for introduction, ten minutes to detail the instruction of each sub-test and twenty-five, thirty and twenty minutes to take VR, NA and AR respectively. The allocation of time was adequate.

Scores

The three sub-tests yielded five scores for each student. Three of these were obtained from the sub-tests and the rest two were derived from the sub-total of VR+NA(ST) and the grand total of ST+AR(TT) respectively. Thus the five obtained scores were on TT, ST, VR, NA and AR.

Procedure

The final test was administered to all the available students of VIII, IX and X from seven randomly selected schools in Dacca, Bangladesh.

The participating schools were: (1) Polytechnique High School, (2) Intermediate Technical College, (3) Nazneen High School, (4) Motijheel Government Girls High School, (5) Dhanmondi Government Girls High School, (6) Khilgaon Government Boys High School and (7) Azimpur Girls High School.

Students of VIII, IX and X of a selected school

were required to take the test.

Each class had both boys and girls. The boys of IX and X belonged to four groups, namely Humanities, Science, Commerce and Industrial Arts. The girls of IX and X belonged to three groups, namely Humanities, Science and Home Economics. Students of VIII did not belong to such groups because there was no such grouping in this class. Thus the total sample consisted of sixteen groups.

The test was administered to 1292 students by the researcher in co-operation with the teachers of respective schools. The students were 425 from VIII, 456 from IX and 411 from X.

A manual for administering and scoring of the test was prepared in Bengali. It contained detailed description of the test materials and the methods of administering and scoring. The testing of the total sample for this study was performed during the period between seventeenth July and thirty-first August, 1978.

Validation

For the validation of the tests five external criteria were used. These were scores on: (1) Bengali(B), (2) Mathematics (M), (3) Bengali plus Mathematics (BM), (4) Elective Subjects (ES) and (5) all school subjects (AS), obtained by the students in the preceding Half-yearly/First

terminal examination conducted by the respective schools.

For validation of the sub-tests and the items in each sub-test two internal criteria were used. These were scores on the test and score on each sub-test.

Measures of validity of the tests were obtained for each group and for the total group. The coefficients of correlation between each criterion measure and each of the tests were treated as validity coefficients. The coefficients of correlation were computed by the Pearson Product-Moment method. Since the product-moment coefficient of correlation pre-supposes linear relationship between the variables involved, the hypothesis that there was no departure from linearity was tested in the case of each validity coefficient.

To test the significance of each validity coefficient the hypothesis that rho was equal to zero against the alternative that rho was greater than zero was tested for significance.

To estimate the validity coefficient of any of the tests for the total group, weighted average of the validity coefficients of the sixteen groups was computed. The average validity coefficients could be relied upon, as measures of validity of any of the tests for the total group, if it could be demonstrated that the bivariate sub-groups, for which the validity coefficients were computed would be drawn from a common bivariate population. The chi-square test was carried

out to investigate into this in the cases of each pair of variables.

Investigation was also made to find out whether the difference between validity coefficients obtained against each criterion measure was significant. This was expected to provide information as to which of the criteria can be efficiently predicted by which of the tests.

Reliability

Split-half reliability was computed by the Product-Moment method and was corrected by the Spearman-Brown Prophecy formula. The hypothesis tested was rho equal to 0.60, against the alternative that rho was greater than 0.60.

Comparison of Group Differences

Bartlett's test of homogeneity of variance was applied. The significance of the overall differences among the mean values of scores was tested by the application of the F-test and the paired comparison of mean values was done by the t-test.

Scholastic Aptitude Grouping

On the basis of the aptitude test criteria and achievement criteria the students in the sample were classified into five categories. The chi-square test was applied to find out if the existing groups in IX and X differs from

the reference groups.

Item Analysis

Item analysis was carried out to determine difficulty index and discriminating index of each item. Difficulty index was calculated by averaging the percentages of correct response in the higher and in the lower groups. Discriminating index was read from the Table of r-bis.

Findings

Test Results

The mean values ranged from 29.88 to 53.67 for TT, 19.39 to 36.96 for ST, 11.04 to 16.33 for VR, 6.18 to 21.05 for NA, and 9.86 to 16.61 for AR.

Validity of the Tests

For VIIIB, the significant validity coefficients indicated that the degree of success can be predicted in each of B, BM and AS by each of the tests; and in M by each of TT, ST and NA. For B, NA can be considered a better predictor than VR; for BM, each of TT, ST and NA can be considered a better predictor than VR, NA is also a better predictor than AR; and for AS, each of TT, ST and NA can be considered a better predictor than VR or AR.

For VIIIG, the significant validity coefficients

indicated that the degree of success in each of the criteria can be predicted by each of the tests except AR for AS. For each of B and M each of TT, ST, VR and NA can be considered a better predictor than AR; and for BM each of TT, VR and NA can be considered a better predictor than AR.

For IXBH, the significant validity coefficients indicated that the degree of success can be predicted in each of B, BM and AS by TT; in each of B, BM, ES and AS by each of ST and VR; and in each of B, BM and AS by NA. Differ-ences between pairs of predictors were not significant.

For IXBS, the significant validity coefficients indicated that the degree of success can be predicted in each of B, BM, ES and AS by each of TT and VR; in each of the criteria by each of ST and NA; and in each of B and M by AR. Differences between pairs of predictors were nonsignifi-cant.

For IXBC, the validity coefficients were each non-significant.

For IXBIA, the significant validity coefficients indicated that the degree of success can be predicted in B by AR; in each of M and AS by each of TT, ST and NA; in BM by each of ST and NA; and in ES by each of the tests. Differences between pairs of predictors were nonsignificant.

For IXGH, the significant validity coefficients indicated that the degree of success can be predicted in B

by VR; in M by each of TT and ST; in BM by each of TT, ST and VR; and in AS by each of the tests. Differences between pairs of predictors were nonsignificant.

For IXGS, each of the validity coefficients was significant indicating that each of the tests can be used to predict the degree of success in each of the criteria. For each of BM and AS, ST can be considered a better predictor than AR; and for ES each of TT and ST can be considered a better predictor than AR.

For IXGHE, the significant validity coefficients indicated that the degree of success can be predicted in B by each of TT, ST and VR; in M by NA; in BM by each of TT, ST and NA; and in each of ES and AS by each of the tests. Differences between pairs of predictors were nonsignificant.

For XBH, each of the validity coefficients was nonsignificant.

For XBS, the significant validity coefficients indicated that the degree of success can be predicted in each of B, BM and AS by each of TT, ST, VR and NA; and in each of M and ES by each of TT, ST and NA. Differences between pairs of predictors were nonsignificant.

For XBC, the only validity coefficient between B and ST was significant indicating that the degree of success can be predicted in B by ST. Here the question of difference of the validity coefficients did not arise.

For XBIA, the significant validity coefficients indicated that the degree of success can be predicted in B by each of ST, VR and NA; in M by each of TT, ST and NA; and in each of BM, ES and AS by each of TT, VR and NA. Differences between pairs of predictors were nonsignificant.

For XGH, the significant validity coefficients indicated that the degree of success can be predicted in B by each of TT, ST, VR and NA; in M by AR; in each of BM and AS by each of TT, ST, NA and AR; and in ES by each of TT, ST and VR. Differences between the pairs of predictors were nonsignificant.

For XGS, the significant validity coefficients indicated that the degree of success in each of the criteria can be predicted by each the tests. For M each of TT, ST and NA can be considered a better predictor than VR and NA is also a better predictor than AR; for BM each of TT, ST and NA can be considered a better predictor than AR and each of ST and NA is a better predictor than VR; for ES, ST can be considered a better predictor than AR; and for AS each of TT and ST can be considered a better predictor than AR.

For XGHE, the only validity coefficient between ES and ST was significant indicating that the degree of success can be predicted in ES by ST. Here the question of difference of the validity coefficients did not arise.

Validity coefficients against the internal criterion

were all significantly greater than zero with the only exception for NA for IXBC. It was, therefore, indicated that each sub-test was a valid instrument in almost all cases.

The chi-square test did not support the hypothesis that the groups for validation of the tests against the criteria used were drawn from a common bivariate population excepting for those between AR and each of AS and VR.

Coefficients of correlation between any two sub-test for most of the groups were low in magnitude. It was also found, as expected, that as large as seventy-seven per cent of the coefficients of inter-sub-test correlation were less than 0.50 in magnitude. This substantiated the assumption of low inter-sub-test correlation to an extent.

Reliability of the tests

Sixty-eight per cent of the reliability coefficients reported were significantly greater than 0.60. For the total group of 1292 students each of the tests was found to be reliable. Nonsignificant reliability coefficients were obtained for the smaller groups and for the groups where most of the students were of below average calibre.

Paired Comparison of Groups

Bartlett's test indicated that the variances for the groups were all heterogeneous. Analysis of variance

indicated that the population mean values were unequal. Thus the test or at least some sub-test(s) were/was differential in nature.

Scholastic Aptitude Grouping

Scholastic aptitude grouping indicated that the placement of students into different groups, as existing in the sample, had no proper basis. In most cases students are misplaced.

Item Analysis

Items retained in the final form of the test were thirty-two in VR, forty in NA and twenty-eight in AR. The range of difficulty indexes of the three sub-tests were 0.76 to 0.26, 0.72 to 0.23 and 0.78 to 0.22 respectively and the corresponding range of discriminating indexes were 0.76 to 0.20, 0.69 to 0.20 and 0.58 to 0.16 respectively.

Conclusion

Results reported in chapter IV and summarized above, led to the following conclusions:

1. Significant validity coefficients indicated that the test or some of the tests was/were valid for each of the external criteria for each of the sixteen groups except that for IXBC and XBH.
2. Validity coefficients against the internal

criterion were all significantly greater than zero with the only exception for NA for IXBC. It was, therefore, indicated that each sub-test was a valid instrument in almost all cases.

3. Coefficients of correlation between any two sub-tests for most of the groups were low in magnitude substantiating the assumption of low inter-sub-test correlation to an extent.
4. Sixty-eight per cent of the reported reliability coefficients were significantly greater than 0.60. For the total group of 1292 students each of the tests was found to be reliable.
5. The results of F-tests and t-tests indicated that the test and the sub-tests discriminated the groups significantly.
6. Students of IX and X in the sample group were mostly misplaced.

Recommendations

On the basis of the above conclusions the following recommendations are made:

1. With a view to obtaining more rigorous measures of relationships between the test scores and the criteria for validation, the latter has to be more reliable and valid. Further and more

rigorous study may be conducted to obtain more valid and reliable criterion measures.

2. Since for practical, administrative, and financial reasons the study had to be conducted on a small selective sample and within a narrow geographical region, the results cannot be generalized immediately to a very wide region and to any thing other than a restrictive and hypothetical population, from which the sample was drawn. Further study may be carried out, using larger and more representative samples from the entire area covered by Bangladesh.
3. Further study should be conducted to establish further the reliability of the test and the sub-tests in it by applying other methods of finding reliability.
4. Further research should be conducted by a team of workers to validate the findings of this present study.

Through extensive research work a group test of aptitude of this type, which will be very useful for Bangladesh, may be developed. Devoted efforts by experts and sufficient physical facilities will be required to accomplish this.

APPENDIX A.

SUMMARIZED RESULTS

SUMMARIZED RESULTS

Group	N	Statis-tics.	Test				
			TT	ST	VR	NA	AR
Total	1292	Ls-Hs	10-96	5-70	2-31	1-39	1-27
		Mean	40.39	27.61	13.16	14.48	12.78
		SD	13.84	9.85	4.68	6.88	5.63
VIIIB	223	Ls-Hs	16-60	12-51	5-24	4-28	3-21
		Mean	37.53	26.59	13.67	13.67	10.96
		SD	9.49	7.43	3.85	5.36	3.63
VIIIG	202	Ls-Hs	12-57	5-46	2-24	2-26	2-24
		Mean	32.30	22.45	11.95	10.51	9.86
		SD	10.11	8.35	4.68	4.98	4.63
IXBH	15	Ls-Hs	10-59	5-42	4-20	1-22	3-17
		Mean	33.07	22.67	11.13	11.53	10.40
		SD	12.36	9.29	3.44	6.27	4.08
IXBS	84	Ls-Hs	20-96	14-70	6-31	5-39	4-26
		Mean	53.54	36.96	16.43	20.54	16.60
		SD	16.42	11.78	6.19	7.32	6.16
IXBC	9	Ls-Hs	33-55	20-88	8-19	6-20	8-17
		Mean	42.11	28.89	12.56	16.33	13.22
		SD	7.00	5.02	3.97	3.24	2.86
IXBIA	76	Ls-Hs	25-68	17-49	6-23	6-30	6-26
		Mean	45.22	30.37	13.37	17.00	14.86
		SD	10.58	7.46	3.80	5.29	4.92
IXGH	102	Ls-Hs	15-67	10-44	3-22	3-28	3-23
		Mean	33.94	23.18	11.52	11.66	10.76
		SD	10.20	7.41	4.13	4.92	4.60
IXGS	109	Ls-Hs	18-79	11-55	3-27	3-30	3-27
		Mean	46.08	31.06	13.98	17.08	14.93
		SD	14.06	9.54	5.16	5.95	6.13
IXGHE	61	Ls-Hs	16-45	11-30	4-20	2-13	4-18
		Mean	30.89	20.38	12.70	7.67	10.51
		SD	6.47	4.66	3.64	2.65	3.47

SUMMARIZED RESULTS

Group	N	Statis-tics.	Test TT	ST	VR	NA	AR
XBH	26	Ls-Hs	17-71	10-47	3-18	5-29	3-24
		Mean	36.58	25.08	11.04	14.04	11.50
		SD	12.81	8.31	4.30	6.52	5.90
XBS	69	Ls-Hs	21-79	16-55	5-26	4-33	3-26
		Mean	49.93	33.38	14.38	19.00	16.61
		SD	13.24	9.29	4.84	6.42	6.30
XBC	21	Ls-Hs	31-76	20-57	7-26	9-33	10-22
		Mean	53.67	35.43	14.67	20.76	18.24
		SD	10.89	9.14	4.20	6.95	3.56
XBIA	85	Ls-Hs	26-76	14-51	3-26	3-31	4-27
		Mean	46.86	31.44	13.99	17.46	15.44
		SD	11.80	8.03	4.31	4.88	5.99
XGH	82	Ls-Hs	13-66	9-41	4-22	3-24	2-25
		Mean	33.30	22.10	11.39	10.71	11.21
		SD	10.42	7.24	3.98	5.33	4.79
XGS	95	Ls-Hs	23-90	17-65	5-28	9-37	4-25
		Mean	51.41	35.62	14.63	21.05	15.93
		SD	13.64	9.39	4.90	6.47	5.46
XGHE	33	Ls-Hs	11-54	10-33	8-20	1-14	1-23
		Mean	29.88	19.39	13.21	6.18	10.48
		SD	8.11	5.26	3.76	3.35	4.55

APPENDIX B.

VALIDITY COEFFICIENTS AND RELEVANT STATISTICS

VALIDITY COEFFICIENTS AND RELEVANT STATISTICS FOR VIIIB

Variables		r	t	η^2	F	K-2	N-K
B	TT	0.31	4.77	0.43	0.48	73	148
B	ST	0.31	4.92	0.43	0.47	73	148
B	VR	0.15	2.25	0.44	0.58	73	148
B	NA	0.34	5.46	0.41	0.41	73	148
B	AR	0.17	2.49	0.40	0.54	73	148
M	TT	0.28	4.35	0.43	0.56	67	154
M	ST	0.30	4.72	0.43	0.55	67	154
M	VR	0.13	1.88	0.43	0.66	67	154
M	NA	0.32	4.96	0.41	0.50	67	154
M	AR	0.12	1.76	0.39	0.62	67	154
BM	TT	0.33	5.24	0.55	0.31	106	115
BM	ST	0.35	5.53	0.53	0.29	106	115
BM	VR	0.15	2.32	0.55	0.37	106	115
BM	NA	0.38	6.02	0.58	0.30	106	115
BM	AR	0.16	2.43	0.55	0.37	106	115
AS	TT	0.35	5.51	0.78	0.17	151	70
AS	ST	0.36	5.77	0.78	0.17	151	70
AS	VR	0.16	2.35	0.71	0.19	151	70
AS	NA	0.40	6.44	0.72	0.15	151	70
AS	AR	0.17	2.61	0.78	0.20	151	70

VALIDITY COEFFICIENTS AND RELEVANT STATISTICS FOR VIIIG

Variables		r	t	n^2	F	K-2	N-K
B	TT	0.57	9.86	0.62	0.35	69	131
B	ST	0.60	10.67	0.73	0.41	69	131
B	VR	0.46	7.36	0.61	0.47	69	131
B	NA	0.58	10.04	0.73	0.43	69	131
B	AR	0.16	2.32	0.34	0.44	69	131
M	TT	0.51	8.28	0.56	0.44	62	138
M	ST	0.53	8.89	0.65	0.49	62	138
M	VR	0.43	6.79	0.56	0.54	62	138
M	NA	0.49	7.91	0.64	0.54	62	138
M	AR	0.14	2.05	0.40	0.61	62	138
BM	TT	0.59	10.29	0.72	0.21	102	98
BM	ST	0.62	11.17	0.74	0.20	102	98
BM	VR	0.49	7.90	0.69	0.26	102	98
BM	NA	0.58	10.17	0.70	0.20	102	98
BM	AR	0.17	2.40	0.65	0.36	102	98
AS	TT	0.56	9.51	0.90	0.11	149	51
AS	ST	0.62	11.04	0.92	0.10	149	51
AS	VR	0.49	7.90	0.85	0.11	149	51
AS	NA	0.58	9.98	0.92	0.10	149	51
AS	AR	0.11	1.55	0.81	0.15	149	51

VALIDITY COEFFICIENTS AND RELEVANT STATISTICS FOR IXBH

Variables		r	t	n^2	F	K-2	N-K
B	TT	0.58	2.57	0.91	0.05	11	2
B	ST	0.60	2.74	0.97	0.06	11	2
B	VR	0.53	2.25	1.00	0.07	11	2
B	NA	0.60	2.73	0.93	0.05	11	2
B	AR	0.38	1.49	0.60	0.05	11	2
M	TT	0.39	1.55	0.69	0.06	11	2
M	ST	0.41	1.64	0.73	0.06	11	2
M	VR	0.40	1.56	0.63	0.05	11	2
M	NA	0.39	1.54	0.80	0.06	11	2
M	AR	0.25	0.95	0.70	0.07	11	2
BM	TT	0.61	2.76	1.00	0.00	13	0
BM	ST	0.63	2.96	1.00	0.00	13	0
BM	VR	0.57	2.52	1.00	0.00	13	0
BM	NA	0.63	2.89	1.00	0.00	13	0
BM	AR	0.40	1.57	1.00	0.00	13	0
ES	TT	0.49	2.04	0.93	0.03	12	1
ES	ST	0.53	2.22	0.92	0.03	12	1
ES	VR	0.55	2.39	0.82	0.02	12	1
ES	NA	0.47	1.94	0.97	0.03	12	1
ES	AR	0.30	1.11	0.97	0.04	12	1
AS	TT	0.56	2.44	1.00	0.00	13	0
AS	ST	0.60	2.68	1.00	0.00	13	0
AS	VR	0.59	2.62	1.00	0.00	13	0
AS	NA	0.56	2.44	1.00	0.00	13	0
AS	AR	0.34	1.32	1.00	0.00	13	0

VALIDITY COEFFICIENTS AND RELEVANT STATISTICS FOR IXBS

Variables		r	t	n^2	F	K-2	N-K
B	TT	0.41	4.05	0.61	0.29	40	42
B	ST	0.37	3.64	0.55	0.28	40	42
B	VR	0.43	4.28	0.58	0.26	40	42
B	NA	0.24	2.24	0.53	0.33	40	42
B	AR	0.37	3.59	0.62	0.31	40	42
M	TT	0.15	1.41	0.59	0.25	48	34
M	ST	0.21	1.98	0.62	0.25	48	34
M	VR	0.11	1.01	0.62	0.27	48	34
M	NA	0.25	2.34	0.64	0.25	48	34
M	AR	0.00	0.02	0.57	0.26	48	34
BM	TT	0.36	3.48	0.69	0.16	56	26
BM	ST	0.38	3.71	0.64	0.14	56	26
BM	VR	0.34	3.28	0.60	0.14	56	26
BM	NA	0.32	3.09	0.69	0.16	56	26
BM	AR	0.23	2.10	0.83	0.20	56	26
ES	TT	0.24	2.23	0.89	0.09	68	14
ES	ST	0.27	2.56	0.92	0.09	68	14
ES	VR	0.26	2.45	0.90	0.09	68	14
ES	NA	0.22	2.01	0.90	0.09	68	14
ES	AR	0.12	1.06	0.78	0.09	68	14
AS	TT	0.34	3.28	0.86	0.08	68	14
AS	ST	0.37	3.55	0.85	0.08	68	14
AS	VR	0.36	3.48	0.85	0.08	68	14
AS	NA	0.28	2.68	0.82	0.08	68	14
AS	AR	0.21	1.91	0.83	0.09	68	14

VALIDITY COEFFICIENTS AND RELEVANT STATISTICS FOR IXBC

Variables		r	t	η^2	F	K-2	N-K
B	TT	0.22	0.58	1.00	0.00	7	0
B	ST	0.29	0.80	1.00	0.00	7	0
B	VR	-0.05	-0.12	1.00	0.00	7	0
B	NA	0.40	1.16	1.00	0.00	7	0
B	AR	0.02	0.06	1.00	0.00	7	0
M	TT	-0.52	-1.63	1.00	0.00	7	0
M	ST	-0.54	-1.70	1.00	0.00	7	0
M	VR	-0.34	-0.96	1.00	0.00	7	0
M	NA	-0.41	-1.17	1.00	0.00	7	0
M	AR	-0.34	-0.94	1.00	0.00	7	0
BM	TT	-0.27	-0.74	1.00	0.00	7	0
BM	ST	-0.24	-0.66	1.00	0.00	7	0
BM	VR	-0.27	-0.74	1.00	0.00	7	0
BM	NA	-0.09	-0.23	1.00	0.00	7	0
BM	AR	-0.23	-0.63	1.00	0.00	7	0
ES	TT	-0.27	-0.73	1.00	0.00	7	0
ES	ST	-0.09	-0.25	1.00	0.00	7	0
ES	VR	-0.32	-0.90	1.00	0.00	7	0
ES	NA	0.14	0.38	1.00	0.00	7	0
ES	AR	-0.48	-1.46	1.00	0.00	7	0
AS	TT	-0.09	-0.25	1.00	0.00	7	0
AS	ST	0.03	0.07	1.00	0.00	7	0
AS	VR	-0.27	-0.74	1.00	0.00	7	0
AS	NA	0.25	0.69	1.00	0.00	7	0
AS	AR	-0.27	-0.75	1.00	0.00	7	0

VALIDITY COEFFICIENTS AND RELEVANT STATISTICS FOR IXBIA

Variables		r	t	η^2	F	K-2	N-K
B	TT	-0.07	-0.57	0.68	0.32	41	33
B	ST	0.07	0.61	0.62	0.31	41	33
B	VR	-0.09	-0.81	0.60	0.30	41	33
B	NA	0.17	1.45	0.57	0.28	41	33
B	AR	-0.25	-2.22	0.65	0.29	41	33
M	TT	0.45	4.33	0.67	0.23	41	33
M	ST	0.49	4.88	0.69	0.21	41	33
M	VR	0.22	1.89	0.63	0.29	41	33
M	NA	0.54	5.53	0.70	0.19	41	33
M	AR	0.22	1.94	0.60	0.28	41	33
BM	TT	0.21	1.88	0.67	0.16	52	22
BM	ST	0.33	3.04	0.70	0.15	52	22
BM	VR	0.06	0.51	0.71	0.71	52	22
BM	NA	0.43	4.07	0.73	0.13	52	22
BM	AR	-0.05	.0.40	0.72	0.18	52	22
ES	TT	0.49	4.89	0.91	0.09	59	15
ES	ST	0.49	4.82	0.84	0.08	59	15
ES	VR	0.27	2.38	0.89	0.11	59	15
ES	NA	0.50	4.94	0.79	0.08	59	15
ES	AR	0.32	2.93	0.87	0.10	59	15
AS	TT	0.39	3.63	0.88	0.04	67	7
AS	ST	0.46	4.40	0.88	0.04	67	7
AS	VR	0.14	1.18	0.81	0.05	67	7
AS	NA	0.54	5.59	0.94	0.03	67	7
AS	AR	0.15	1.27	0.92	0.05	67	7

VALIDITY COEFFICIENTS AND RELEVANT STATISTICS FOR IXGH

Variables		r	t	η^2	F	K-2	N-K
B	TT	0.18	1.87	0.48	0.27	53	47
B	ST	0.19	1.89	0.49	0.27	53	47
B	VR	0.21	2.10	0.57	0.30	53	47
B	NA	0.11	1.07	0.49	0.28	53	47
B	AR	0.11	1.10	0.47	0.28	53	47
M	TT	0.21	2.16	0.53	0.32	50	50
M	ST	0.20	2.01	0.52	0.32	50	50
M	VR	0.14	1.46	0.41	0.28	50	50
M	NA	0.18	1.78	0.61	0.36	50	50
M	AR	0.15	1.52	0.54	0.33	50	50
BM	TT	0.23	2.33	0.75	0.20	67	33
BM	ST	0.22	2.26	0.74	0.20	67	33
BM	VR	0.20	2.08	0.77	0.20	67	33
BM	NA	0.16	1.63	0.67	0.19	67	33
BM	AR	0.15	1.51	0.66	0.19	67	33
ES	TT	0.17	1.77	0.60	0.18	67	33
ES	ST	0.16	1.66	0.64	0.18	67	33
ES	VR	0.13	1.33	0.65	0.19	67	33
ES	NA	0.14	1.37	0.65	0.19	67	33
ES	AR	0.12	1.24	0.63	0.19	67	33
AS	TT	0.31	3.29	0.91	0.08	84	16
AS	ST	0.30	3.19	0.92	0.08	84	16
AS	VR	0.26	2.64	0.92	0.08	84	16
AS	NA	0.24	2.51	0.90	0.08	84	16
AS	AR	0.20	2.08	0.82	0.08	84	16

VALIDITY COEFFICIENTS AND RELEVANT STATISTICS FOR IXGS

Variables		r	t	η^2	F	K-2	N-K
B	TT	0.48	5.61	0.60	0.21	56	51
B	ST	0.51	6.14	0.66	0.22	56	51
B	VR	0.49	5.83	0.63	0.22	56	51
B	NA	0.39	4.42	0.62	0.26	56	51
B	AR	0.30	3.21	0.45	0.23	56	51
M	TT	0.55	6.85	0.65	0.17	59	48
M	ST	0.56	6.93	0.67	0.17	59	48
M	VR	0.45	5.24	0.65	0.22	59	48
M	NA	0.50	5.98	0.70	0.21	59	48
M	AR	0.40	4.57	0.60	0.22	59	48
BM	TT	0.58	7.41	0.76	0.11	73	34
BM	ST	0.60	7.78	0.83	0.12	73	34
BM	VR	0.53	6.45	0.68	0.11	73	34
BM	NA	0.51	6.06	0.81	0.14	73	34
BM	AR	0.40	4.52	0.69	0.15	73	34
ES	TT	0.59	7.60	0.92	0.04	95	12
ES	ST	0.64	8.68	0.92	0.03	95	12
ES	VR	0.55	6.78	0.92	0.04	95	12
ES	NA	0.56	6.90	0.92	0.04	95	12
ES	AR	0.36	3.93	0.91	0.05	95	12
AS	TT	0.57	7.21	0.86	0.05	92	15
AS	ST	0.60	7.82	0.87	0.04	92	15
AS	VR	0.52	6.26	0.86	0.05	92	15
AS	NA	0.52	6.27	0.90	0.05	92	15
AS	AR	0.37	4.11	0.85	0.06	92	15

VALIDITY COEFFICIENTS AND RELEVANT STATISTICS FOR IXGHE

Variables		r	t	η^2	F	K-2	N-K
B	TT	0.37	3.07	0.60	0.28	30	29
B	ST	0.34	2.79	0.55	0.27	30	29
B	VR	0.27	2.15	0.66	0.34	30	29
B	NA	0.23	1.81	0.43	0.25	30	29
B	AR	0.23	1.84	0.52	0.30	30	29
M	TT	0.17	1.32	0.53	0.24	34	25
M	ST	0.25	1.98	0.64	0.26	34	25
M	VR	0.08	0.61	0.63	0.28	34	25
M	NA	0.33	2.69	0.53	0.20	34	25
M	AR	-0.02	-0.15	0.47	0.24	34	25
BM	TT	0.33	2.69	0.76	0.14	43	16
BM	ST	0.37	3.03	0.81	0.14	43	16
BM	VR	0.21	1.66	0.78	0.15	43	16
BM	NA	0.35	2.92	0.75	0.13	43	16
BM	AR	0.12	0.95	0.79	0.16	43	16
ES	TT	0.33	2.71	0.81	0.10	47	12
ES	ST	0.26	2.10	0.79	0.10	47	12
ES	VR	0.12	0.96	0.67	0.10	47	12
ES	NA	0.29	2.36	0.92	0.11	47	12
ES	AR	0.26	2.11	0.82	0.11	47	12
AS	TT	0.38	3.20	0.92	0.05	53	6
AS	ST	0.34	2.78	0.96	0.05	53	6
AS	VR	0.20	1.54	0.98	0.05	53	6
AS	NA	0.33	2.66	0.94	0.05	53	6
AS	AR	0.26	2.06	0.89	0.05	53	6

VALIDITY COEFFICIENTS AND RELEVANT STATISTICS FOR XBH

Variables		r	t	η^2	F	K-2	N-K
B	TT	-0.10	-0.51	0.64	0.16	17	7
B	ST	-0.13	-0.65	0.67	0.16	17	7
B	VR	-0.12	-0.60	0.71	0.17	17	7
B	NA	-0.09	-0.42	0.64	0.16	17	7
B	AR	-0.04	-0.20	0.63	0.16	17	7
M	TT	-0.42	-2.28	0.66	0.06	20	4
M	ST	-0.40	-2.12	0.70	0.06	20	4
M	VR	-0.20	-1.01	0.80	0.08	20	4
M	NA	-0.37	-1.97	0.82	0.07	20	4
M	AR	-0.36	-1.87	0.73	0.07	20	4
BM	TT	-0.31	-1.61	0.69	0.03	22	2
BM	ST	-0.32	-1.64	0.64	0.03	22	2
BM	VR	-0.18	-0.91	0.90	0.04	22	2
BM	NA	-0.28	-1.45	0.69	0.03	22	2
BM	AR	-0.23	-1.17	0.82	0.04	22	2
ES	TT	-0.16	-0.81	0.90	0.04	22	2
ES	ST	-0.18	-0.91	0.95	0.04	22	2
ES	VR	-0.05	-0.24	0.87	0.04	22	2
ES	NA	-0.20	-1.00	1.00	0.04	22	2
ES	AR	-0.10	-0.49	0.87	0.04	22	2
AS	TT	-0.17	-0.84	0.96	0.02	23	1
AS	ST	-0.18	-0.90	0.94	0.02	23	1
AS	VR	-0.08	-0.39	1.00	0.02	23	1
AS	NA	-0.18	-0.88	0.92	0.02	23	1
AS	AR	-0.11	-0.57	1.00	0.02	23	1

VALIDITY COEFFICIENTS AND RELEVANT STATISTICS FOR XBS

Variables		r	t	η^2	F	K-2	N-K
B	TT	0.32	2.81	0.74	0.23	41	26
B	ST	0.38	3.31	0.73	0.22	41	26
B	VR	0.29	2.52	0.68	0.22	41	26
B	NA	0.32	2.77	0.70	0.22	41	26
B	AR	0.11	0.92	0.68	0.25	41	26
M	TT	0.28	2.39	0.65	0.19	43	24
M	ST	0.30	2.61	0.58	0.17	43	24
M	VR	0.19	1.62	0.65	0.21	43	24
M	NA	0.29	2.51	0.55	0.17	43	24
M	AR	0.10	0.84	0.69	0.22	43	24
BM	TT	0.37	3.22	0.83	0.15	48	19
BM	ST	0.41	3.65	0.83	0.14	48	19
BM	VR	0.29	2.46	0.65	0.14	48	19
BM	NA	0.37	3.28	0.87	0.15	48	19
BM	AR	0.14	1.13	0.75	0.17	48	19
ES	TT	0.37	3.26	0.88	0.12	51	16
ES	ST	0.39	3.42	0.87	0.12	51	16
ES	VR	0.21	1.73	0.85	0.14	51	16
ES	NA	0.40	3.59	0.85	0.12	51	16
ES	AR	0.19	1.57	0.76	0.13	51	16
AS	TT	0.43	3.86	0.99	0.01	66	1
AS	ST	0.47	4.36	0.99	0.01	66	1
AS	VR	0.28	2.37	1.00	0.01	66	1
AS	NA	0.47	4.36	0.98	0.01	66	1
AS	AR	0.17	1.45	1.00	0.01	66	1

VALIDITY COEFFICIENTS AND RELEVANT STATISTICS FOR XBC

Variables		r	t	η^2	F	K-2	N-K
B	TT	0.43	2.08	0.87	0.10	15	4
B	ST	0.47	2.33	0.81	0.09	15	4
B	VR	0.37	1.71	0.88	0.11	15	4
B	NA	0.40	1.90	0.81	0.10	15	4
B	AR	0.11	0.47	0.88	0.12	15	4
M	TT	0.09	0.40	0.90	0.13	15	4
M	ST	0.19	0.86	0.90	0.12	15	4
M	VR	0.17	0.77	0.96	0.13	15	4
M	NA	0.15	0.66	0.80	0.12	15	4
M	AR	-0.21	-0.95	0.80	0.11	15	4
BM	TT	0.29	1.31	0.76	0.07	16	3
BM	ST	0.38	1.78	0.74	0.06	16	3
BM	VR	0.31	1.42	0.96	0.08	16	3
BM	NA	0.31	1.42	0.54	0.05	16	3
BM	AR	-0.09	-0.39	0.88	0.09	16	3
ES	TT	0.35	1.61	0.94	0.02	18	1
ES	ST	0.34	1.56	0.95	0.02	18	1
ES	VR	0.41	1.98	0.99	0.02	18	1
ES	NA	0.19	0.86	0.89	0.03	18	1
ES	AR	0.19	0.87	0.95	0.03	18	1
AS	TT	0.31	1.41	1.00	0.00	19	0
AS	ST	0.34	1.56	1.00	0.00	19	0
AS	VR	0.34	1.56	1.00	0.00	19	0
AS	NA	0.24	1.07	1.00	0.00	19	0
AS	AR	0.08	0.33	1.00	0.00	19	0

VALIDITY COEFFICIENTS AND RELEVANT STATISTICS FOR XBIA

Variables		r	t	η^2	F	K-2	N-K
B	TT	0.20	1.88	0.57	0.31	43	40
B	ST	0.35	3.38	0.54	0.25	43	40
B	VR	0.37	3.65	0.51	0.23	43	40
B	NA	0.24	2.27	0.48	0.26	43	40
B	AR	-0.07	-0.61	0.57	0.34	43	40
M	TT	0.25	2.32	0.47	0.38	35	48
M	ST	0.30	2.86	0.49	0.37	35	48
M	VR	0.18	1.67	0.50	0.43	35	48
M	NA	0.33	3.24	0.39	0.28	35	48
M	AR	0.09	0.79	0.47	0.43	35	48
BM	TT	0.28	2.26	0.63	0.18	54	29
BM	ST	0.39	3.91	0.71	0.17	54	29
BM	VR	0.33	2.22	0.66	0.18	54	29
BM	NA	0.35	3.45	0.72	0.19	54	29
BM	AR	0.02	0.16	0.51	0.18	54	29
ES	TT	0.26	2.49	0.78	0.11	65	18
ES	ST	0.36	3.51	0.81	0.10	65	18
ES	VR	0.33	3.16	0.79	0.11	65	18
ES	NA	0.30	2.88	0.85	0.11	65	18
ES	AR	0.04	0.35	0.76	0.12	65	18
AS	TT	0.27	2.60	0.89	0.10	68	15
AS	ST	0.37	3.63	0.87	0.09	68	15
AS	VR	0.34	3.30	0.80	0.08	68	15
AS	NA	0.31	2.93	0.88	0.09	68	15
AS	AR	0.04	0.41	0.87	0.10	68	15

VALIDITY COEFFICIENTS AND RELEVANT STATISTICS FOR XGH

6

Variables		r	t	η^2	F	K-2	N-K
B	TT	0.40	3.92	0.63	0.63	45	35
B	ST	0.44	4.39	0.63	0.21	45	35
B	VR	0.31	2.89	0.59	0.24	45	35
B	NA	0.37	3.55	0.57	0.22	45	35
B	AR	0.21	1.89	0.50	0.24	45	35
M	TT	0.21	1.87	0.38	0.28	37	43
M	ST	0.10	0.87	0.37	0.30	37	43
M	VR	-0.02	.0.19	0.35	0.30	37	43
M	NA	0.15	1.34	0.38	0.30	37	43
M	AR	0.30	2.81	0.47	0.30	37	43
BM	TT	0.36	3.49	0.69	0.22	48	01
BM	ST	0.33	3.09	0.60	0.20	48	32
BM	VR	0.18	1.61	0.53	0.22	48	32
BM	NA	0.31	2.93	0.62	0.22	48	32
BM	AR	0.30	2.79	0.73	0.25	48	32
ES	TT	0.26	2.39	0.87	0.11	64	16
ES	ST	0.29	2.68	0.81	0.10	64	16
ES	VR	0.28	2.64	0.80	0.10	64	16
ES	NA	0.18	1.62	0.80	0.11	64	16
ES	AR	0.13	1.16	0.91	0.12	64	16
AS	TT	0.33	3.14	0.87	0.06	70	10
AS	ST	0.31	2.94	0.84	0.06	70	10
AS	VR	0.21	1.91	0.85	0.06	70	10
AS	NA	0.27	2.48	0.80	0.06	70	10
AS	AR	0.25	2.31	0.90	0.06	70	10

VALIDITY COEFFICIENTS AND RELEVANT STATISTICS FOR XGS

Variables		r	t	η^2	F	K-2	N-K
B	TT	0.48	5.29	0.63	0.19	52	41
B	ST	0.52	5.94	0.69	0.19	52	41
B	VR	0.44	4.71	0.68	0.23	52	41
B	NA	0.43	4.61	0.61	0.21	52	41
B	AR	0.29	2.93	0.55	0.24	52	41
M	TT	0.59	7.01	0.77	0.17	54	39
M	ST	0.60	7.27	0.82	0.18	54	39
M	VR	0.31	3.10	0.75	0.27	54	39
M	NA	0.64	8.10	0.74	0.14	54	39
M	AR	0.41	4.33	0.61	0.20	54	39
BM	TT	0.62	7.64	0.83	0.09	67	26
BM	ST	0.65	8.26	0.84	0.09	67	26
BM	VR	0.42	4.43	0.66	0.11	67	26
BM	NA	0.63	7.83	0.86	0.10	67	26
BM	AR	0.41	4.37	0.81	0.14	67	26
ES	TT	0.55	6.40	0.87	0.06	78	15
ES	ST	0.58	0.90	0.06	0.06	78	15
ES	VR	0.40	4.22	0.80	0.07	78	15
ES	NA	0.55	6.33	0.91	0.06	78	15
ES	AR	0.33	3.42	0.78	0.07	78	15
AS	TT	0.62	7.57	0.91	0.04	82	11
AS	ST	0.65	8.27	0.92	0.03	83	11
AS	VR	0.46	5.04	0.92	0.05	82	11
AS	NA	0.60	7.17	0.92	0.04	82	11
AS	AR	0.40	4.25	0.89	0.05	82	11

VALIDITY COEFFICIENTS AND RELEVANT STATISTICS FOR XGHE

Variables		r	t	η^2	F	K-2	N-K
B	TT	0.14	0.78	0.75	0.23	20	11
B	ST	0.28	1.62	0.80	0.22	20	11
B	VR	0.31	1.83	0.83	0.22	20	11
B	NA	0.09	0.49	0.70	0.22	20	11
B	AR	-0.07	-0.41	0.62	0.21	20	11
M	TT	-0.03	-0.19	0.61	0.35	16	15
M	ST	0.01	0.03	0.58	0.34	16	15
M	VR	-0.16	0.91	0.65	0.35	16	15
M	NA	0.19	1.08	0.45	0.27	16	15
M	AR	-0.07	-0.37	0.43	0.28	16	15
BM	TT	0.08	0.45	0.86	0.16	23	8
BM	ST	0.19	1.09	0.86	0.15	23	8
BM	VR	0.12	0.70	0.82	0.15	23	8
BM	NA	0.16	0.91	0.77	0.15	23	8
BM	AR	-0.08	-0.43	0.72	0.14	23	8
ES	TT	0.16	0.89	0.53	0.08	25	6
ES	ST	0.35	2.05	0.69	0.08	25	6
ES	VR	0.19	1.07	0.76	0.10	25	6
ES	NA	0.33	1.94	0.70	0.08	25	6
ES	AR	-0.12	-0.66	0.61	0.09	25	6
AS	TT	0.09	0.51	0.72	0.08	26	5
AS	ST	0.27	1.58	0.86	0.08	26	5
AS	VR	0.15	0.85	0.89	0.09	26	5
AS	NA	0.26	1.49	0.90	0.08	26	5
AS	AR	-0.15	-0.87	0.67	0.07	26	5

VALIDITY COEFFICIENTS AND RELEVANT STATISTICS AGAINST TT

Group	Test	r	t	η^2	F	K-2	N-K
	VR	0.69	14.08	0.57	0.29	39	182
VIIIB	NA	0.79	19.38	0.70	0.20	39	182
	AR	0.70	14.54	0.63	0.39	39	182
	VR	0.79	18.12	0.75	0.33	37	163
VIIIG	NA	0.76	16.36	0.74	0.43	37	163
	AR	0.58	9.96	0.64	0.83	37	163
	VR	0.88	6.58	0.99	0.02	11	2
IXBH	NA	0.95	11.37	0.99	0.01	11	2
	AR	0.83	5.28	0.95	0.02	11	2
	VR	0.78	11.29	0.82	0.11	42	40
IXBS	NA	0.88	16.82	0.87	0.05	42	40
	AR	0.83	13.62	0.86	0.08	42	40
	VR	0.68	2 .45	0.99	0.04	6	1
IXBC	NA	0.63	2.17	0.97	0.05	6	1
	AR	0.80	3.51	0.97	0.03	6	1
	VR	0.68	8.07	0.55	0.07	31	43
IXBIA	NA	0.79	11.06	0.74	0.10	31	43
	AR	0.77	10.50	0.75	0.12	31	43
	VR	0.75	11.39	0.72	0.18	34	66
IXGH	NA	0.74	11.03	0.79	0.26	34	66
	AR	0.75	11.30	0.71	0.17	34	66
	VR	0.79	13.55	0.84	0.17	42	65
IXGS	NA	0.80	13.82	0.78	0.12	42	65
	AR	0.84	16.04	0.82	0.10	42	65

VALIDITY COEFFICIENTS AND RELEVANT STATISTICS AGAINST TT

Group	Test	r	t	η^2	F	K-2	N-K
IXGHE	VR	0.77	9.23	0.78	0.20	21	38
	NA	0.45	3.83	0.51	0.37	21	38
	AR	0.72	7.88	0.64	0.14	21	38
XBH	VR	0.56	3.27	0.73	0.06	19	5
	NA	0.82	7.04	0.86	0.03	19	5
	AR	0.86	8.23	0.93	0.03	19	5
XBS	VR	0.64	6.86	0.76	0.17	36	31
	NA	0.81	11.44	0.85	0.09	36	31
	AR	0.76	9.52	0.84	0.12	36	31
XBC	VR	0.69	4.15	0.91	0.06	15	4
	NA	0.83	6.61	0.94	0.03	15	4
	AR	0.62	3.41	0.80	0.06	15	4
XBIA	VR	0.72	9.50	0.73	0.14	39	44
	NA	0.82	12.99	0.83	0.10	39	44
	AR	0.79	11.58	0.78	0.10	39	44
XGH	VR	0.54	5.77	0.60	0.24	35	45
	NA	0.84	13.75	0.80	0.07	35	45
	AR	0.79	11.60	0.79	0.11	35	45
XGS	VR	0.68	8.96	0.70	0.17	42	51
	NA	0.87	17.15	0.90	0.09	42	51
	AR	0.84	14.82	0.87	0.11	42	51
XGHE	VR	0.56	3.73	0.57	0.20	14	17
	NA	0.72	5.69	0.67	0.11	14	17
	AR	0.80	7.34	0.76	0.09	14	17

VALIDITY COEFFICIENTS AND RELEVANT STATISTICS (INTER SUB-TEST)

Group	Variables	r	t	η^2	F	K-2	N-K
	VR NA	0.29	4.50	0.22	1.45	16	205
VIIIB	VR AR	0.31	4.92	0.24	1.43	16	205
	NA AR	0.32	5.05	0.34	1.54	23	198
	VR NA	0.50	8.12	0.45	1.27	20	180
VIIIG	VR AR	0.18	2.56	0.24	1.51	20	180
	NA AR	0.07	1.06	0.19	1.47	19	181
	VR NA	0.81	5.02	0.85	0.09	7	6
IXBH	VR AR	0.57	2.48	0.65	0.17	7	6
	NA AR	0.67	3.23	0.79	0.12	8	5
	VR NA	0.52	5.47	0.54	0.48	22	60
IXBS	VR AR	0.46	4.67	0.45	0.46	22	60
	NA AR	0.64	7.49	0.56	0.20	27	55
	VR NA	-0.04	-0.11	1.00	0.08	6	1
IXBC	VR AR	0.59	1.92	0.94	0.05	6	1
	NA AR	0.21	0.56	0.91	0.34	4	3
	VR NA	0.33	2.99	0.31	0.55	16	58
IXBIA	VR AR	0.35	3.17	0.32	0.55	16	58
	NA AR	0.37	3.41	0.45	0.51	22	52
	VR NA	0.33	3.55	0.36	0.83	18	82
IXGH	VR AR	0.41	4.50	0.31	0.49	18	82
	NA AR	0.27	2.82	0.27	0.61	20	80
	VR NA	0.47	5.54	0.33	0.34	20	87
IXGS	VR AR	0.53	6.41	0.36	0.26	20	87
	NA AR	0.49	5.76	0.41	0.43	24	83

VALIDITY COEFFICIENTS AND RELEVANT STATISTICS (INTER SUB-TEST)

Group	Variables		r	t	η^2	F	K-2	N-K
	VR	NA	0.08	0.58	0.11	0.29	14	45
IXGHE	VR	AR	0.33	2.65	0.38	0.64	14	45
	NA	AR	-0.01	-0.08	0.20	0.81	10	49
	VR	NA	0.14	0.71	0.30	0.22	12	12
XBH	VR	AR	0.32	1.65	0.32	0.16	12	12
	NA	AR	0.57	3.43	0.69	0.18	13	11
	VR	NA	0.35	3.04	0.23	0.26	17	50
XBS	VR	AR	0.21	1.75	0.28	0.54	17	50
	NA	AR	0.42	3.81	0.53	0.44	23	44
	VR	NA	0.30	1.37	0.65	0.31	10	9
XBC	VR	AR	0.34	1.59	0.69	0.30	10	9
	NA	AR	0.25	1.11	0.92	0.26	12	7
	VR	NA	0.52	5.52	0.42	0.38	18	65
XBIA	VR	AR	0.28	2.68	0.35	0.72	18	65
	NA	AR	0.43	4.30	0.37	0.42	20	63
	VR	NA	0.19	1.76	0.16	0.42	16	64
XGH	VR	AR	0.13	1.20	0.13	0.41	16	64
	NA	AR	0.55	5.90	0.59	0.61	18	62
	VR	NA	0.36	3.76	0.27	0.36	21	72
XGS	VR	AR	0.36	3.72	0.27	0.38	21	72
	NA	AR	0.68	8.84	0.61	0.27	24	69
	VR	NA	0.09	0.52	0.24	0.39	10	21
XGHE	VR	AR	0.10	0.55	0.19	0.31	10	21
	NA	AR	0.46	2.90	0.64	0.47	11	20

APPENDIX C

z COEFFICIENTS FOR THE SIGNIFICANT VALIDITY COEFFICIENTS

z COEFFICIENTS FOR THE SIGNIFICANT VALIDITY COEFFICIENTS

Criterion	TT	ST	VR	NA	AR	Group
B	0.66	0.69	0.59	0.69	-	
BM	0.71	0.74	0.65	0.74	-	IXBH
ES	-.	0.59	0.62	-	-	
AS	0.63	0.69	0.68	0.63	-	
B	0.44	0.39	0.43	0.24	0.39	
M	-	0.21	-	0.26	-	
BM	0.38	0.40	0.35	0.33	0.23	IXBS
ES	0.24	0.28	0.27	0.22	-	
AS	0.35	0.39	0.38	0.29	-	
B	-	-	-	-	0.25	
M	0.48	0.54	-	0.60	-	
BM	-	0.34	-	0.46	-	IXBIA
ES	0.54	0.54	0.28	0.55	0.33	
AS	0.41	0.50	-	0.60	-	
B	-	-	0.21	-	-	
M	0.21	0.20	-	-	-	
BM	0.23	0.22	0.20	-	-	IXGH
AS	0.32	0.31	0.27	0.24	0.20	
B	0.39	0.35	0.28	-	-	
M	-	-	-	0.34	-	
BM	0.34	0.39	-	0.37	-	IXGHE
ES	0.34	0.27	-	0.30	0.27	
AS	0.40	0.35	-	0.34	0.27	

APPENDIX C CONTINUED.

Criterion	TT	ST	VR	NA	AR	Group
B	0.33	0.40	0.30	0.33	-	
M	0.29	0.31	-	0.30	-	
BM	0.39	0.44	0.30	0.39	-	XBS
ES	0.39	0.41	-	0.42	-	
AS	0.46	0.51	0.29	0.51	-	
B	-	0.37	0.39	0.24	-	
M	0.26	0.31	-	0.34	-	
BM	0.29	0.41	0.34	0.37	-	XBIA
ES	0.27	0.38	0.34	0.31	-	
AS	0.28	0.39	0.35	0.32	-	
B	0.42	0.47	0.32	0.39	-	
M	-	-	-	-	0.31	
BM	0.38	0.34	-	0.32	0.31	XGH
ES	0.27	0.30	0.29	-	-	
AS	0.34	0.32	-	0.28	0.26	

APPENDIX D

CHI-SQUARE TEST OF COMMON POPULATION FOR AVERAGING VALIDITY COEFFICIENTS

CHI-SQUARE TEST OF COMMON POPULATION FOR AVERAGING VALIDITY COEFFICIENTS

Variables		$\Sigma(N-3)$	$\Sigma(N-3)z$	$\Sigma(N-3)z^2$	χ^2	$\bar{z}$	$\bar{r}$
B	TT	1244	465.41	223.14	49	0.37	0.35
B	ST	1244	517.82	261.19	45	0.41	0.39
B	VR	1244	397.51	168.83	41	0.31	0.30
B	NA	1244	445.15	199.09	39	0.35	0.34
B	AR	1244	188.64	57.91	29	0.15	0.15
M	TT	1244	429.22	211.18	63	0.34	0.33
M	ST	1244	458.22	234.95	66	0.36	0.35
M	VR	1244	267.45	98.06	40	0.21	0.21
M	NA	1244	471.26	233.93	55	0.37	0.36
M	AR	1244	195.42	64.60	33	0.15	0.15
BM	TT	1244	522.71	277.98	58	0.42	0.39
BM	ST	1244	573.81	324.67	59	0.46	0.43
BM	VR	1244	382.85	160.84	43	0.30	0.29
BM	NA	1244	538.86	282.08	48	0.43	0.40
BM	AR	1244	221.07	68.64	29	0.17	0.17
ES	TT	864	307.22	150.14	74	0.24	0.24
ES	ST	864	336.13	177.09	86	0.27	0.26
ES	VR	864	248.99	99.59	49	0.20	0.19
ES	NA	864	295.83	140.30	69	0.23	0.23
ES	AR	864	157.29	48.74	28	0.12	0.12
AS	TT	1244	546.76	280.32	40	0.43	0.41
AS	ST	1244	600.02	336.52	47	0.48	0.44
AS	VR	1244	405.69	170.08	37	0.32	0.31
AS	NA	1244	558.70	290.76	39	0.44	0.42
AS	AR	1244	236.45	65.84	20*	0.19	0.18
TT	VR	1244	1133.43	1060.90	28	0.91	0.72
TT	NA	1244	1353.79	1522.43	49	1.08	0.79
TT	AR	1244	1216.17	1234.02	45	0.97	0.75
VR	NA	1244	485.43	224.26	34	0.39	0.37
VR	AR	1244	410.33	157.89	22*	0.32	0.31
NA	AR	1244	497.92	269.42	70	0.40	0.38

*Nonsignificant at the 0.05 level.

APPENDIX E

RELIABILITY COEFFICIENTS AND RELEVANT STATISTICS FOR THE SUB-TESTS

RELIABILITY COEFFICIENTS AND RELEVANT STATISTICS FOR THE SUB-TESTS

Group	Sub-tests	r	η^2	F	K-2	N-K
	VR	0.73	0.36	1.53	14	1276
Total	NA	0.92	0.74	0.22	19	1271
	AR	0.85	0.56	1.10	13	1277
	VR	0.74	0.41	0.93	10	211
VIIIB	NA	0.89	0.66	0.18	13	208
	AR	0.74	0.42	1.09	9	212
	VR	0.80	0.49	0.45	12	188
VIIIG	NA	0.92	0.78	0.57	12	188
	AR	0.88	0.67	0.45	11	189
	VR	0.56	0.44	0.32	5	8
IXBH	NA	0.91	0.89	0.12	6	7
	AR	0.79	0.78	0.22	5	8
	VR	0.84	0.62	0.33	12	70
IXBS	NA	0.94	0.82	0.07	15	67
	AR	0.84	0.54	0.19	12	70
	VR	0.26	0.75	0.31	4	3
IXBC	NA	0.68	0.68	0.64	2	5
	AR	0.48	0.64	0.44	3	4
	VR	0.57	0.24	0.57	8	66
IXBIA	NA	0.89	0.69	0.10	12	62
	AR	0.74	0.47	0.50	11	63
	VR	0.65	0.29	0.43	10	90
IXGH	NA	0.86	0.63	0.28	12	88
	AR	0.79	0.60	0.90	10	90

Group	Sub-tests	r	η^2	F	K-2	N-K
	VR	0.79	0.48	0.28	12	81
IXGS	NA	0.88	0.65	0.17	14	79
	AR	0.85	0.62	0.38	12	81
	VR	0.51	0.25	0.56	9	50
IXGHE	NA	0.55	0.20	0.53	5	54
	AR	0.57	0.34	0.83	8	51
	VR	0.31	0.19	0.32	7	17
XBH	NA	0.93	0.79	0.53	8	16
	AR	0.95	0.93	0.07	11	13
	VR	0.61	0.42	0.89	10	57
XBS	NA	0.87	0.69	0.20	13	54
	AR	0.87	0.69	0.20	13	54
	VR	0.74	0.74	0.25	9	10
XBC	NA	0.89	0.95	0.17	9	10
	AR	0.69	0.52	0.59	4	15
	VR	0.67	0.34	0.37	11	72
XBIA	NA	0.80	0.54	0.35	11	72
	AR	0.88	0.65	0.14	10	73
	VR	0.53	0.34	0.99	11	69
XGH	NA	0.89	0.69	0.17	11	69
	AR	0.65	0.36	0.46	13	67
	VR	0.80	0.51	0.36	11	82
XGS	NA	0.89	0.68	0.11	12	81
	AR	0.84	0.57	0.25	11	82
	VR	0.52	0.25	0.34	24	7
XGHE	NA	0.79	0.47	0.11	24	7
	AR	0.78	0.55	0.25	23	8

APPENDIX F

ITEM ANALYSIS DATA

ITEM ANALYSIS DATA FOR VR

Item number (Try out test)	Score		Percentage of scores		Difficulty Index	Discriminating Index	Item number (Final test)
	Higher Group	Lower Group	Higher Group	Lower Group			
1	67	40	88	53	0.70	0.45	3
2	51	25	67	33	0.50	0.34	17
3	53	34	70	45	0.57	0.26	13
4	49	27	65	35	0.50	0.30	-
5	72	30	95	39	0.67	0.65	-
6	61	38	80	50	0.65	0.34	5
7	67	46	88	61	0.74	0.36	2
8	17	11	22	14	0.18	0.12	-
9	67	51	88	67	0.78	0.27	-
10	74	42	97	55	0.76	0.65	1
11	65	32	86	42	0.64	0.48	6
12	44	19	58	25	0.41	0.34	-
13	40	21	53	28	0.40	0.27	27
14	70	21	92	28	0.60	0.68	12
15	59	23	78	30	0.54	0.49	15
16	57	34	75	45	0.60	0.32	-
17	68	23	90	30	0.60	0.63	11
18	32	21	42	28	0.35	0.16	-
19	15	4	20	5	0.12	0.45	-
20	44	23	58	30	0.44	0.29	25
21	29	15	38	20	0.29	0.22	-
22	67	63	88	83	0.85	0.09	-
23	55	21	72	28	0.50	0.45	19
24	59	36	78	47	0.62	0.33	9
25	59	39	78	51	0.64	0.28	7
26	74	57	97	75	0.86	0.52	-
27	46	13	61	17	0.39	0.45	-
28	44	6	58	8	0.33	0.57	31
29	34	38	45	50	0.47	-	-
30	48	21	63	28	0.45	0.36	23
31	55	21	72	28	0.50	0.45	20
32	67	15	88	20	0.54	0.67	-
33	57	38	75	50	0.63	0.28	8

ITEM ANALYSIS DATA FOR VR

Item number (Try out test	Score		Percentage of scores		Difficulty Index	Discriminating Index	Item number (Final test)
	Higher Group	Lower Group	Higher Group	Lower Group			
34	44	42	58	55	0.56	0.07	-
35	4	8	5	11	0.08	-	-
36	57	15	75	20	0.48	0.56	22
37	19	17	25	22	0.24	0.06	-
38	63	29	83	38	0.60	0.48	10
39	53	23	70	30	0.50	0.40	18
40	46	29	61	38	0.49	0.22	-
41	44	29	58	38	0.48	0.25	21
42	68	40	90	53	0.71	0.46	-
43	44	25	58	33	0.45	0.28	-
44	21	29	28	38	0.33	-	-
45	4	0	5	0	0.02	-	-
46	40	11	53	14	0.34	0.43	30
47	30	17	39	22	0.31	0.20	-
48	42	27	55	36	0.45	0.20	-
49	32	17	42	22	0.32	0.23	-
50	32	23	42	30	0.36	0.13	-
51	72	34	95	45	0.70	0.63	4
52	51	30	67	39	0.53	0.29	-
53	57	17	75	22	0.49	0.53	-
54	19	4	25	5	0.15	0.37	-
55	51	17	67	22	0.45	0.46	24
56	57	10	75	13	0.44	0.61	26
57	72	15	95	20	0.57	0.76	14
58	2	11	3	14	0.09	-	-
59	72	51	95	67	0.82	0.46	-
60	61	21	80	28	0.54	0.53	16
61	30	10	39	13	0.26	0.34	32
62	48	13	63	17	0.40	0.48	28
63	57	15	75	20	0.47	0.57	-
64	36	19	47	25	0-36	0.23	29

ITEM ANALYSIS DATA FOR NA

Item number (Try out test)	Score		Percentage of scores		Difficulty Index	Discriminating Index	Item number (Final test)
	Higher Group	Lower Group	Higher Group	Lower Group			
1	66	65	95	93	0.94	0.15	-
2	69	66	99	95	0.97	0.19	-
3	66	66	95	95	0.95	-	-
4	42	13	60	18	0.39	0.45	1
5	56	54	80	77	0.78	0.08	-
6	38	14	54	20	0.37	0.36	2
7	50	46	71	66	0.68	0.05	-
8	57	53	81	75	0.78	0.10	-
9	43	45	61	64	0.62	-	-
10	25	17	36	24	0.30	0.14	-
11	23	11	33	15	0.24	0.25	-
12	16	7	23	10	0.16	0.22	-
13	63	50	90	71	0.80	0.21	-
14	66	61	95	87	0.91	0.19	-
15	63	38	90	54	0.72	0.45	19
16	67	62	96	89	0.92	0.27	-
17	66	56	95	80	0.87	0.32	-
18	61	56	87	80	0.83	0.12	-
19	53	28	75	40	0.57	0.36	3
20	53	22	75	32	0.53	0.43	4
21	70	51	100	72	0.86	0.51	-
22	33	7	47	10	0.28	0.46	6
23	48	24	68	35	0.51	0.34	5
24	55	40	78	57	0.67	0.24	7
25	42	30	60	43	0.51	0.17	-
26	51	23	72	33	0.52	0.38	8
27	44	15	63	21	0.42	0.44	9
28	27	5	39	7	0.23	0.40	10
29	17	9	24	13	0.18	0.17	-
30	43	28	61	40	0.50	0.20	14
31	56	35	80	50	0.65	0.33	11
32	58	28	82	40	0.61	0.45	12
33	40	9	57	13	0.35	0.50	-
34	44	29	63	42	0.52	0.21	13
35	41	9	58	13	0.35	0.49	15

ITEM ANALYSIS DATA FOR NA

Item Number (Try out test)	Score		Percentage of scores		Difficulty Index	Discriminating Index	Item number (Final test)
	Higher Group	Lower Group	Higher Group	Lower Group			
36	34	12	49	17	0.33	0.38	16
37	30	20	43	29	0.36	0.15	-
38	37	10	53	14	0.38	0.44	18
39	45	17	64	24	0.44	0.41	17
40	26	12	38	17	0.27	0.27	20
41	58	29	82	42	0.62	0.43	24
42	61	33	87	47	0.67	0.45	22
43	44	25	63	36	0.49	0.28	26
44	63	32	90	46	0.68	0.51	21
45	49	17	70	24	0.47	0.46	-
46	51	24	72	35	0.53	0.38	-
47	54	28	77	40	0.58	0.39	-
48	29	19	42	27	0.34	0.17	-
49	14	8	20	11	0.15	0.11	-
50	52	12	74	17	0.45	0.57	-
51	56	27	80	39	0.59	0.43	-
52	63	27	90	39	0.64	0.56	23
53	38	20	54	29	0.41	0.26	28
54	37	21	53	30	0.41	0.24	27
55	48	22	68	32	0.50	0.36	25
56	49	11	70	15	0.42	0.56	-
57	53	12	75	17	0.46	0.58	-
58	41	7	58	10	0.34	0.54	-
59	43	13	61	18	0.39	0.46	31
60	46	9	66	13	0.39	0.56	32
61	36	22	52	32	0.42	0.21	29
62	35	18	50	25	0.37	0.27	30
63	28	7	40	10	0.25	0.40	-
64	21	13	30	18	0.24	0.16	-
65	32	8	46	11	0.28	0.43	-
66	66	41	95	58	0.77	0.53	-
67	66	23	95	33	0.64	0.69	33
68	65	24	93	35	0.64	0.63	34
69	65	22	93	32	0.62	0.61	-
70	45	11	64	15	0.39	0.52	35

ITEM ANALYSIS DATA FOR NA

Item number (Try out test)	Score		Percentage of scores		Difficulty Index	Discriminating Index	Item number (Final test)
	Higher Group	Lower Group	Higher Group	Lower Group			
71	46	9	66	13	0.39	0.53	36
72	47	13	67	18	0.42	0.50	37
73	47	13	67	18	0.42	0.50	38
74	47	5	67	7	0.37	0.65	-
75	36	5	52	7	0.28	0.56	39
76	26	0	38	0	0.19	-	-
77	40	2	57	3	0.30	0.69	40
78	26	0	38	0	0.19	-	-
79	19	0	27	0	0.13	-	-
80	20	0	29	0	0.14	-	-

ITEM ANALYSIS DATA FOR AR

Item number (Try out test)	Score		Percentage of scores		Difficulty Index	Discriminating Index	Item number (Final test)
	Higher Group	Lower Group	Higher Group	Lower Group			
1	74	60	77	63	0.70	0.17	3
2	77	51	80	53	0.66	0.30	4
3	54	24	56	25	0.40	0.32	16
4	64	42	67	44	0.55	0.23	9
5	62	19	65	11	0.38	0.58	19
6	69	29	72	30	0.51	0.42	12
7	56	22	58	23	0.40	0.37	17
8	83	39	87	41	0.64	0.49	5
9	72	29	76	30	0.53	0.46	9
10	87	63	91	66	0.78	0.36	1
11	72	36	75	37	0.56	0.39	8
12	53	38	55	39	0.47	0.16	13
13	46	22	48	23	0.35	0.28	21
14	51	25	53	26	0.39	0.29	18
15	88	52	92	54	0.73	0.49	15
16	71	31	74	32	0.53	0.42	10
17	72	42	75	44	0.59	0.33	7
18	9	4	9	14	0.11	-	-
19	31	17	32	17	0.24	0.19	26
20	58	15	60	15	0.37	0.49	20
21	25	14	26	14	0.20	0.18	-
22	78	38	81	39	0.60	0.45	6
23	12	8	12	8	0.10	0.10	-
24	55	35	57	36	0.46	0.21	14
25	66	16	69	16	0.42	0.54	15
26	16	12	16	12	0.14	0.08	-
27	29	16	30	16	0.23	0.19	27
28	5	2	5	2	0.03	0.14	-
29	48	17	50	17	0.33	0.38	23
30	22	8	23	8	0.15	0.27	-
31	45	19	47	20	0.33	0.31	22
32	52	7	54	7	0.30	0.57	25
33	33	11	34	11	0.22	0.32	28
34	12	18	12	18	0.15	-	-
35	40	21	42	22	0.32	0.23	24

APPENDIX G

RAW SCORES AND CORRESPONDING STANDARD SCORES FOR EACH SUB-TEST (GROUP-WISE NORM)

Note of Caution

For the establishment of norms, the scores on each sub-test for each group were expressed as standard scores, with mean of 50 and standard deviation of 10. A standard score of 50 would, therefore, represent the average or typical performance of the students of a group. It is, however, cautioned that the norms as given should not be used at present to make inferences about the aptitude of individuals or groups who differ markedly from the standard -ization sample, as reported in this study. The norms are subject to modification in the light of further study. At present the norms may be used for research purposes rather than for any practical application.

RAW SCORES AND CORRESPONDING STANDARD SCORES FOR EACH SUB-TEST (GROUP-WISE NORMS)

	VIIIB			VIIIG			IXBH			IXBS		
RS*	VR	NA	AR	VR	NA	AR	VR	NA	AR	VR	NA	AR
39											76	
38											74	
37											73	
36											71	
35											70	
34											69	
33											67	
32											66	
32										87	64	
30										85	63	
29										82	61	
28		78								80	60	
27		76								78	59	
26		74			80					75	57	65
25		72			78					72	56	63
24	77	70		74	76	78				70	54	62
23	75	68		72	74	76				68	53	60
22	72	66		70	72	74		67		65	51	58
21	70	64	75	68	70	72		65		62	50	57
20	67	62	72	66	68	70	80	63		60	49	55
19	65	60	70	64	66	68	77	62		58	47	53
18	62	58	68	62	64	66	73	60		55	46	52
17	60	56	65	60	62	64	70	58	52	52	44	50
16	57	54	62	58	60	62	67	57	50	50	43	48
15	55	52	60	56	58	60	63	55	48	48	41	47
14	52	50	58	54	56	58	60	53	46	45	40	45
13	50	48	55	52	54	56	57	52	44	42	39	43
12	48	46	52	50	52	54	53	50	42	40	37	42
11	45	44	50	48	50	52	50	48	40	38	36	40
10	43	42	48	46	48	50	47	47	38	35	34	38
9	40	40	45	44	46	48	43	45	36	32	33	37
8	38	38	43	42	44	46	40	43	34	30	31	35
7	35	36	40	40	42	44	37	42	32	28	30	33
6	33	34	38	38	40	42	33	40	30	25	29	32
5	30	32	35	36	38	40	30	38	28	-	27	30
4	-	30	32	34	36	38	27	37	26	-	-	28
3	-	-	30	32	34	36	-	35	24	-	-	-
2	-	-	-	30	32	34	-	33	-	-	-	-
1	-	-	-	-	-	-	-	32	-	-	-	-

*RS stands for Raw Score

RAW SCORES AND CORRESPONDING STANDARD SCORES
FOR EACH SUB-TEST (GROUP-WISE NORMS)

	IXBC			IXBIA			IXGH			IXGS		
RS*	VR	NA	AR	VR	NA	AR	VR	NA	AR	VR	NA	AR
30					76						72	
29					74						70	
28					72			82			68	
27					70			80		76	67	70
26					68	72		78		74	65	68
25					66	70		76		72	63	67
24					64	68		74		70	62	65
23				75	62	66		72	74	68	60	63
22				72	60	64	75	70	72	66	58	62
21				70	58	62	72	68	70	64	57	60
20		60		68	56	60	70	66	68	62	55	58
19	65	58		65	54	58	68	64	66	60	53	57
18	62	55		62	52	56	65	62	64	58	52	55
17	60	52	63	60	50	54	62	60	62	56	50	53
16	58	50	60	58	48	52	60	58	60	54	48	52
15	55	48	57	55	46	50	58	56	58	52	47	50
14	52	45	53	52	44	44	55	54	56	50	45	48
13	50	42	50	50	42	42	52	52	54	48	43	47
12	48	40	47	48	40	40	50	50	52	46	42	45
11	45	38	43	45	38	38	48	48	50	44	40	43
10	42	35	40	42	36	36	45	46	48	42	38	42
9	40	32	37	40	34	34	42	44	46	40	37	40
8	38	30	33	38	32	32	40	42	44	38	35	38
7	-	28	-	35	30	30	30	40	42	36	33	37
6	-	25	-	32	28	28	35	38	40	34	32	35
5	-	-	-	-	-	-	32	36	38	32	30	33
4	-	-	-	-	-	-	30	34	36	30	28	32
3	-	-	-	-	-	-	28	32	34	28	27	30

*RS stands for Raw Score

RAW SCORES AND CORRESPONDING STANDARD SCORES FOR EACH SUB-TEST (GROUP-WISE NORMS)

	IXGHE			XBH			XBS			XBC		
RS*	VR	NA	AR	VR	NA	AR	VR	NA	AR	VR	NA	AR
33								73			67	
32								72			66	
31								70			64	
30								68			63	
29					71			67			61	
28					70			65			60	
27					69			63			59	
26					67		74	62	65	78	57	
25					66		72	60	63	75	56	
24					64	72	70	58	62	72	54	
23					63	70	68	57	60	70	53	
22					61	68	66	55	58	68	51	60
21					60	67	64	53	57	65	50	58
20	68				59	65	62	52	55	62	49	55
19	65				57	63	60	50	53	60	47	52
18	62		73	64	56	62	58	48	52	58	46	50
17	60		70	62	54	60	56	47	50	55	44	48
16	58		67	60	53	58	54	45	48	52	43	45
15	55		63	58	51	57	52	43	47	50	41	42
14	52		60	56	50	55	50	42	45	48	40	40
13	50	67	57	54	49	53	48	40	43	45	39	38
12	48	63	53	52	47	52	46	38	42	42	37	35
11	45	60	50	50	46	50	44	37	40	40	36	32
10	42	57	47	48	44	48	42	35	38	38	34	30
9	40	53	43	46	43	47	40	33	37	35	33	-
8	38	50	40	44	41	45	38	32	35	32	-	-
7	35	47	37	42	40	43	36	30	33	30	-	-
6	32	43	33	40	39	42	34	28	32	-	-	-
5	30	40	30	38	37	40	32	27	30	-	-	-
4	28	37	27	36	-	38	-	25	28	-	-	-
3	-	33	-	34	-	32	-	-	27	-	-	-
2	-	30	-	-	-	-	-	-	-	-	-	-
1	-	-	-	-	-	-	-	-	-	-	-	-

*RS stands for Raw Score

RAW SCORES AND CORRESPONDING STANDARD SCORES
FOR EACH SUB-TEST (GROUP-WISE NORMS)

	IXBIA			XGH			XGS			XGHE		
RS*	VR	NA	AR	VR	NA	AR	VR	NA	AR	VR	NA	AR
37								77				
36								75				
35								73				
34								72				
33								70				
32								68				
31		64						67				
30		63						65				
29		62						63				
28		61					76	62				
27		60	70				74	60				
26	80	59	68				72	58				
25	78	58	67			78	70	57	68			
24	75	57	65		76	76	68	55	66			
23	72	56	63		74	74	66	53	64			76
22	70	54	62	78	72	72	64	52	62			74
21	68	53	60	75	70	70	62	50	60			72
20	65	52	58	72	68	68	60	48	58	68		70
19	62	51	57	70	66	66	58	47	56	65		68
18	60	50	55	68	64	64	56	45	54	62		66
17	58	49	53	65	62	62	54	43	52	60		64
16	55	48	52	62	60	60	52	42	50	58		62
15	52	47	50	60	58	58	50	40	48	55		60
14	50	46	48	58	56	56	48	38	46	52	77	58
13	48	44	47	55	54	54	46	37	44	50	73	56
12	45	43	45	52	52	52	44	35	42	48	70	54
11	42	42	43	50	50	50	42	33	40	45	67	52
10	40	41	42	48	48	48	40	32	38	42	63	50
9	38	40	40	45	46	46	38	30	36	40	60	48
8	35	39	38	42	44	44	36	-	34	38	57	46
7	32	38	37	40	42	42	34	-	32	-	53	44
6	30	37	35	38	40	40	32	-	30	-	50	42
5	28	36	33	35	38	38	30	-	28	-	47	40
4	25	34	32	32	36	36	-	-	26	-	43	38
3	22	33	-	-	34	34	-	-	-	-	40	36
2	-	-	-	-	-	32	-	-	-	-	37	34
1	-	-	-	-	-	-	-	-	-	-	33	32

*RS stands for Raw Score

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