situated, membership of voluntary organizations, the
type of the schools children studied, savings etc. which
also add to socio-economic status, have been left out
in these scales.

In the present investigation a modified form
of Dev Mohan socio-economic status scale (1972) developed
at the Panjab University, Department of Education,
Chandigarh was used. This scale suitably was revised
by the investigator to include certain important areas
which were not covered in the original scale. The need
to modify the existing scale was felt by the investigator
in the context of increasing population of the city,
increase in the number of schools, colleges, industries
and rapid developments taking place in this urban area.

The scale is designed to measure socio-economic
status of urban families. It collects informations about
the following component variables:

1. Occupation of the family members.
2. General education of the members of the family.
3. Economic Indicators—Monthly income of the
   family, and the income of other relations
   living with the family, average income, if any,
   of the family from sources other than the
   occupation of family members.
4. Cultural Indicators—Types and number of news-
   papers/magazines and their frequency, membership
   of clubs, societies, organizations, participation
in social gatherings like parties, fêtes, picnics, cultural programme, tours, theaters etc.

5. Psychological Indicator- Types of colony, type of general thinking of others about your family, belief in caste and mobility, leisure time activities, social attitude etc.

The scale (Appendix A6) contains 13 items. Each item is provided with a number of alternatives, this number varies from item to item. The subjects are required to fill in the particulars concerning their bio-data (Name, age, Sex, class/year, section, Roll No., college/school, Residence, date etc.) before they write anything on the sheet. They are instructed to read the items carefully and write their response on the dotted space (———) against every question. In case of more than one choice, they are required to tick (/) the one or more that apply the most to them. It is also made clear to the subjects in the very beginning that the information obtained through this scale will be kept confidential and will be used entirely for the research purposes. They are also to reply every question frankly and sincerely.

Each item in the socio-economic status scale is divided into number of sub-items. The first item relates to the number of family members and other relations staying with the family. The second and the third items
relate to information about the academic qualifications and profession of the family members of the subjects respectively. Item number four asks for the family income. Item number five relates to the information about the landed property. Item number six enquires about the modes of conveyance etc. possessed by the family members. Item number seven seeks information about the type of accommodation they are living in. Item number eight enquires if the members of their family are member of any club and arrange or participate in social gatherings. Item number nine asks whether their parents entertain or invite guests while item number ten enquires whether the family goes out for trips or tours in vacations. Item number eleven serves the purpose of getting information about the various luxury items possessed by their family. Item twelve seeks information about the hostel expenses if any, the subjects residing in the hostels incurring. The last item i.e. item number thirteen enquires whether they have a library at home and read news papers and magazines.

3.1.1

SCORING OF THE SOCIO-ECONOMIC STATUS SCALE

The scoring of the socio-economic status scale is done by following the scoring key (Appendix A). Each item requiring 'yes' or 'no' response is scored by giving a score of (1) to 'yes' and (0) to 'no'. Each alternative in a particular item carries a specific
score. The grand total for a particular subject is obtained by adding up the scores against his tick marks. This grand total determines the socio-economic status of the testee.

3.1.2

RELIABILITY OF THE SOCIO-ECONOMIC STATUS SCALE

For the purpose of present investigation the reliability of the scale was calculated by using test-retest method with a short interval of 15 days. The scale was given to 50 students from a college in Chandigarh. The coefficient of correlation was found to be quite high i.e. .91 which compares favourably with Dev Mohan socio-economic status scale (1972) test-retest reliability coefficient of .93.

3.1.3

VALIDITY OF THE SOCIO-ECONOMIC STATUS SCALE

The scale has content validity as the items included in the scale are framed as a result of suggestions, interviews and discussions with the experts, people and the Heads of certain institutions. Thus, the universe of the concept was widely covered.

3.2

LEVEL OF ASPIRATION TASKS

Frank (1935) demonstrated significant correlation coefficients between various laboratory level of aspiration tasks and from his experiments he concluded that level of aspiration represents a relatively
permanent characteristic of the personality and that this performance can be demonstrated regardless of the type of ability which the task requires. Mohanty (1974) has also pointed out that level of aspiration does not change with varying tasks of situations.

In the present investigation three level of aspirations tasks were used for measuring the level of aspiration of the subjects namely - letter cancellation test, digit symbol substitution test and computation task. These tasks were designed and developed following mostly the lines of Muthayya, B.C. who used these tasks in his 1959 study. These tasks have been widely used in the field of educational and psychological researches in India and abroad. Mohanty (1974, 76, 78), Ali (1978) used one or more of these tasks in their studies and found them to be reliably measures of level of aspiration.

The details of these tasks are discussed as follows:

3.2.1 LETTER CANCELLATION TEST

This test (Appendix-A) consists of 40 rows of letters of the English alphabet arranged at random in each row without any sequence and proper meaning. The subject is required to write his particulars pertaining to the name of school/college, his own name, class section and age etc. on the title page which bears the time limit also.
The subject has to cross out all the 'a's and 'i's by a horizontal stroke. In each row the number of 'a's and 'i's ranges from 4 to 8. There are 151 'a's and 112 'i's making a total of 263 'a's and 'i's on the sheet. The subject is to proceed systematically line by line down the sheet. His score is the number of letters crossed out within the time limit. If he leaves out any letter in a line, it is deducted from his total score for the trial. The score on this test thus varies from 0 to 263. In addition, the subjects are required to write their aspiration score (aspired score) in the space specified for the purpose. After each trial their sheets are evaluated by the investigator and their obtained score is written in the box meant for the purpose.

3.2.2

COMPUTATION TASK

This task (Appendix -A4) consists of adding single digits. There are fifteen rows, each row having ten digits. For each trial the subject has to add fifteen rows correctly and put the total at the bottom of the each row on the sheet. If the answer is wrong it is not counted for the total score. The time limit for each trial is 60 seconds. The subject's score for each trial would be the number of rows, out of 15 added correctly. The score range here is 0 to 15. Five trials are given preceded by one practice trial.
3.2.3

DIGIT-SYMBOL SUBSTITUTION TEST

This task (Appendix-A_3) consists of two sheets. On the front sheet the subject is required to give his particulars regarding his name, name of the school/college, class, section and age. The time limit is also indicated on the front sheet. On the second sheet there are six rows of digits, each row consisting of 20 digits. The subject has to substitute the digits by proper symbols by looking into the key given at the top of the sheet. The time limit is 60 seconds. The subject is required to enter his aspiration score (aspired score) in the box provided on the top left corner of the sheet. Thus the subject is made to write his aspiration score rather than the usual method of telling the aspiration score to the experimenter, in order to avoid the subjective factors which may hinder his free expression.

The subject's score for each trial is the number of digits he substitutes by correct symbols within the prescribed time limit. The correctness of symbols reproduced by the subject is determined by their gross resemblance to those provided in the key. The score range in this task is 0 to 120. Error, if any is deducted from the total score of the trial. Five trials were given preceded by one practice trial (as explained in the previous chapter). The score is counted
by the investigator after the every trial. This obtained score is written in the obtained score box at the bottom of the page.

3.2.4

RELIABILITY OF THE LEVEL OF ASPIRATION TASKS

Previous researches have established the reliability and validity of the three level of aspiration tasks used in the present investigation. It has been reported in a number of studies related to level of aspiration experiments that, digit symbol substitution test, computation task and letter cancellation tasks are fairly reliable and valid measures of level of aspiration (Muthayya, 1959, Mohanty, 1976).

Muthayya (1959) asserts that the test-retest method of finding out reliability is considered to be best in this type of testing. The following table shows the correlation coefficients of the three tasks as calculated by test-retest and split-half methods in Muthayya’s, (1959) study.

<table>
<thead>
<tr>
<th>Task</th>
<th>Test - Retest</th>
<th>SPLIT HALF</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1st testing</td>
<td>2nd testing</td>
</tr>
<tr>
<td>1. Symbol Digit</td>
<td>.18</td>
<td>.84</td>
</tr>
<tr>
<td>2. Letter cancellation</td>
<td>.78</td>
<td>.91</td>
</tr>
<tr>
<td>3. Computation</td>
<td>.84</td>
<td>.90</td>
</tr>
</tbody>
</table>

TABLE -23
TEST- RETEST AND SPLIT HALF RELIABILITY COEFFICIENTS OF LOA TASKS (MUTHAYYA, 1959)
Reliability of the three level of aspiration tasks used in the present investigation was calculated by split-half method. In the split half method the splitting was done in terms of odd/even trials. Goal discrepancy scores formed the essential data for the purpose.

**TABLE -24**

<table>
<thead>
<tr>
<th>Task</th>
<th>Split half reliability</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Letter cancellation</td>
<td>.85</td>
</tr>
<tr>
<td>2. Digit-symbol substitution</td>
<td>.90</td>
</tr>
<tr>
<td>3. Computation</td>
<td>.77</td>
</tr>
</tbody>
</table>

The above results show that the goal discrepancy scores obtained through three level of aspiration tasks used in the present study are quite reliable. The range of reliability co-efficient varies from 0.77 to 0.90. The results compare favourably with those of Muthayya's Madras study (Muthayya, 1959). All these coefficients lead us to belief that the tasks used are reliable and the procedure adopted to measure level of aspiration is also reliable.
3.2.5

VALIDITY OF LEVEL OF ASPIRATION TASKS

Validity of the three level of aspiration tasks was determined by calculating the product moment inter-correlation between the goal discrepancy scores of subjects on the three tasks.

TABLE -25

PRODUCT MOMENT INTER-CORRELATION OF THREE LEVEL OF ASPIRATION TASKS

<table>
<thead>
<tr>
<th>Task</th>
<th>Letter cancellation</th>
<th>Digit-symbol substitution</th>
<th>Computation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Letter cancellation</td>
<td></td>
<td>.72</td>
<td>.79</td>
</tr>
<tr>
<td>Digit-symbol substitution</td>
<td></td>
<td></td>
<td>.69</td>
</tr>
<tr>
<td>Computation</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

It can be observed from the table that coefficient of correlation between the GDS of subjects on letter cancellation and digit-symbol substitution was found to be .72 and coefficient of correlation between the GDS on letter cancellation and computation tasks was calculated to be .79. However, the coefficient of correlation between digit-symbol substitution and computation was .69.

All the above coefficients of correlation suggest that the level of aspiration tasks used in the present investigation were sufficiently valid.
CHAPTER ... FOUR

DESIGN OF THE

STUDY
CHAPTER FOUR

DESIGN OF THE STUDY

The main purpose of the present investigation was to study the effect of level of aspiration and socio-economic status on performance in a linear programme. Thus, it was necessary to construct a suitable research design or specification of operations for testing hypotheses.

This chapter therefore discusses the plan for experimentation, the methodology and procedure adopted including the nature of the sample and the experimental design followed for verification of hypotheses and the statistical techniques employed.

4.1

METHODOLOGY In the present investigation experimental method was followed since the main purpose of the researcher was to study the relationship between different variables. From operational point of view, experimentation is a matter of varying the independent variable in order to study the effect of such variation on the dependent variable. Variables may also be called as factors.
Independent variable is that factor which is measured, manipulated, or selected by the experimenter to determine its relationship to an observed phenomenon (Tuckman, 1972). An independent variable used in an experiment may be either a treatment variable or a classification variable (Ferguson, 1971). A treatment variable involves a modification which is controlled by the experimenter. This involves direct control since in this case the experimenter deliberately manipulates a treatment variable by setting its levels at pre-determined values for groups of experimental subjects.

Classification variables on the other hand can not be manipulated but must be accepted by the experimenter in their modified form. These classification variables are usually attributes of subjects of different level of intelligence, sex and grade etc.

This categorisation of variables although is important from the design point of view but is irrelevant as far as statistical analyses are concerned. The effectiveness of the treatment is determined by the amount of attainment recorded by the subjects. The criteria by which a particular condition or treatment is evaluated are called dependent variables (Fox, 1963). Thus the dependent variable is that factor which is observed and measured to determine the effects of the independent variable.
In the present study, level of aspiration and socio-economic status of subjects are the independent variables and measures of students' achievement scores on the criterion test were used as dependent variable.

Factorial experiments are those experiments which are designed to study the effects of two or more independent variables simultaneously. Within the factorial design, it is possible to assess the effect of each independent variable separately as well as their joint or simultaneous effects (Tuckman, 1972). In this study, a factorial experiment with two factors viz., level of aspiration and socio-economic status having three levels each was employed.

4.2

*DIMENSIONS AND LAY OUT OF THE DESIGN* The dimensions of a factorial design refer to the number of factors and the number of levels within each factor. As already mentioned independent variables are called factors and the number of ways in which a factor is varied is called the number of levels of the factor. In the present experiment the first factor is socio-economic status which varied in three ways viz., high, average and low socio-economic status. The second factor is level of aspiration which also varied in three ways viz., high, average and low level of aspiration.
A factorial design is labelled in terms of the number of levels of the factors involved. The present factorial experiment may, thus, be termed as $3 \times 3$ factorial experiment. For simplicity and clarity, the two factors have been abbreviated as SES (socio-economic status) and LOA (level of aspiration). It may also be mentioned that the codes H, A and L were used to represent high, average and low levels of socio-economic status and level of aspiration respectively. The $3 \times 3$ factorial design is schematically represented in Table-26.

**Table-26**

**Schematic Representation of the $3 \times 3$ Factorial Design**

![Diagram of $3 \times 3$ factorial design]

It may be inferred from the table-26 that three levels of SES (socio-economic status) and three levels of LOA (level of aspiration) have been used in the present experiment. Therefore, in all nine treatment combinations were obtained as shown in Table-27.
### TABLE-27

**TREATMENT COMBINATIONS OF 3 x 3 FACTORIAL DESIGN**

<table>
<thead>
<tr>
<th></th>
<th>HLOA</th>
<th>ALOA</th>
<th>LLOA</th>
</tr>
</thead>
<tbody>
<tr>
<td>HSES</td>
<td>HSES</td>
<td>HSES</td>
<td>HSES</td>
</tr>
<tr>
<td>HLOA</td>
<td>ALOA</td>
<td></td>
<td>LLOA</td>
</tr>
<tr>
<td>ASES</td>
<td>ASES</td>
<td>ASES</td>
<td></td>
</tr>
<tr>
<td>HLOA</td>
<td>ALOA</td>
<td></td>
<td>LLOA</td>
</tr>
<tr>
<td>LSES</td>
<td>LSES</td>
<td>LSES</td>
<td></td>
</tr>
<tr>
<td>HLOA</td>
<td>ALOA</td>
<td></td>
<td>LLOA</td>
</tr>
</tbody>
</table>

4.3 **SAMPLING**

Research is invariably conducted by means of a sample drawn from the accessible population on the basis of which generalizations are drawn and made applicable to the target population as a whole.

The target population, in the present study covered all the biology students of Higher Secondary Part II classes in English medium schools and Prep-Medical classes in all the colleges of Chandigarh. Owing to obvious constraints of the field situation, it was not considered feasible to encompass the entire accessible population. Accordingly, the sample was drawn from two colleges, two central schools and two girls' Higher Secondary schools in Chandigarh.
These schools and colleges were selected randomly. Random samples may be defined as those drawn in such a way that there is no reason to believe that bias will result, and that every case in the population has an equal chance of being selected (Rummel, 1958).

For random sampling in the selection of experimental population, lottery method was followed. Though errors in the sampling, random or systematic, can not be completely eliminated, every possible effort was made to reduce them by increasing the size of the sample and also by randomising it.

Garrett (1971), contends that if we draw samples at random from the population, we know atleast that (a) there will be no consistent biases; (b) on the average these samples will be representative; (c) the degree of discrepancy likely to occur in any given sample can be determined by probability methods. Again, random selection is appropriate for data analysis which includes the use of inferential statistics (Fox, 1969).

The sample was chosen with the under-lying assumption: Other things being equal the larger the sample, the greater the precision and accuracy of the data it provides (Mouly, 1964).
TABLE-28

STRUCTURE OF THE SAMPLE IN RESPECT OF CLASS, AVERAGE AGE, AND SCHOOLS/COLLEGES SELECTED FOR THE EXPERIMENT

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Name of School/College</th>
<th>No. of students</th>
<th>Average age</th>
<th>Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Kendriya Vidyalaya Sector-47</td>
<td>33</td>
<td>16</td>
<td>XI</td>
</tr>
<tr>
<td>2.</td>
<td>Kendriya Vidyalaya Sector-31</td>
<td>17</td>
<td>16.5</td>
<td>XI</td>
</tr>
<tr>
<td>3.</td>
<td>Govt.girls Higher Secondary School Sector-18</td>
<td>6</td>
<td>16</td>
<td>XI</td>
</tr>
<tr>
<td>4.</td>
<td>Govt.girls Higher Secondary School Sector-20</td>
<td>7</td>
<td>16</td>
<td>XI</td>
</tr>
<tr>
<td>5.</td>
<td>D.A.V.College for men Sector-10</td>
<td>117</td>
<td>16.5</td>
<td>Prep-Medical</td>
</tr>
<tr>
<td>6.</td>
<td>S.G.C.S.College Sector-7</td>
<td>70</td>
<td>16.5</td>
<td>Prep-Medical</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>250</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

It may be observed from the table-28 that the average age of students in all the institutions ranged between 16 to 16.5 years. The number of girls and boys included in the experiment was equal i.e. 125 girls and 125 boys.
Out of the four schools selected for the study, two were co-educational and the remaining two were exclusively for girls. And out of the two colleges one college was for men and other was co-educational. The total number of subjects was 250.

It was ensured from the Heads of the institutions that any of the criteria of merit or socio-economic status was not made the basis of the formation of sections.

4.4

ADMINISTRATION OF SOCIO-ECONOMIC STATUS SCALE

To begin with all the 250 students drawn from the six institutions were given socio-economic status scale. The sheets were evaluated and scored with the help of a key. The raw scores of the socio-economic status scale were taken into consideration for classifying the students into high, average and low socio-economic status groups. The socio-economic status scale and the procedure for its administration has already been discussed in details in the previous chapter.

Kelley's (1939) formula of 27 per cent top and 27 per cent bottom students was applied for dividing the students into three socio-economic status groups, but within these levels the subjects were assigned to the experimental conditions by randomization.
4.5

ADMINISTRATION OF LEVEL OF ASPIRATION TASKS

In order to classify the students into high, average and low aspiration groups, all the students were administered three levels of aspiration tasks.

The level of aspiration tasks were administered individually by the investigator himself with a regular interval of a few minutes between each task.

The testing was done individually and a standard procedure (Frank, 1935) was followed in the administration of each task. Each task was explained and all necessary instructions were given to each student individually. The students were allowed some practice trials. The practice trials consisted of one trial in each of the three tasks.

After a student had acquainted himself with the task, he was told to begin with the actual trials. The time limit for each task was one minute or 60 seconds. After being informed of his obtained score on the first trial, the subject was asked to predict his performance on the next trial (aspired score).

The experimental question used to elicit the subject's estimate for the next trial or aspired score was, "What score are you going to make in the next trial?"
This question was made clear to the subjects by giving practical examples before actual trials were started. The question was repeated after every trial. Five trials on each task were given to each student.

The level of aspiration measure used was Goal Discrepancy Score (the discrepancy between the individual's expressed level of aspiration and his immediately preceding performance). The subject's performance on each trial was subtracted from his stated aspiration for the immediately following trial to obtain goal discrepancy score. These differences were then averaged over all trials on each task for each subject to obtain mean goal discrepancy score (GDS) for each subject on each task. Further, the mean goal discrepancy score on the three level of aspiration tasks was then calculated for each subject (Appendix-Bg).

The mean goal discrepancy score on the three level of aspiration tasks formed the raw scores which were utilized in order to classify the subjects into high, average and low level of aspiration groups. As already mentioned Kelley's (1939) formula of 27 per cent top and 27 per cent bottom students was applied for dividing students into three level of aspiration groups. Within these levels the subjects were assigned to the experimental conditions by randomization.
<table>
<thead>
<tr>
<th>No. of students</th>
<th>High (HLOA)</th>
<th>Average (ALOA)</th>
<th>Low (LLOA)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>67</td>
<td>116</td>
<td>67</td>
<td>250</td>
<td></td>
</tr>
</tbody>
</table>

The table-29 indicates the composition, of sample in respect of level of aspiration. The subjects were divided into three levels of aspiration on the basis of their mean goal discrepancy scores on all the tasks applying Kelley's formula. The high and low level of aspiration groups consisted of 67 students each while average level of aspiration group had 116 students, out of the total number of 250 students.

4.6 EXPERIMENTATION

The present experiment based upon 3 x 3 factorial design was conducted on a sample of 250 students including both boys and girls equal in number. These subjects were then classified into three level of aspiration and socio-economic groups. Finally, nine treatment combinations were obtained for the conduct of the present experiment.
The layout of the experiment including the composition of the subjects in each treatment group, is schematically explained in the following diagram.

<table>
<thead>
<tr>
<th></th>
<th>HLOA</th>
<th>ALOA</th>
<th>LLOA</th>
</tr>
</thead>
<tbody>
<tr>
<td>HSES</td>
<td>20</td>
<td>27</td>
<td>20</td>
</tr>
<tr>
<td>ASES</td>
<td>28</td>
<td>46</td>
<td>36</td>
</tr>
<tr>
<td>LSES</td>
<td>20</td>
<td>36</td>
<td>17</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>68</strong></td>
<td><strong>109</strong></td>
<td><strong>79</strong></td>
</tr>
</tbody>
</table>

**Factorial Design**

3 x 3

Sample
(125)

Socio-Economic status

HSES  ASES  LSES

HLOA  ALOA  LLOA  HLOA  ALOA  LLOA  HLOA  ALOA  LLOA

(15)  (15)  (15)  (15)  (15)  (15)  (15)  (15)  (15)
<table>
<thead>
<tr>
<th></th>
<th>HLOA</th>
<th>ALOA</th>
<th>LLOA</th>
</tr>
</thead>
<tbody>
<tr>
<td>HSES</td>
<td>15</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>ASES</td>
<td>15</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>LSES</td>
<td>15</td>
<td>15</td>
<td>15</td>
</tr>
</tbody>
</table>

Total sample size = 135

It is evident from table-30 that the total sample size came out to be 135 for the final analysis. It may also be observed from the table that each cell in the final analysis consisted of 15 students. These 15 students for each cell were taken out of the sample structure shown in table-29. These subjects were randomly selected for the final analysis from the various treatment combinations made on the basis of level of socio-economic status and level of aspiration.

Before the administration of the programmed material, appropriate rapport was established with the subjects. They were also given to understand that the purpose of the study was to examine certain research issues pertaining to the process of learning.
and not an evaluation of their performance. However, they were urged to work meticulously so that useful information could be gathered for the study.

The students were briefly acquainted with the method of learning through the programmed material. They were informed that they were going to learn the process of vegetative reproduction in plants through a new method of teaching. They were also told in the beginning that the content had been broken into small steps and that each step, called a frame, followed on logically from the preceding frame so that it was easy to understand the content. Since learning through programmed material was a new experience for the subjects, they exhibited lot of interest in it and remained attentive throughout the experiment.

It may also be mentioned that before the conduct of the experiment, it was made sure that the students had not studied the same content in their usual classroom teaching schedule. For this the Heads of the biology departments and the concerned teachers in respective schools/colleges were consulted.

Precautions were also taken to ensure that the extraneous factors did not affect the result. An attempt was also made to control the
intraprocedural factors which could add an element of bias and thereby contaminate the treatment effects. The five sources of bias mentioned by Fox (1963), as follows, were duly considered in the present experiment.

- The Experimenter or His Agent: The attitude of the experimenter or his associates may affect the treatment effects differently. They may also create "Hawthorne effect". This effect refers to performance increments prompted by more inclusion of the workers (or teachers) in an experiment (Tuckman, 1972). This source of bias was controlled by seeking co-operation of those teachers who were not aware of the concept of programmed instruction and the biological concepts which were programmed.

- Measuring Devices Employed: The new sets of measuring devices employed in the experiment could avoid the effect related with this source of bias.

- Leakage or Dilution of Independent Variable: It was controlled by arranging the experiment in two or three separate rooms (depending upon the number of students) so that the subjects might not show curiosity for others. The subjects were also given to read the programme in rather a formal situation.

- The Experimental Conditions: The experimental conditions were kept similar in all the institutions and the investigator along with his colleagues
made every possible effort to keep strict vigilence throughout the experiment.

- The Experimental Process: The bias resulting from the experimental process itself was controlled by keeping experimental conditions similar in all the settings.

- Internal Validity of the Experiment: A study has internal validity if the outcome of the study is a function of the programme or approach being tested rather than the result of other causes not systematically dealt within the study (Tuckman, 1972).

The process of conducting an experiment, exercising some control over the environment, contributes to internal validity. For an experiment to have internal validity the researcher must establish experimental control that will enable him to conclude that differences occur as a result of experimental treatments. Every effort was made to control following extraneous variables, described by Tuckman (1972). The seven classes of extraneous variables are outlined as under:

History: In research, the term "history" refers to specific external events beyond the control of the researchers, taking place during experimentation which may have stimulating or disturbing effect upon the performance of the subjects. Thus besides the independent variable under study these also
affect the changes in the dependent variable.

Limitations on internal validity by virtue of history were dealt with by providing the same external or historical experiences to all the treatment groups. Further, materials, conditions and procedures used within the experiment were almost identical in all the settings.

**Maturation:** Maturation refers to the process of changes that take place within those persons who are participating in the experiment. This extraneous variable was automatically controlled since the experiment in a particular institution lasted only for two-three days.

**Testing:** Testing applies to the effects of taking a pre-test on the subsequent post-test performance of individuals. In the present study, pre-test had no effect on the subsequent post-test performance since the subjects had no knowledge of the concepts while taking the pre-test.

**Instrumentation:** Instrumentation pertains to changes that occur in the measurement or observation procedures during an experiment. While the measuring instrument will not undergo a change during the course of an experiment, it is not unlikely that observers and scorers may change their manner of data collecting and recording as the experiment proceeds.
This risk was avoided by securing the services of those observers who were not aware of the concept of programmed learning.

**Statistical Regression:** Statistical regression refers to tendency on any post-test measurement for the higher scores to decrease towards the mean, and of the lower scores to increase towards the mean. Such a problem of statistical regression occurs only when groups are chosen on the basis of extreme scores on a particular variable.

**Experimental Mortality:** Experimental mortality was almost nil since the experiment was conducted for a short duration of two-three days in a particular institution. However, to avoid experimental mortality, reasonably large groups were taken up for experimentation and their representativeness was assured by randomisation.

**Stability:** Bias due to stability implies a tendency for a finding to be unreliable, i.e. to occur once but not thereafter. This difficulty was met by examining the data through the use of 'F' test which is reliable.

4.7

**Experimental Procedure**

First of all the level of aspiration tasks were administered individually to each subject in all the institutions selected for conducting the experiment. The procedure
followed for administration and scoring of these tasks has been explained in the previous section of this chapter. The details of the time spent on administration of level of aspiration tasks is given in table-31.

**TABLE-31**

TIME TAKEN TO COMPLETE THE ADMINISTRATION OF THREE LEVELS OF ASPIRATION TASKS

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Name of School/ College</th>
<th>No. of Time spent on LOA Tasks Adm.</th>
<th>No. of sessions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Kendriya Vidyalaya Sector-47</td>
<td>33 6.25 hrs</td>
<td>2</td>
</tr>
<tr>
<td>2.</td>
<td>Kendriya Vidyalaya Sector-31</td>
<td>17 4.25 hrs</td>
<td>1</td>
</tr>
<tr>
<td>3.</td>
<td>Govt. girls H/S School Sector-18</td>
<td>6 1.50 hrs</td>
<td>1</td>
</tr>
<tr>
<td>4.</td>
<td>Govt. girls H/S School Sector-20</td>
<td>7 1.75 hrs</td>
<td>1</td>
</tr>
<tr>
<td>5.</td>
<td>D.A.V. College for men Sector-10</td>
<td>117 29.25 hrs</td>
<td>7</td>
</tr>
<tr>
<td>6.</td>
<td>S.G.G. College Sector-7</td>
<td>70 17.50 hrs</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>250 62.50 hrs</td>
<td>16</td>
</tr>
</tbody>
</table>
It may be observed from the table-31 that 62-50 hours were spent on the administration and scoring of three level of aspiration tasks spreading over sixteen sessions. The length of the session depended upon the number of students in a particular college/school. It ranged between 1-4 hours per session.

The administration of three level of aspiration tasks was followed by the administration of the socio-economic status scale. The socio-economic status scale was administered to all the subjects. For this whole class/section in a particular school or college was taken and after thorough instructions, the students were given socio-economic status scale, which they were required to fill in independently without discussing with their colleagues. The average time taken by students to complete the scale ranged between half an hour to one hour. The scoring of the socio-economic status scale was done by the investigator himself following the key for scoring.

After completing the administration and scoring of three level of aspiration tasks and socio-economic status scale, the third phase of experimental procedure started which encompasses
the administration of the programmed material.
For this services of one person, who was given
training for the job in hand, were utilized. For
effective and smooth administration, help of the
teachers from the same school/college was also
sought, if, required.

Before exposing the subjects to the
programmed material, pre-test was administered.
The purpose of giving the pre-test was to assess
the subjects' initial knowledge, if any, in the
content being taught. This was followed by
administration of the programme. The subjects were
asked to read the instructions carefully printed
in the programmed text before going through the
programmed material. Each subject was allowed to
proceed at his own pace. Proper supervisions was
done to ensure that the process was free from
cheating conditions. Average time taken by the
students to complete each unit of the programme was
recorded. In order to avoid the factors of fatigue,
length and boredom, the students in all the schools/
colleges were required to work with the programme only
for two hours in one sitting. They were given an
interval of five minutes after one hour to relax
in all the experimental settings. At the end of
the duration of two hours the texts were taken back
from the students and kept in safe custody in the
school/college. The same process was repeated the
next day.

In the end when all the students had completed the programme, the post-test was administered to the subjects. This was done to see how much the students had gained as a result of teaching through programmed instruction.

The same process was followed for administration of programmed text in different schools and colleges. However, the number of days spent in completing the programme was different in different institutions because of the varying number of subjects in the class.

**Table-32**

**Total average time taken to complete the programme and total number of days spent on experimentation**

(TOTAL NO. OF FRAMES = 379).

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Name of School/college</th>
<th>No. of students</th>
<th>Average time taken Hours/minutes</th>
<th>No. of days lasted for completion of experiment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Kendriya Vidyalaya</td>
<td>33</td>
<td>4.40</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Sector-47</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Kendriya Vidyalaya</td>
<td>17</td>
<td>4.54</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Sector-31</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Govt. girls H.S</td>
<td>6</td>
<td>4.34</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>School, Sector-18</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>Govt. girls H/S</td>
<td>7</td>
<td>4.50</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>School, Sector-20</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>DAV college for men</td>
<td>117</td>
<td>4.36</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Sector-10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>S.G.G.S. college</td>
<td>70</td>
<td>4.40</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Sector-7</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
It may be observed from the table-32 that average time taken to read the programme in respective institutions ranged from 4.34 hours to 4.54 hours. Further, the table shows that the experiment in all the six institutions, lasted twenty two working days.

The criterion test scripts were scored by the investigator for collecting the data for further statistical analyses. The various statistical techniques employed to interpret the data obtained as a result of treatments given to experimental groups are provided in the following pages.

4.8

**ANALYSIS OF VARIANCE**

In the present study, factorial design was modelled. The technique of analysis of variance was used for interpreting the data obtained as a result of treatment given to the experimental groups.

The analysis of variance is a method for dividing the variation observed in experimental data into different parts, each part assignable to a known source, cause or factor. We may assess the relative magnitude of variation resulting from different sources and ascertain whether a particular part of the variation is greater than expectation under the null hypothesis (Ferguson, 1971).
Analysis of variance is a composite test that gives an over-all idea about the significance of difference between means. The main characteristic of this technique is that variances can be simultaneously analyzed into two components; the mean of the variances within the group, and the variance of the group means (between group variance). Analysis of variance also makes it possible to study the interaction effects which are ascribable to none of the factors operating singly but to conjoint effects of the factors acting together.

Thus this statistical technique made it possible to study the main effects and the interaction effects of the two factors included in the present study. For studying the main effects of the level of aspiration (A), Socio-Economic Status (B) and the interaction effects of A X B, multifactor analysis was applied to find (i) whether level of aspiration variable affects the performance of subjects on a programmed material, (ii) whether socio-economic status of students has any effect on performance on programmed instruction; (iii) whether the two variables, level of aspiration and socio-economic status, have any combined effect on the performance of subjects on programmed material.
The effects investigated by first and second analyses were the main effects while the third one was the interaction effect. The end product of these analyses were three 'F' ratios. The analysis of various sum of squares is recorded in table-33.

**TABLE-33**

**ANALYSIS OF 3 x 3 FACTORIAL DESIGN**

<table>
<thead>
<tr>
<th>Source of variance</th>
<th>df.</th>
<th>Sum of squares</th>
</tr>
</thead>
<tbody>
<tr>
<td>A (Level of aspiration)</td>
<td>a-1</td>
<td>$SS_A$</td>
</tr>
<tr>
<td>B (Socio-Economic status)</td>
<td>b-1</td>
<td>$SS_B$</td>
</tr>
<tr>
<td>A x B Error(b)</td>
<td>(a-1)(b-1)</td>
<td>$SS = SS_{AB}$</td>
</tr>
<tr>
<td></td>
<td>Ab(n-1)</td>
<td>$SS_A = SS_B$</td>
</tr>
</tbody>
</table>

$$SS_{error(b)} = SS_{res(b)}$$

In table-33, small 'a' and 'b' represent the levels of factors A and B respectively. Small 'n' represents the number of subjects in each treatment combination and bar(·) represents the cell sum of squares.
Analysis of variance provides a global picture about the nature of variance. A significant 'F' indicates that there are non-chance variations among means some where in the list of sets. If 'F' is not significant, there is no reason for further testing, as none of the mean differences will be significant.

4.8.1

LEVELS OF SIGNIFICANCE

The customary level of significance, alpha, was adopted at .05 or less. Here the chances are 5 in 100, or less, that the difference between means could result when the treatment applied was having no effect.

4.9.

ANALYSIS OF CO-VARIANCE

The co-variance analysis can help effect adjustment in the final or terminal scores which will allow for differences in some initial variable. In the planning for analysis of the obtained data it was stipulated to apply analysis of co-variance but was later given up as a futile attempt since in the preliminary analysis of X and Y scores it was found that F test as applied to initial(x) scores fell far short of significance at the .05 level of confidence. It therefore, signified that X means did not differ significantly and also that the random sampling of subjects to the nine treatment groups was successful. Further, it was also found that the experimental group had little learning of
biological concepts which were programmed by the investigator. The correlation between X and Y scores was almost negligible.