3.1 INTRODUCTION:

The experimental method of research was employed to investigate the effectiveness of objective based curriculum design in terms of achievement of educational objectives and acquisition of process skills by Science students. Review of previous research studies revealed that intelligence level of students and their personality characteristics significantly affect academic achievement. A \((2 \times 3 \times 2)\) factorial design was used to conduct the study. Independent variables in the study were curriculum design, intelligence and personality. Criterion variables were achievement in Science (knowledge, comprehension and application categories of educational objectives) and acquisition of process skills. Curriculum design was manipulated at two levels, intelligence at three levels and personality at two levels.
3.2 SAMPLE:

The sampling method was resorted to at three stages:

(i) For the try-out of the preliminary draft of the achievement test and process skills test. The sample consisted of thirty students.

(ii) For the try-out of second draft of the achievement test and process skills test. A sample of sixty four students was raised.

(iii) For the conduct of experiment.

In the first two stages regorous method of randomisation was not employed. Both the tests were developed on samples drawn out of the Xth Class students taught by the investigator.

For finding reliability of the tests, a random sample was raised. For the conduct of experiment a sample of 150 students was raised randomly from tenth class students. Five schools were selected randomly from government and privately run High/Higher Secondary Schools of Ropar district. To have a sample fairly representative of the population, students were selected from

(a) rural and urban areas.
(b) boys and girls schools.
(c) Government and aided-institutions.
The average age of the sample was 16.1 years. The break up of the sample is given below:

<table>
<thead>
<tr>
<th>Name of the School</th>
<th>Total Number of Students in Class X</th>
<th>Number of students taken</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Govt. High School, Desu-Majra.</td>
<td>60</td>
<td>27</td>
</tr>
<tr>
<td>2. Govt. Girls High School, Kurali.</td>
<td>65</td>
<td>27</td>
</tr>
<tr>
<td>3. Christian High School for Boys, Kharar.</td>
<td>92</td>
<td>42</td>
</tr>
<tr>
<td>5. Govt. High School, Ghruan.</td>
<td>57</td>
<td>27</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>344</strong></td>
<td><strong>150</strong></td>
</tr>
</tbody>
</table>

3.3 TOOLS:

The criterion referenced science achievement test, process skills test, the group test of general mental ability and personality inventory were used as basic tools for the collection of data.

3.3.1 Science-Achievement Test:

An achievement test was developed to measure knowledge, comprehension and application. The test consisted of items on the three topics of general science, namely, carbon and its allotropic forms, compounds of carbon (carbon-dioxide and
carbon-monoxide) and general characteristics of metals and non-metals. The test was validated and revised at three stages: individual testing, small group testing and field testing.

An individual testing stage, 140 items of multiple choice were designed. There were sixty items for knowledge level, forty items for comprehension and forty items for application level.

At small group testing stage, there were thirty students. 140 items of multiple-choice were prepared, out of which 69, 38 and 33 were of knowledge, comprehension and application respectively. The item difficulty ranged from .10 to .70 and discriminating power of the item ranged from .03 to .46.

The final draft was given to sixty four students and consisted of 110 items, all multiple choice type, out of which 48 items measured knowledge, 28 items measured comprehension and 34 items measured application. Item difficulty value ranged from .41 to .67 and the t-ratio value ranged from 1.742 to 3.546. The reliability of the test was calculated by test-retest method and was found to be .90. It was validated for its content only. The details of the test-development have been given in Chapter Fifth.
3.3.2 Process Skills Test:

A process skills test to measure the following cognitive skills was developed:

1. Observation of objects and phenomena.
3. Seeing a problem and seeking ways to solve it.
4. Formulation of working hypothesis and proving the hypothesis.
5. Solving the problem giving reason.
6. Formulation of conclusion.
7. Interpretation of data.

The test was validated and revised at small group testing and field testing levels. The samples taken for both levels in this test were the same as taken for achievement test. The first draft, given to thirty students, consisted of 18 items; each item further divided into parts, a, b, ... The difficulty values and discriminating powers of the items were calculated using Kelley's method. The difficulty value of the items ranged from .10 to .60 and the discriminating power ranged from .06 to .53. Items having D.V. and D.P. .40 and above were accepted as such and those having these values between .10 and .39 were revised and modified. Items having D.V. and D.P. below .10 were rejected. After revision and modification of the first draft, the second draft was developed. It consisted of 14 items and was
To carry out the item administered to sixty four students, analysis, difficulty values and t-ratios of the items were calculated. All the items having difficulty value above .40 were selected. Items with insignificant t-value were revised and modified. The final draft consisted of 14 items. Content validity, reliability and normality of the items distributed were calculated. The reliability of the test calculated by test retest method was .670. The details of the development of this test have been given in chapter sixth.

3.3.3 Group-Test of General Mental Ability:

(a) Jalota's group test of general mental ability was used to measure the intelligence of the sample. The test consists of 100 different items pertaining to numerical ability, reasoning, similarities, analogies and language ability. The time limit for this test was twenty minutes but because Hindi was second language for the students, they were given twenty five minutes. Separate answer sheets were provided to the students so as to reuse the test-booklets. The author refers to the reliability and its concurrent validity coefficient ranging from .50 to .78 against the examination marks as criteria. The test was administered and scored strictly in accordance with the instruction given in the manual. The raw scores were used to classify the students of each group into three groups e.g., above-
average intelligence group, average-intelligence group and
below average-intelligence group.

(b) The Neymann- Kohlstedt Diagnostic Test for Introversion-
Extroversion:

This test was used to find Introversion-Extroversion
trait of personality. The test is composed of fifty statements,
each followed by the word 'yes' and 'No'. Out of fifty state-
ments, thirty statements pertain to extroversion trait of the
personality and twenty statements pertain to Introversion trait
of the personality. The time limit for this test was twenty
minutes. Separate answer sheets were provided to the students
so as to reuse the test-sheets. Each statement was given the
weightage of one score. The student was given one score each if
he answered 'Yes' for extroversion and 'No' for introversion.
The scores thus obtained were used as such for the classification
of extroverts and introverts. The students who got twenty five
scores and above were placed in the category of extroverts and
those who got score less than twenty five were placed in the
category of introverts.

3.4 PROCEDURE:

Pre-test-Post-test experimental design was used. The
sample was given:

- General mental ability test.
- Test of Introversion and Extroversion.
Two groups, each containing seventy five students were made by random sampling.

- Group I was taught through conventional curriculum.
- Group II was taught through objective based curriculum.
- Achievement test and process skills test were given at the end of the experiment.

The diagramatic representation of the procedure is as given below:

TOTAL SAMPLE
150

(i) General-Mental ability test
(ii) Personality test
(iii) Achievement test (Pre-test)
(iv) Process skill test (Pre-test)

Group I (75 students)
Taught through conventional curriculum
(i) Achievement test
(ii) Process Skill Test

Group II (75 students)
Taught through objective-based curriculum
(i) Achievement test (Post-test)
(ii) Process Skill Test (Post-test)
3.5 **COLLECTION OF DATA** :

The collection of data followed the scheme as presented above. The following types of data for the sample were available for further analysis:

- Intelligence test's scores.
- Personality test scores.
- Pre-test scores (achievement and process skills).
- Post-test scores (achievement and process skills).

3.6 **STATISTICAL ANALYSIS OF DATA** :

In the present study, intelligence, personality traits and two modes of curriculum act as independent variables. The effect of these three variables was evaluated on the criterion variables of achievement in respect of knowledge, comprehension and application and on acquisition of process skills.

Guided by the design of the study, the main analysis included the use of analysis of variance and t-ratios, which have been described below. The details of each have been given in Chapter Seven.

**Analysis of Variance**: It was used to obtain a global picture as to whether there were any significant differences in achievement of different categories of educational objectives by different groups having learnt the same material through different types of curriculum. It was applied to ascertain the main effects of curriculum, intelligence and personality along with their interactions.