CHAPTER IV

METHOD

1. DESIGN

This investigation is intended to find the relationships of Intelligence, Aptitude, Personality, Academic Achievement and Occupational Choice of the students in the polytechnic institutions. The scores of Intelligence, Aptitude, Personality and Occupational Choices will be obtained through the use of standardised tests selected for this purpose in this study. Academic Achievement scores (external) of the students may be obtained on the basis of the average of the marks obtained by them in their examinations in their earlier classes conducted by the Board of Technical Education. The Academic Achievements (internal) given to each student by the respective institutes on their earlier examinations. The intercorrelations among all these variables will be studied.

2. SAMPLE

Startified sample of the students of the popular branches (Electrical, Civil and Mechanical) of Engineering of the three year diploma courses in Engineering Education were taken from six polytechnics. These six polytechnics were chosen by method of random sampling of drawing the lots. The number of students undergoing the courses are not in equal proportion. Mechanical Engineering had the maximum number and Electrical Engineering had the least in these institutions. The branches of Engineering courses are offered on the demands of the students, the discretion of the authorities of the polytechnics and the availability of the seats.
in the respective branch of Engineering. In this study Mechanical Engineering students (150), Civil Engineering (125) and Electrical Engineering (125) were taken. In all there were 400 male students in this sample. The sample was restricted to the final year students of these branches because they have taken maximum number of examinations for which the Academic Achievements will be considered. The sample consisted of male students because most of the institutes for girls did not have parallel and equivalent courses as offered by the polytechnics for boys. It was also found that hardly any girl student had taken Mechanical Engineering even in the co-educational polytechnics. Thus, to keep the data uniform and homogeneous only boy students were considered.

Since the number of tests to be given were seven to each of the students, these were scheduled to be administered by spreading the schedule at three different occasions. Some students missed one test or the other due to their absence in the polytechnics. A few response sheets were found incomplete on scrutiny and had to be rejected. Some students had come after migration from other institutions, so their achievements could not be made available. These were not considered in the effective sample. The remaining sample comprised of 125 students from Mechanical Engineering, 110 from Civil Engineering and 100 from Electrical Engineering. All the processing and analysis of the results was done on the responses of this sample.
3. MATERIALS OR TOOLS

To get the desired data on Intelligence, Aptitudes, Personality and Occupational Choices, following tools were used:


(ii) Space Relation, Numerical Ability, Mechanical Reasoning and Abstract Reasoning Aptitude tests for the Differential Aptitude Test Battery (Form A) by George Bennett, Wesman and Seashore (1959).

(iii) Eysenck's Personality Inventory (1964).

(iv) Semantic Differential Scale for Occupational Choices.

The Academic Achievements were taken from the official records of the Institute (Mohan & Banth, 1975).

(A) Standard Progressive Matrices (SPM)

The General Intellectual Ability (Intelligence) was proposed to be measured by SPM (revised) sets A, B, C, D, E by J.C. Ravens (1960). The SPM is a non-linguistic test to apprehend meaningless figures presented for observation to see the relationships between them, conceive the nature of the figure completing each system of relations presented and by doing so, develop a systematic method of reasoning (Ravens, 1960). It is often useful to describe the scale, as a test of observation and clear thinking. Each problem in the scale is really the mother or 'source' of a system of thought, hence the name progressive matrices. This matrices test can provide valid means of a person's present capacity for clear thinking and accurate intellectual work. It indicates where a person must begin any course of training he wishes to pursue or work he will have to undertake while the former indicates the rate at which he may be

* SPM will be used in place of its full form Standard Progressive Matrices.
expected to progress. By itself, the SPM is a culture fair measure of general intellectual ability, and hence of international use. In such a sample 'culture fair' tests may work better when the educational experiences and rural and urban environment of the students in the polytechnics varies so much. The selection task is to pick according to ability or aptitude regardless of ethnic group (Fredrick R. Wickert, 1972). SPM (1956) has been quite popular with researchers and many studies have been carried out with the same (Atualla, 1956; Deb, 1957; Desai, 1961; Dhar and Marr 1959; Dosajh, 1958; Kundu, 1964; Mohan, 1971) etc. Dosajh (1958) found this test to be better test for classifying students for general and technical courses. This scale has retest reliability varying from .83 to .93. It correlates with Terman-merril Scale and has been found to have a 'g' saturation of .82. In practice, as an untimed 'capacity' test and even as a 20 Minute Speed Test (Ravens, 1938) or efficiency test; the results have been found to be more reliable and psychologically valid than one might expect from sixty problems arranged in five sets of overlapping difficulty as in this test. It must be kept in mind that the scale is intended to span the whole range of Intellectual development rather than to differentiate clearly between individual persons.

The scale consists of sixty problems divided into five sets under A, B, C, D and E. These problems in each set are progressively difficult. The five sets provide five opportunities for grasping five methods of meeting the problems and five
progressive assessments of a person's capacity for intellectual activity. The scale is intended to cover the whole range of intellectual development from the time a child is able to grasp the idea of finding a missing piece to complete a pattern. The test is sufficiently long to assess a person's capacity to form comparisons and reason by analogy.

Every one, whatever his age is given the same series of problems in the same order. As the order of the problem provides the standard training in the method of work, the scale can be given either as individual or as a group test. A person's total score provides an index, of his intellectual capacity, whatever his nationality or education.

Test

B) Differential Aptitude/Battery (DAT)*

Industry has long recognised the need for multiple measurement and many tests of specific aptitudes early found a place in employment procedures. In 1930's great many tests aiming at the prediction of rather specific kinds of behaviour and performance were developed. They sample narrow segment of aptitudes with the intent of predicting success in a relatively narrow field of vocational behaviour.

The DAT (1940) were developed to assist the counsellor in his broad gauge book at career possibilities and professional courses. The most widely used tests in this field of aptitude

* Differential Aptitude Test Battery is popularly called DAT.
measurement are by Bennett, Wessman and Seashore (1950-54). These tests are for common use, in addition, these tests are designed for boys in high schools, trade schools, for certain industrial groups and for engineering school applicants. According to Bennett, Seashore and Wessman (1960), students who are superior in numerical ability, spatial relations, besides mechanical reasoning will do better in Engineering courses.

The principle of DAT is that level of operation is usually the most important aspect of abilities which should be known. The attempt was made to include tests in the battery each of which would be useful in many areas rather than in only one or two, and each of which would provide meaningful scores. Although each of the tests is expected to make a unique contribution to the understanding of the individual student, it may be advantageous to consider such groups of two or more scores together. Space relations and Mechanical Reasoning relate to students ability to visualize, correlate objects and manipulate those visualisations and to recognize everyday physical forces and principles. They are particularly important in dealing with things rather than with popular words. In preparing the combinations, it was necessary to select tests to be grouped from a large number of possible combinations. If the writing is concerned chiefly with Technical and Scientific matter; the mechanical reasoning, and possibly also the space relations and abstract reasoning (AR) scores should be given attention. In considering other occupations, such as cost accounting or Industrial purchasing, the technical group may need to be linked with Numerical Ability (NA).
Thus, in the technician job as described earlier, the combination of space relation, numerical ability, mechanical reasoning and abstract reasoning.

(a) **Space Relations (SR)**

The item type devised for Space Relations Test represents a combination of two previous approaches to measurement of this ability. The ability to visualise a constructed object from a picture of a pattern has been used frequently in tests of structural visualisation. Similarly, the ability to imagine how an object would appear if rotated in various ways has been used effectively in the measurement of space perception. A feature inherent in these items is that they require mental manipulation of objects in three dimensional space. Item forms which refer to only two dimensions are less useful, since there are relatively few occasions when perception of two dimensional space alone is important. The space relation test is a measure of ability to deal with concrete material through visualisation. This ability to manipulate things mentally, to create structure in one's mind from a plan, is what the test is designed to evaluate. It is an ability needed in such fields as drafting, architecture, art, die-making or wherever there is need to visualize objects in three dimensions.

(b) **Numerical Ability (NA)**

Numerical Ability Test is a measure of students' ability to reason with numbers, to manipulate numerical relationships and to deal intelligently with quantitative materials. Educationally, it
is important for prediction in fields as mathematics, commerce, physics, chemistry, engineering and other curricula in which quantitative thinking is essential.

Items in this test are designed to measure understanding of Numerical Relations and facility in handling numerical concepts. The problems are framed in the item type called "Arithmetic Computation", rather than in what is usually called "Arithmetic Reasoning". It is evident from the inspection of the items that the measurement of reasoning ability is not sacrificed by use of the computation type. Some of the items test only for skill in numerical processes, many of the items however, call for understanding of numerical relationships, though computationally simple; they are, as problems, fully as complex as framed in verbal terms.

The job of technician and of supervisory level require use of Numerical Ability in purchases and maintaining accounts calculating and designing jobs and in Civil Engineering construction and Electrical current strengths and Mechanical job designing.

(c) Mechanical Reasoning (MR)

Each item consists of a pictorially presented mechanical situations together with a simply worded question. Care has been taken to present items in terms of simple, frequently encountered mechanisms that do not resemble text book illustrations or require special knowledge.

The ability measured by the mechanical reasoning test may be regarded as one aspect of Intelligence also. The person who stands high in this characteristics finds it easy to learn the
principles of operation and repair of complex devices, the score is affected by the previous experience of the subject but not to a degree that introduces serious difficulties in interpretation. The test is useful in those curricula and occupations where an appreciation of the principles of common physical forces is required. If the student intended to join a major in a physical science field or in a technical or manual training courses does not make a good score on this test, he should expect to find the work difficult.

(d) **Abstract Reasoning (AR)**

This test is intended for a non-verbal measure of students' Reasoning Ability. The series presented in each problem requires the perception of an operating principle in the changing diagrams. In each diagram the student must discover the principle or principles governing the change of the figures and give evidence of his understanding by designating the diagram which should logically follow. In each case the task is generalizing the changes into the operating principles - thinking with abstract symbols. The complexity is obtained from increasing conceptual difficulty. The differences are apparent; discerning why the patterns differ in the intellectual exercise. It involves the ability to perceive relationships in abstract figure patterns - generalisations of principles from non-language designs. Under ordinary conditions, the Abstract score will be relevant when the curriculum, profession or vocation requires perception of relationships among things rather than words or numbers. In this it may as properly be grouped with
Space and Mechanical Reasoning Tests as with verbal and numerical ability tests. The ability to reason with abstract figures for technician Mechanical Engineering, Civil Engineering and Electrical Engineering courses require the perception of the relationships of things in performance of jobs daily.

(C) **Semantic Differential Scale for Occupational Choices**

The words 'occupations' and 'vocations' have come to be used as synonymous and so these are used almost interchangeably.

Vocation (Good, 1959) is a calling as to a particular occupation, a business or profession. 'Occupation', according to Webster's dictionary, 'is an employment or work, calling, pursuit or business'. Similarly, International Standard Classification of Occupation (1949) defined, 'occupation is the kind of work performed by the individual regardless of the industry in which this work is performed and of the status of employment of the individual'.

So, in the prevailing literature both terms are used interchangeably unless specifically mentioned. Here, the term occupation has been preferred as a broad connotation for pursuit as used by International Standard Classification of Occupations, 1949. Therefore, when an individual makes a decision to enter an occupation this decision or process of decision is called Occupational Choice.

To study the pattern of occupational choices made by the subjects, Semantic Differential Scale for Occupational Choices (SDSOC) by Mohan and Santh (1975, 1977) was used. This scale consists of various descriptions of occupations selected on the basis of
Roe's (1956) classification of occupations into groups and levels. It was not possible to present the entire anthology of occupations, so classification of professions into eight groups, i.e., (1) Social Service, (ii) Business, (iii) Organisation, (iv) Technology, (v) Outdoor, (vi) Science, (vii) General and Cultural, (viii) Arts and Entertainment (Roe, 1956; Osipow, 1968; Mohan and Banth, 1975), was taken. These groups were further elaborated through the classification into levels which was based upon degrees of responsibility, capacity and skill.

To achieve the purpose of presenting the groups of occupations every occupation was classified in each of the two sets of categories, one called 'groups' and other 'levels'. Group division indicates the primary focus of activity in the occupation. There were eight groups. Classification of occupations into levels depends upon the degree of personal autonomy and the level of skill and training required. There are six levels. This results in 8 by 6 descriptions of occupations.

Categorization by primary focus is related most to factorization of interests, but may not be identical with any of them. The forms of an occupation may be on personal interactions - supportive or exploitive, close or more distant. The groups have been mentioned before. The descriptions of the groups are given below:

(1) **Social Service**

These occupations are primarily concerned with serving and attending the personal tastes, needs, welfare of other persons. Included are occupations in guidance, social work, domestic and
protective services.

(ii) Business Contact:

The occupations are primarily concerned with the face to face relation to deal with commodities, investment, real estate and services. Also included are such occupations as demonstrators, auctioner and some kinds of agents.

(iii) Organization:

These are the managerial and white collar jobs in business, industry and government, the occupations concerned primarily with the organisation and efficient functioning of commercial enterprises and of government activities.

(iv) Technology:

The group includes occupations concerned with production, maintenance and transportation of commodities and utility. Here are occupations in Engineering, Crafts and Machine trades.

(v) Outdoor:

The group includes agriculture, fishery, forestry, mining and kindred occupations, the occupations primarily concerned with the cultivation, preservation and gathering of crops, of marine, of inland, water resources, of mineral resources, of forest products and other natural resources and with animal husbandry.

(vi) Science:

These are the occupations primarily concerned with scientific theory and its application under specified circumstances, other than technology.
(vii) **General Culture**

These occupations are primarily concerned with the preservation and transmission of the general cultural heritage. The group embraces occupations concerning the subjects usually called the humanities. It includes occupations in education, journalism, jurisprudence, the ministry, linguists and so on. All elementary and high school teachers are included in this group.

(viii) **Arts and Entertainment**

These occupations include those occupations primarily concerned with the use of special skills in the creative arts and in the field of entertainment. Both creators and performers are included.

**Classification by Level of Function**

This classification is based upon degree of responsibility, capacity and skill or should be noted that these are not exactly correlated wherever there are marked differences. By level of responsibility is meant not only the number and difficulty of the decisions to be made but also how many different kinds of problems must be decided. This is an aspect that has not been much considered, yet in terms of the meaning and value of the occupation to the individual it is of the utmost importance. The same title may be preferred to different levels for example business executives may be in level 1, 2, 3 or 4. These do not always apply. In group VIII occupations may be of any level, for example - education is often irrelevant.
(i) **Professional and Managerial**

Independent Responsibility - This level includes not only the innovations and creations but also the top management and administrative people as well as those professional people who have independent responsibility in important respects (a) Important, independent and varied responsibility (b) Policy making, (c) Education (Doctor level or equivalent).

(ii) **Professional and Managerial**

The distinction between this level and the level I is primarily of degree only. German, autonomy may be present but with less significant responsibilities than in level I, (a) Medium level responsibility, for self and others both regards to importance and variety, (b) Policy Interpretation, (c) Education at or above the bachelor level but below the doctor or equivalent.

(iii) **Semi-Professional and Small Business**

The criteria suggested here are:

(a) low level responsibility for others

(b) application of policy or determination for self only (managing a small business).

(c) Education - high school plus technical school or the equivalent.

(iv) Skilled - require apprenticeship or other special training or experience.

(v) Semi-skilled - Training for less than four, unautonomy.

(vi) Unskilled - no special training.
Putting these two classification together, a table with 48 cells is formed. But some cells are empty as there is hardly any occupation which may be fitted therein, and there is no hard and fast commitment that it must be there.

There were 24 descriptions of occupations of professions because the unskilled (4th) level had been eliminated from the original SD80C. Mohan and Banth (1975) found that scores on the last level were very low score. Each of the description was rated on SD80C of five pairs of polar adjectives on a seven point scale by the subjects. The use of seven point scale was intended to increase precision of measurement and to provide forced choice differentiating subjects responses as reflecting greater preference for one or the other bipolar adjectives (Osgood-1957).

(D) Eysencks Personality Inventory

Eysenck claims that Extraversion and Neuroticism are the two main dimensions of personality and has produced good deal of evidence to demonstrate their importance. To measure the personality dimensions of Extraversion and Neuroticism, Eysenck's Personality Inventory in English (1964) was used. The original MPI (Maudsley Personality Inventory) is a rough and ready measure of Neuroticism and Extraversion. The inventory has been constructed on the basis of item analysis and factor analysis (Eysenck, 1959). EPI was the modified form of MPI - with 57 statements to be responded 'Yes' or 'No'. There are two A and B parallel versions of EPI. Both are designed to measure the same factors. Form 'A' was used in this study.
(1) Academic Achievements

The academic achievement records of the sample, for internal and external three examinations were obtained from the official registers of the respective institutes. The internal marks are given on the basis of the performance of the students in examinations conducted by the polytechnics. These marks are added in the final marks in determining his performance. The academic achievements (external) are based on performance on the external examinations which are conducted by the Board of Technical Education. The average aggregate marks of the three sessions were obtained and percentages calculated. These marks were taken as achievement scores.

4. PROCEDURE

The polytechnics in which the tests were to be administered had been given prior information. The schedule was fixed so that the persons involved were ready and expected the administration of the tests. Mostly the session reserved for the administration were marked in the forenoon, so that the subjects are fresh. A Rapport was created with the subjects by seeking brief introduction and talking to them informally on the importance of study of human behaviour. Then they were told the purpose of tests for each session. They were requested to co-operate fully in the conduct of tests and respond sincerely and truthfully.

As the tests used were primarily to reduce anxiety before starting the tests the subjects were assured that these responses would in no way affect their assessments and the information would be kept confidential meant for research study only. It was assumed that
the administration of seven tests would take about six hours. Thus the tests were so grouped that the monotony is avoided and the interests of the students is maintained. So, these tests were divided into three convenient sessions in such a way that all the digital tests are not given one after the other (Bennett, Seashore Wesman, 1959). Or the figure tests do not come together one after the other. To bring in variety the digital and figures tests were interpolated by reading or description tests. Between two tests some rest time was interposed during which the subject was made to relax and some informal conversation was carried on. The help of some teachers from respective polytechnics was taken to supervise and see the students are not tempted to consult. Teachers were also explained the administration of the tests. The tests were spread over 2 weeks duration so that the practice effect is minimum. The tests were grouped as follows: EPIM & SPM in first group. The second and third group were maintained on the basis of manual of instruction of DAT - second group, i.e., MR & SR and third group MA & SDSOC and AR respectively (Bennett, Seashore, Wesman, 1959). Their sequence was followed as suggested in Manual.

The seating arrangement was so adjusted that subjects have least access to consulting each other. Before the start of each session it was checked that the subjects had ball pens or pencils. A few spare ball pens and pencils were also kept in reserve. Then the instructions were explained in accordance to the standard instruction sheets or manuals for the tests. The time for the time
bound tests was maintained with the help of stop watch. The instructions for DAT, Personality and SDOCS were permitted on the respective forms. If anything was still not clear, the doubts were clarified by the investigator.

Instructions for Administering Standard Progressive Matrices (SPM), Aptitude (Space Relations, Numerical Ability, Mechanical Reasoning and Abstract Reasoning) and Personality Inventory:

(a) Instructions for SPM:

The physical setting and preparations as stated in the above said procedure were made for group testing. The response sheets were given to the students to fill in the desired information. The filled in response sheets were checked. They were told to follow the directions. The instructions for doing the SPM were given verbally by the investigator in accordance to Manual for SPM (Raven, 1960).

(b) Instructions for Space Relations, Numerical Ability, Mechanical Reasoning and Abstract Reasoning:

The physical setting and related preparations were made for group testing. The tests Space Relations, Numerical Ability, Mechanical Ability and Abstract Ability were conducted as per instructions (Form 'A') given in Manual of DAT (Bennett, Seashore, Wesman, 1959).

(c) Instructions for Personality Inventory:

Eysenck's Personality Inventory was administered as per instructions printed on the sheets. First few responses of the students were checked. There was no time limit for this inventory.
(II) Instructions for Semantic Differential Scale for Occupational Choices

The physical arrangements and other conditions for conducting the test were created. The response sheets on which the responses were to be recorded by the sample were distributed to them. They were told to fill in the preliminary informations asked for. Then the sheets, containing the stimulus descriptions marked 'Description of Occupation' for each type of occupations were given to each subject.

They were requested to focus on the response sheets of seven point semantic differential scale with five bipolar adjectives. They were requested to put 1, 2 ......30 numbers with each set of responses. Although the standard instructions were printed on the response sheets but these were explained on the blackboard by giving one example, so that the subjects could understand these clearly.

Following instructions were read out by the investigator while the students were told to read themselves alongwith investigator:

"Below stated you will find some pairs of adjectives, such as interesting or uninteresting; like, dislike, good or bad and so on, you will be given descriptions of various types of occupations to be called description no. 1, 2, 3 ... 30, for each type of description. Please go through each of the description carefully one by one and have the full understanding of the various descriptions and then give your choices to each along the scale for the pair of adjectives by putting ( / ) mark in the respective squares (follow the example)." There are degrees to which you can
react, i.e., 'very interesting', 'quite interesting', 'slightly interesting', 'neutral', 'slightly uninteresting', 'quite uninteresting' and 'very uninteresting'. You have to give your responses for each of the descriptions in the appropriate squares against each description of occupation at appropriate sequence. Try your best to avoid 'neutral' using it only in those cases where it is the only response you have.

I am interested in knowing how do you feel personally and not socially about these occupations. Give your first response. Do it as quickly as possibly you can, of course, you can take your own time."

The reactions of the subjects for the first descriptions were seen to make it sure that they had understood how to do it. If they had done correctly, they were asked to carry with their tasks otherwise they were explained again how to do it. Thus, the responses were obtained for all the thirty descriptions of occupations in the respective sequence number on the response sheet. The data was thus collected for SDSOC. This data of the sample on Intelligence-2 (time and SPM), Aptitude-4 (Space Relations, Numerical Ability, Mechanical Reasoning and Abstract Reasoning), Personality-3 (Extraversion/Introversion, Neuroticism and Lie Scale), Academic Achievements-2 (Internal and External) and Semantic Differential Scale for Occupational Choices-24 (8 groups x 3 levels) yielded 33 scores. This data was used investigating the relationships of among these variables.