CHAPTER - V

EXPERIMENTAL DESIGN

5.1 Introduction

5.2 Pre-requisites to the Formation of Hypothesis

5.3 Formulation of Hypothesis

5.4 Basic Requirements of the Experiment

5.5 Sample Schools

5.6 Formation of Equivalent Groups

5.7 Steps of Design

5.8 Naming of Groups

5.9 Time Allowance
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EXPERIMENTAL DESIGN

5.1 **Introduction:**

The previous chapter dealing with planning and procedure gives the idea of the syllabus of Higher Secondary Education in elements of commerce in std. XI and study of some text-books and other supplementary materials dealing with this subject for Std. XI. Here it is also discussed how this syllabus is imparted to the students through content and techniques. The general and specific objectives and delimitation of the syllabus part selected for the experiment have also been discussed in a greater detail. In the present experiment two types of programme learning approaches
are selected as two different treatments for the same syllabus part. The treatments are controlled by the controlling variables.

5.2 Pre-requisites to the Formation of Hypotheses:

The following questions have been formulated to serve as pre-requisite to the formulation of hypotheses.

1. What happens to the scores of criterion test on Transport and Banking services of students of Std. XI who have studied specially prepared Linear programmes on these topics?

2. What happens to the scores of criterion test on Transport and Banking Services of students of Std. XI who have studied specially prepared Branching programmes on these topics?

3. What happens to the scores when these pupils study the Linear and Branching programmes in the context of controlled variables and in independent variables?

The answers to the above questions are the pre-requisite to the formation of hypotheses for the
5.3 **Formulation of Hypotheses**:

A sound research must make the use of carefully formulated hypotheses. Hypotheses or a hunch can give an idea or suggestion put forward as a starting point for reasoning or explanation. Like objectives, hypotheses have also a definite place in any research work. Mouly has rightly stated,

"It is an explanation of a complex set of data, admittedly tentative and not yet proved." ¹

So it was decided to formulate the following operational forms of hypotheses for the present investigation which could be tested statistically:

1. The eleventh grade students of Linear group would not score significantly higher than those of Branching group controlling IQ, SES, Social maturity, Personality traits and types of adjustments.

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¹ Horace B. English; *A Comprehensive Dictionary of Psychological and Psycho-analytical Terms*, (Longmans, Green and Co.) p. 246
2. The eleventh grade boys students of Linear group would not score significantly higher than girls students of the same group.

3. The eleventh grade boys students of branching group would not score significantly higher than girls students of the Branching group.

4. The eleventh grade boys students of the Linear group would not score significantly higher than the boys students of the branching group.

5. The eleventh grade girls students of the Linear group would not score significantly higher than the girls students of the branching group.

The hypotheses thus formulated have guided the investigator in selection of appropriate method of experiment. For this the researcher had to go through different methods of experimentation. In the field of education the following three methods are most widely used by the researchers.

1. One-group method,
2. Parallel or equivalent group method,
3. Rational group method.
Out of these three methods, the second method i.e. parallel or equivalent group method is widely used because it is convenient in it to control other intervening variables.

Before describing the actual steps of the method it would be in the fitness of the things to consider the basic requirements of the experiment.

5.4 Basic Requirements of the Experiment:

In order to test the hypotheses formulated earlier the following requirements are essential:

1. Representative sample of the population.
2. An appropriate experimental design.
3. Comparative presentation of the programme.
4. Reliable criterion test to measure learning in Transport and Banking services.
5. Scores of criterion tests of the sample.
6. Scores of pre-testing on Transport and Banking services, I.Q., SES, Social maturity, personality traits and adjustments.

The requirement No. 3 is described in the previous chapter. The remaining requirements are described in
the following paragraphs:

5.5 **Sample Schools**:

It was decided to select the schools in such a way that the representative sample of pupils studying in Std. XI of higher secondary schools would be procured for the purpose. The representative sample proves to be immensely helpful in drawing out reliable and valid conclusion. The main purpose of the investigator is to study the effectiveness of the programmes of teaching elements of commerce in general and two topics such as transport and banking services in specific on the students of Std. XI of Kheda district of Gujarat state. Therefore nine schools of the district were selected keeping in view the following criteria:

1. Strength of the school.
2. Area of the School.
3. Only mixed school.

In all nine schools were selected from the district. Four schools were selected from Anand Taluka and five schools were selected within the twenty kms. range. All the nine schools were comparatively found on the same plan so far the academic achievement and
school results in the public examinations are concerned. It is observed that the students of higher and above average generally opt for science stream, students of average and just above average opt for commerce stream and students of below average opt for arts stream.

The students studying in XI commerce stream could be treated as representative and randomized since it was found from the discussion with the heads of the higher secondary schools that the students are generally admitted in the institutions on the 'first come first served' basis. There are no selection criteria for the students except that their desire to be commerce students on the basis of their average and just above average performance on the public examination to be held at the end of X grade by the S.S.C.E. Board. This has been the common practice found in the whole district. There are no specific criteria found to be observed for formation of different classes. Therefore, students who are admitted to the commerce stream are likely to be placed in any division.

Besides this, the sample is also treated as representative of the population. The primary and secondary education in Gujarat state is free, practically
all children from all the strata of the society attend the school and most of the students who are declared successful at the end of secondary stage in the public examination would desire to complete the higher secondary stage by paying nominal fees for this stage. Those who are economically backward have not to pay fees from their pockets but their fees are paid by the government directly. Therefore no students because of the economic constrain would give up their higher secondary study which opens the venue for higher academic studies as well as better jobs at the end of this stage. Hence economic condition is not the barrier for the students who want to continue their study in commerce branch. Hence in this group students belonging to all kinds of economic strata are generally found. Consequently, it could be said that this group is heterogenous from the point of view of status like economic, social and religion.

From the above discussion it becomes evident that the sample is quite representative and members of the groups called 'subjects' are randomly assigned to the classes of Std. XI commerce stream.

Looking to this, it was presumed that the sample
taken represented in all respects the population of the eleventh grade students opting for commerce subjects of higher secondary schools of Kheda district.

5.6 **Formation of Equivalent Groups:**

In order to test five hypotheses of the research an experimental method of equivalent group was contemplated. For the formulation of equivalent group generally two methods are popular, namely Matched pair and matched-groups. Of the two, matched-paired method is possible when the number of the subjects is restricted to 30 or less and number of control variables are not many. For this the investigator has to administer tests on control variables to a fairly large number of students defined population studying in different higher secondary schools and then has to form pairs for experimental purpose making them equal in all the control variables. In the present study there are six control variables and of the six two variables like traits which has been studied into four and adjustment which has been studied into five subsections. It is equally a stupendous task if not possible to prepare matched pairs. For matching groups
the tests of control variables were administered to the subjects of two groups and then means and S.D. were compared. The F ratio are also worked out for each control variable. If the F ratios are well within the random variation and not differing significantly the groups were considered to be matched. Even in this techniques matching of the groups on six main as well as four and five sub-variables of traits adjustment respectively incorporated would be indeed a strupendous task. For this a fairly large sample is needed to be administered upon while matching the groups. In social sciences where data from human beings are collected it is really very tough to have completely matched pairs without any error. Even if pairs evolved out with a lot of extra labour it is equally inconvenient to the school teachers and the Heads of schools to redistribute the students according to the need of the researcher. So the researcher has to resort to such a statistical technique as would help him to take care of all the possible errors and to form two equal groups.

Forming groups as desired would require a sort of manipulation of students for experimental purposes. It is indeed often impracticable to move students from
one teacher to another or from one syllabus to another in order to help the investigator in working out a 'tight' research design. Therefore the researcher must resort himself to the necessity of dealing with 'intact' student-groups on many occasions. It is already discussed previously that the matching operation inevitably reduces the size of the sample. Since many students cannot be properly matched and must be discarded for the analysis.

The use of 'intact groups', of course, poses certain research design problems. In such circumstances, it is advisable to use such a statistical tools as would allow the researcher to exploit the easiest situation and yet would control the errors creeping in. As the researcher has to administer tests on a wider scale and has to drop a large number of students for matching purpose.

Fortunately, a statistical tool of considerable value known as 'Analysis of Covariance' can be employed in just such instances where a researcher cannot afford to administer tests of predictor variables to a sufficiently large sample and then drop out the subjects who do not match. This technique is an extension of the 'Analysis of variance model' combined with certain
features of 'Regression analysis'. It provides a useful statistical device for educational investigations.

"Analysis of covariance may be used when relationship is being studied between a dependent variable and two or more groups representing an independent variable. This powerful technique allows the researcher to statistically equate the independent variable groups with respect to one or more variables which are relevant to the dependent variable". To put in another way,"analysis of co-variance allows the researcher to study the performance of several groups which are unequal with regard to an important variable as though they were equal in this respect."²

This powerful technique has important implications for educational researchers since it permits the use of 'intact student groups' still the controlling variables might otherwise confound the results of investigation.

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In the light of above discussion the researcher decided to use analysis of co-variance statistical technique to overcome the possible hazard in equating the groups.

After deciding this the experimenter took up the school classes for two different treatment techniques such as Linear and Branching as shown in the table 5.1. on the following page.
TABLE 5.1
SCHOOLS AND NUMBERS OF STUDENTS INCLUDED IN LINEAR AND BRANCHING GROUPS

<table>
<thead>
<tr>
<th>No.</th>
<th>Name of Schools</th>
<th>Number of subjects in Linear Group</th>
<th>Number of subjects in Branching group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Boys</td>
<td>Girls</td>
</tr>
<tr>
<td>1.</td>
<td>D.N. Higher Sec. School</td>
<td>10</td>
<td>-</td>
</tr>
<tr>
<td>2.</td>
<td>Pioneer Higher Sec. Sch.</td>
<td>06</td>
<td>10</td>
</tr>
<tr>
<td>3.</td>
<td>Anand Higher Sec. School</td>
<td>05</td>
<td>11</td>
</tr>
<tr>
<td>4.</td>
<td>B.R.L. High School, Nar</td>
<td>09</td>
<td>08</td>
</tr>
<tr>
<td>5.</td>
<td>M.L. Patel Higher Secondary School, Shihol</td>
<td>08</td>
<td>08</td>
</tr>
<tr>
<td>6.</td>
<td>V.B. Patel Higher Sec. School, Sunav</td>
<td>12</td>
<td>07</td>
</tr>
<tr>
<td>7.</td>
<td>Sarsa Higher Sec. School Sarsa.</td>
<td>06</td>
<td>08</td>
</tr>
<tr>
<td>8.</td>
<td>T.V. Patel Higher Sec. Complex, V. Vidyanagar</td>
<td>08</td>
<td>09</td>
</tr>
<tr>
<td>9.</td>
<td>Sarda Mandir Higher Sec. School, Ode.</td>
<td>05</td>
<td>08</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>69</td>
<td>69</td>
</tr>
</tbody>
</table>
The steps followed after the formation of Linear and Branching groups are given below:

5.7 Steps of Design:

To ascertain whether specially constructed programmes of Learning of Transport and Banking Services would be equal by two different approaches like Linear and Branching, the investigator followed the steps with a little modification suggested by Van Dalen.

1. Test the groups on dependent variable (scores on achievement in learning the curriculum of Transport and Banking services) and find out the mean of pre-test scores for both the groups undertaking two different treatments. \(X_{1}^{L}\) for Linear programme and \(X_{1}^{B}\) for Branching programme.

2. Keep all conditions identical for the groups except for exposing the subjects of two separate groups to unidentical programes in techniques. (Two identical matched-groups matched on various control variables; one is taking Linear treatment and the other is taking Branching treatment).
3. Test the groups on dependent variable and find the means of post test scores of the groups controlling control variables in turns. (Y_L criterion test scores in achievement in Transport and Banking services of Linear group and Y_B criterion test scores in achievement in Transport and Banking services of Branching group).

4. Find the mean differences between X_1^L and X_2^B and Y_L and Y_B for each replication controlling control variables in turn. (Here F ratio of Analysis of covariance of D_L and D_B should be brought forth).

5. Compare D_L and D_B to determine whether the application of X caused a significant change in Linear groups' scores as compared with the Branching groups' scores.

6. Apply an appropriate statistical procedure to ascertain whether difference in the scores is significantly great to be a real different or whether it is only a chance occurrence.

All these steps can be depicted as follows:
5.8 Naming the Groups:

In the present experimental design, there are two types of treatments: Linear programmed-method and Branching programmed-method, which were given to the groups. Basically both the groups received either of

<table>
<thead>
<tr>
<th>Group</th>
<th>Pre-test</th>
<th>Treatments</th>
<th>Post-test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linear</td>
<td>$X_1^L$</td>
<td>Linear</td>
<td>$Y^L$</td>
</tr>
<tr>
<td>Branching</td>
<td>$X_1^B$</td>
<td>Branching</td>
<td>$Y^B$</td>
</tr>
</tbody>
</table>

The investigator followed the above steps suggested by Van Dalen\(^3\) with a little modification. He took all the necessary precautions and exactness required for conducting the experiment. With this fundamental concept of the design in mind the investigator conducted the experiment to test the hypotheses mentioned earlier in this chapter.

5.9 **Time Allowance and Other Particulars**:

In fixing up the time allowance, the investigator administered the programmes to a few students randomly selected and noted down their observations and time taken. The total time for each of the programmes was on an average of six hours.

The programme administration work was scheduled in the consultation with the experts and school authorities that it should be given between Monday and Friday and generally in the early hours of school time. The students included in the programme were assigned comfortable seats and do not offering any inconveniences. It was checked that while taking programme students should not exchange any view with his or her fellow student.

The head masters and teachers and students were found most co-operative.