The present work deals with the study of concept formation as a function of general mental ability and achievement motivation.

Scientific research requires scientific methodology of which sampling technique constitutes an essential aspect. With a view to put the hypotheses to test, selection of valid and dependable instruments and scientific metrics and procedure are other requirements. This chapter describes these methodological aspects of this study.

3.10 Sampling Technique:

3.11 The Universe: Its Nature and Attributes

The present study has been designed for grade X pupils of secondary school population of Bilaspur town. Bilaspur is the divisional headquarter of Bilaspur division of Chhattisgarh region in Madhya Pradesh. The universe of pupil population of the higher secondary schools of Bilaspur town during 1942-43 has been presented in Table 3.1.
<table>
<thead>
<tr>
<th>Name of the School</th>
<th>Category</th>
<th>Type</th>
<th>Medium</th>
<th>Tally 1</th>
<th>Tally 2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Govt. Girls</td>
<td>Girls</td>
<td>Hindi</td>
<td></td>
<td>200</td>
<td>222</td>
</tr>
<tr>
<td>Private Boys</td>
<td></td>
<td></td>
<td></td>
<td>33</td>
<td>33</td>
</tr>
<tr>
<td>Fielder Govt.</td>
<td></td>
<td></td>
<td></td>
<td>65</td>
<td>65</td>
</tr>
<tr>
<td>Higher Sec.</td>
<td></td>
<td></td>
<td></td>
<td>80</td>
<td>80</td>
</tr>
<tr>
<td>Govt.</td>
<td></td>
<td></td>
<td></td>
<td>32</td>
<td>32</td>
</tr>
<tr>
<td>Co-Ed.</td>
<td></td>
<td></td>
<td></td>
<td>69</td>
<td>69</td>
</tr>
<tr>
<td>Dharat Mata H.S.</td>
<td></td>
<td></td>
<td></td>
<td>54</td>
<td>54</td>
</tr>
<tr>
<td>Jodhpur</td>
<td></td>
<td></td>
<td></td>
<td>33</td>
<td>33</td>
</tr>
<tr>
<td>Govt. Boys</td>
<td></td>
<td></td>
<td></td>
<td>240</td>
<td>240</td>
</tr>
<tr>
<td>Cit. Jodhpur</td>
<td></td>
<td></td>
<td></td>
<td>40</td>
<td>40</td>
</tr>
<tr>
<td>Co-Ed.</td>
<td></td>
<td></td>
<td></td>
<td>23</td>
<td>23</td>
</tr>
<tr>
<td>Govt. H.S.</td>
<td></td>
<td></td>
<td></td>
<td>24</td>
<td>24</td>
</tr>
<tr>
<td>Govt.</td>
<td></td>
<td></td>
<td></td>
<td>86</td>
<td>86</td>
</tr>
<tr>
<td>Multi-Purpose H.S.</td>
<td></td>
<td></td>
<td></td>
<td>49</td>
<td>49</td>
</tr>
<tr>
<td>Govt.</td>
<td></td>
<td></td>
<td></td>
<td>46</td>
<td>46</td>
</tr>
<tr>
<td>All Saints</td>
<td></td>
<td></td>
<td></td>
<td>65</td>
<td>65</td>
</tr>
<tr>
<td>Multi-Purpose H.S.</td>
<td></td>
<td></td>
<td></td>
<td>69</td>
<td>69</td>
</tr>
<tr>
<td>Govt.</td>
<td></td>
<td></td>
<td></td>
<td>49</td>
<td>49</td>
</tr>
<tr>
<td>Govt. H.S.</td>
<td></td>
<td></td>
<td></td>
<td>48</td>
<td>48</td>
</tr>
<tr>
<td>Govt.</td>
<td></td>
<td></td>
<td></td>
<td>86</td>
<td>86</td>
</tr>
<tr>
<td>Govt. H.S.</td>
<td></td>
<td></td>
<td></td>
<td>52</td>
<td>52</td>
</tr>
<tr>
<td></td>
<td>Totals</td>
<td></td>
<td></td>
<td>156</td>
<td>156</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>247</td>
<td>247</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>430</td>
<td>430</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>491</td>
<td>491</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>779</td>
<td>779</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1190</td>
<td>1190</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>224</td>
<td>224</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>224</td>
<td>224</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>493</td>
<td>493</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>172</td>
<td>172</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>172</td>
<td>172</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>576</td>
<td>576</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>576</td>
<td>576</td>
</tr>
</tbody>
</table>

*Note: Name of the school*

*Date: 3.11. The universe of pupil population of the higher secondary- schools of Kishangarh.*

*Date: 1961-62.*
<table>
<thead>
<tr>
<th>Code</th>
<th>School Name</th>
<th>Hindi Medium Boys</th>
<th>Hindi Medium Girls</th>
<th>Co-Ed. Medium Boys</th>
<th>Co-Ed. Medium Girls</th>
<th>Total Boys</th>
<th>Total Girls</th>
<th>Total No. of Pupils in Hindi Medium Schools</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>15. L.J. H.S. J.B. Boys</td>
<td>295</td>
<td>293</td>
<td>0</td>
<td>2</td>
<td>302</td>
<td>295</td>
<td>597</td>
</tr>
<tr>
<td>2</td>
<td>N.N. Khaparganj Govt. Boys</td>
<td>260</td>
<td>23</td>
<td>0</td>
<td>167</td>
<td>322</td>
<td>276</td>
<td>598</td>
</tr>
<tr>
<td>3</td>
<td>Sureshvar H.S. B.G. Boys</td>
<td>23</td>
<td>288</td>
<td>0</td>
<td>2</td>
<td>290</td>
<td>288</td>
<td>578</td>
</tr>
<tr>
<td>4</td>
<td>Juna Dilaspur B.G. Boys</td>
<td>16</td>
<td>150</td>
<td>0</td>
<td>0</td>
<td>166</td>
<td>150</td>
<td>316</td>
</tr>
<tr>
<td>5</td>
<td>Chhattisgarhi H.S. Private Boys</td>
<td>567</td>
<td>26</td>
<td>0</td>
<td>158</td>
<td>593</td>
<td>283</td>
<td>876</td>
</tr>
<tr>
<td>6</td>
<td>Urges: Girls</td>
<td>114</td>
<td>141</td>
<td>0</td>
<td>0</td>
<td>255</td>
<td>245</td>
<td>500</td>
</tr>
<tr>
<td>7</td>
<td>Andhra Pradesh H.S. Priv Girls</td>
<td>72</td>
<td>28</td>
<td>0</td>
<td>126</td>
<td>100</td>
<td>35</td>
<td>135</td>
</tr>
<tr>
<td>8</td>
<td>Saraswati L... Co. Girls</td>
<td>72</td>
<td>30</td>
<td>0</td>
<td>0</td>
<td>102</td>
<td>30</td>
<td>132</td>
</tr>
<tr>
<td>9</td>
<td>Kushpa Pala H.S. Co-Ed. Girls</td>
<td>19</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>19</td>
<td>0</td>
<td>19</td>
</tr>
<tr>
<td>10</td>
<td>Govt. Girls</td>
<td>103</td>
<td>87</td>
<td>0</td>
<td>0</td>
<td>190</td>
<td>94</td>
<td>284</td>
</tr>
</tbody>
</table>

**Total No. of Pupils in Co-Ed. Medium Schools:** 2457

**Total No. of Pupils in Hindi Medium Schools:** 2281

**Total No. of Girls studying in Hindi medium schools:** 176
The classification of the 25 higher secondary schools located in Dilsapar town in accordance with the sex and medium of instruction has been given in Table 3.2 as under:

Table 3.2 Classification of Higher Secondary Schools in Dilsapar town in accordance with sex and medium of instruction.

<table>
<thead>
<tr>
<th>Sex</th>
<th>No. of Schools</th>
<th>Hindi</th>
<th>English</th>
<th>Others</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boys</td>
<td>10</td>
<td>10</td>
<td>-</td>
<td>-</td>
<td>10</td>
</tr>
<tr>
<td>Girls</td>
<td>7</td>
<td>5</td>
<td>-</td>
<td>1(Urdu)</td>
<td>7</td>
</tr>
<tr>
<td>Co-edu.</td>
<td>3</td>
<td>4</td>
<td>3</td>
<td>1(Bengali)</td>
<td>8</td>
</tr>
<tr>
<td>Total</td>
<td>25</td>
<td>20</td>
<td>3</td>
<td>2</td>
<td>25</td>
</tr>
</tbody>
</table>

It is evident from Table 3.1 and Table 3.2 that the universe of pupil population for the year 1981-82 comprised of 403 pupils in the three classes, i.e., IX, X and XI of the 25 higher secondary schools located in Dilsapar town. In view of the fact that the present study has been designed for pupils studying through their mother tongue as their medium of instruction, only 23 higher secondary schools as universe of pupil population were taken for the present study. The total enrolment of pupils studying at Grade X regardless of medium of instruction in all the 25 higher secondary
schools has been found to be 7457 whereas those enrolled in the 20 higher secondary schools with Hindi as their mother tongue and medium of instruction have been found to be 2284. For the present study, these 2284 pupils studying at grade X of the 20 higher secondary schools with Hindi as their mother tongue and medium of instruction constitute the universe of pupil population of higher secondary schools from where the sample has been drawn.

3.12 The sampling technique employed for selecting the criterion groups:

The present study has been conceptualized with a view to study the relative nature, kind, form and extent of concept formation abilities of the extreme group pupils screened on the tests of verbal intelligence and achievement motivation.

With a view to select these two extreme criterion groups on the tests of verbal intelligence and achievement motivation, and then to conduct the study proper on these extreme criterion groups, the sampling technique underwent three stages:

I. Sampling procedure for drawing out representative sample from the universe so defined for screening test.

II. Sampling procedure for selecting extreme criterion groups; This sampling technique
was employed for selecting the extreme
criterion groups on the tests of Verbal
intelligence and achievement Motivation
from the representative sample of pupils.

I.I. Sample Proper: formation of four Extreme
criterion Interacting Groups.

The performance of the extreme criterion
groups has been estimated on the concept formation
test. This constitutes study proper on four extreme
criterion groups screened as independent groups.
From these four extreme criterion groups, four extreme
criterion interacting groups were formed.

In this study, the highly intelligent (Hi),
the low intelligent (Li), the highly need motivated
(In ech) and the low need motivated (Ln ech) are the
four extreme criterion groups of pupils at grade X
of the higher secondary schools with Hindi as their
mother-tongue and medium of instruction whose relative
performances on concept formation abilities have been
investigated.

5.13 The Sample Proper:

Sampling procedure for Screening Test:

Stage I: From the universe of pupil popula-
tion at grade X of 20 higher secondary schools with
Hindi as their mother tongue and medium of instruct-
ton, 10 higher secondary schools were randomly selected
For the present study, this constituted 50% of the universe of schools. Before employing this technique of random selection, these 20 schools were systematically catalogued alphabetically, and 10 schools listed at even numbers were selected randomly for the present study. The names of the 10 representative schools now for the present study are presented in Table III.3.

The universe of pupil population at grade X of these 10 higher secondary schools has been estimated to be 1544. Employing the sampling technique of random selection, 320 pupils who constitute about 20% of the total population of 1544 pupils in these 10 selected representative schools at grade X were selected for the present study.

Before the pupils were selected, they were alphabetically listed in each of the 10 schools; and every second pupils with even number was randomly picked up for the present study. By employing this random selection technique, 320 representative pupils from grade X of these 10 higher secondary schools were selected. The names of 10 representative schools (50% of the universe) and 320 representative pupils (20%) have been presented in Table III.3.
Table 7.3: Size of Sample Higher Secondary Schools and pupils at Grade X drawn out for screening Test

<table>
<thead>
<tr>
<th>Name of the High Schools</th>
<th>Grade X</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Size of universe of pupils</td>
</tr>
<tr>
<td>1. Surges H.S. School</td>
<td>172</td>
</tr>
<tr>
<td>2. Deokinandan H.S.S.</td>
<td>224</td>
</tr>
<tr>
<td>3. St. Joseph H.S.S.</td>
<td>49</td>
</tr>
<tr>
<td>4. Multipurpose H.S.S.</td>
<td>233</td>
</tr>
<tr>
<td>5. St. Lily H.S.S.</td>
<td>285</td>
</tr>
<tr>
<td>6. Khalsa H.S.S.</td>
<td>56</td>
</tr>
<tr>
<td>7. Guru Nanak H.S.S.</td>
<td>86</td>
</tr>
<tr>
<td>8. Mission H.S.S.</td>
<td>200</td>
</tr>
<tr>
<td>9. Chhattisgarh H.S.S.</td>
<td>260</td>
</tr>
<tr>
<td>10. Rohanti H.S.S.</td>
<td>79</td>
</tr>
<tr>
<td>Total:</td>
<td>1644</td>
</tr>
</tbody>
</table>

Among the 320 Ss, 436 were boys and 334 girls selected from 5 boys schools, 4 girls schools and one co-educational school.

Stage II: Sampling Procedure for Selecting Extreme Criterion Groups:

In the present study, Verbal Intelligence and achievement motivation are the independent variables
which have been treated as two criterion variables.
Four extreme criterion groups (e.g. Hi, Li, Hn Ach and Ln Ach) of these two independent variables have been screened from the selected sample of 820 pupils.

The Verbal Test of Intelligence and Achievement Motive Inventory as the screening Instrument (Chapter III) were administered to all these 820 pupils collectively in a convenient group of 20 as per the directions and instructions given in the manual of norms and responses so collected were scored.

Scores obtained from 820 Ss on each of these two criterion tests were arranged in descending order of their magnitude. Pupils placed at and above 75th percentile on the Verbal Test of Intelligence and Achievement Motive Inventory were said to be respectively highly intelligent (Hi) and highly need motivated (Hn Ach) extreme upper criterion groups whereas those placed at and below 25th percentile were termed as low intelligent (Li) and low need motivated (Ln Ach) extreme lower criterion groups. Thus, on two criterion tests, four extreme criterion groups were formed.
The sample size of screened pupils classified in each of these four criterion groups has been presented in Table III.4.
### Table: Dependent Intelligence Level and Intelligence Quotient

<table>
<thead>
<tr>
<th>Dependent Intelligence Level</th>
<th>Intelligence Quotient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>37.24</td>
</tr>
<tr>
<td>Medium</td>
<td>35.73</td>
</tr>
<tr>
<td>High</td>
<td>33.73</td>
</tr>
</tbody>
</table>

#### Sample Size

- Boys: 214
- Girls: 198

#### Average IQ Scores

<table>
<thead>
<tr>
<th>Dependent Intelligence Level</th>
<th>Average IQ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>37.24</td>
</tr>
<tr>
<td>Medium</td>
<td>35.73</td>
</tr>
<tr>
<td>High</td>
<td>33.73</td>
</tr>
</tbody>
</table>

#### Sample Size

- Boys: 214
- Girls: 198
It is evident from Table III.4 that the HI group consisted of 293 (i.e. 35.73%) pupils whereas in the lower IQ group, 248 (i.e. 30.24%) pupils were included. In the lower criterion groups, 218 (i.e. 26.58%) pupils were included in HI group whereas 274 (i.e. 33.41%) pupils were classified in the IQ group. All those pupils who were placed between 26th and 74th percentiles on either of the screening instruments, were deleted. Thus, out of 820 Ss, 309 (i.e. 37.59%) pupils were deleted on the test of general mental ability whereas 298 (i.e. 36.35%) pupils were deleted on the Achievement Motive Inventory.

Even after screening and selecting the two extreme criterion groups on each criterion instrument, it remains to be verified whether the two extreme criterion groups on each of the criterion variables really constitute two independent groups; and there exists a significant difference between their means ensuring the existence of their independent nature, so that the findings obtained on each one of them could be confidently ascertained with a view to test the independent nature of each of the 4 criterion groups. Means and Standard Deviations of each of the 4 groups were computed; and t values indicating the level of significance in difference between the means of the upper and lower extreme criterion groups
on each of the criterion variables were computed. Table III.5 presents the status of each of the four criterion groups.

Table 3.5  Statistical Differentials of the Criterion Groups.

<table>
<thead>
<tr>
<th>Criterion Variables</th>
<th>Intelligence</th>
<th>Achievement motivation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Hi</td>
<td>Li</td>
</tr>
<tr>
<td>N</td>
<td>293</td>
<td>218</td>
</tr>
<tr>
<td>M</td>
<td>89.65</td>
<td>21.37</td>
</tr>
<tr>
<td>SD</td>
<td>13.80</td>
<td>8.35</td>
</tr>
<tr>
<td>t</td>
<td>54.15</td>
<td></td>
</tr>
<tr>
<td>Inference</td>
<td>P &lt; .001</td>
<td></td>
</tr>
</tbody>
</table>

An inspection of Table III.5 indicates that the difference between the means of Hi (N = 89.65) and Li (M = 21.37) has been found significantly beyond .001 level of confidence (t = 54.15, P < .001). Similarly, the difference between the means of Hn Ach (M = 76.02) and Ln Ach (M = 27.04) has been estimated to be significant beyond .001 level of confidence (t = 50.34, P < .001). The two t values which have been found significant beyond .001 level of confidence, indicate that the four extreme criterion groups, (i.e. Hi, Li, Hn Ach, Ln Ach) are independent groups;
and it is, therefore, assumed that their performance on the concept formation tests would be indicative of the category to which they belong.

Stage III: Sample Proper: Formation of Four Extreme Criterion Interacting Groups:

The study proper which constitutes the administration of concept formation tests, has been undertaken over the four extreme criterion groups. The size of these criterion groups has been presented as under:

<table>
<thead>
<tr>
<th></th>
<th>Verbal intelligence</th>
<th>Achievement motivation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Hi</td>
<td>Li</td>
</tr>
<tr>
<td>Boys</td>
<td>171</td>
<td>128</td>
</tr>
<tr>
<td>Girls</td>
<td>122</td>
<td>90</td>
</tr>
<tr>
<td>Total:</td>
<td>293</td>
<td>218</td>
</tr>
</tbody>
</table>

However, under conditions of interaction among the four extreme criterion groups of the two criterion variables, i.e. verbal intelligence and achievement motivation, the four groups did not remain as independent separate groups; but the other four groups on interactions were formed; and this led to the formation of four extreme criterion
interacting groups (e.g. (1) Hi-Hn Ach, (2) Li-Ln Ach, (3) Hi-Ln Ach, and (4) Li-Hn Ach). Getzels and Jackson's (1958) design has been followed in the formation of these criterion interacting groups.

With a view to form these four extreme criterion interacting groups, all pupils obtaining 75th percentile and above scores consistently in both the criterion variables, i.e. verbal intelligence and achievement motivation, were designated as the (Hi-Hn Ach) group whereas those who obtained consistently scores at 25th percentile and below on both the criterion tests, were said to be (Li-Ln Ach) group. Pupils who scored above 75th percentile marks on the test of verbal intelligence but who obtained below 25th percentile scores on Achievement Motive Inventory were classified in (Hi-Ln Ach) group whereas those who obtained below 25th percentile scores on the Test of Verbal Intelligence but scored above 75th percentile marks on Achievement Motive Inventory were categorized under the (Li-Hn Ach) group. Following these criteria, 4 interacting groups were formed. The composition of these criterion interacting groups after screening the Ss on the above criteria have been given in Table III.6.
### Table 3.6 Composition of the Extreme Criterion Interacting Groups

<table>
<thead>
<tr>
<th>Sample</th>
<th>Extreme criterion interacting groups</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Hi-Hn Ach</td>
</tr>
<tr>
<td>Boys</td>
<td>66(62.8%)</td>
</tr>
<tr>
<td>Girls</td>
<td>39(37.15%)</td>
</tr>
<tr>
<td>Total</td>
<td>105(100%)</td>
</tr>
</tbody>
</table>

Thus from a total of 820 Ss, 415 pupils grouped into the four extreme criterion interacting groups (e.g. Hi-Hn Ach = 105, Hi-Ln Ach = 103, Li-Hn Ach = 98, and Li-Ln Ach = 109) were selected for the study proper which constituted 25.32%, 24.91%, 23.61% and 26.26% of the total representative Ss selected. The dependent variable, i.e. the Concentration Formation Test was administered to these four extreme criterion interacting groups. 405 Ss were deleted in the screening process.

3.14 The Resume of Screening Sampling Procedure:

The entire screening sampling process for the identification, selection and classification of pupils into various criterion groups through various stages of screening has been sketched as under:
<table>
<thead>
<tr>
<th>Steps</th>
<th>Screening process</th>
<th>Size of pupil population</th>
<th>Pupil population and their % retained or eliminated</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Size of the Universe of pupil population at H.S in Bilaspur town</td>
<td>8403</td>
<td>-</td>
</tr>
<tr>
<td>II</td>
<td>Size of the universe of pupil population at Grade X of H.S of Bilaspur town</td>
<td>2457</td>
<td></td>
</tr>
<tr>
<td>III</td>
<td>Elimination of Non-Hindi medium pupils</td>
<td>175</td>
<td>Pupils retained: 2281</td>
</tr>
<tr>
<td>IV</td>
<td>Pupil population at grade X in the selected 50% H.S of Bilaspur town for the screening Test of the present study from 20 H.S</td>
<td>1644</td>
<td>Pupils eliminated: 637</td>
</tr>
<tr>
<td>V</td>
<td>Size of the sample pupils at grade X of the 10 H.S, randomly selected for the present study</td>
<td>820</td>
<td>Pupils deleted (50%) 524 (50%)</td>
</tr>
<tr>
<td>VI</td>
<td>Size of the sample pupils in the 4 extreme criterion groups selected employing criterion tests of:</td>
<td>Selected</td>
<td>Deleted</td>
</tr>
</tbody>
</table>
(a) Verbal Intelligence:

<table>
<thead>
<tr>
<th>Group</th>
<th>Score</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hi</td>
<td>293</td>
<td>35.73%</td>
</tr>
<tr>
<td>Li</td>
<td>218</td>
<td>26.58%</td>
</tr>
</tbody>
</table>

Total: 511 (62.31%) 309 (37.69%)

(b) Achievement motivation:

<table>
<thead>
<tr>
<th>Group</th>
<th>Score</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hn Ach</td>
<td>248</td>
<td>30.24%</td>
</tr>
<tr>
<td>Ln Ach</td>
<td>274</td>
<td>33.41%</td>
</tr>
</tbody>
</table>

Total: 522 (63.65%) 298 (36.35%)

VII Formation of the four extreme criterion Interacting groups:

<table>
<thead>
<tr>
<th>Group</th>
<th>Selected</th>
<th>Deleted</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Hi-Hn Ach</td>
<td>105</td>
<td>415 (50.60%)</td>
</tr>
<tr>
<td>(b) Hi-Ln Ach</td>
<td>103</td>
<td>405 (49.39%)</td>
</tr>
<tr>
<td>(c) Li-Hn Ach</td>
<td>98</td>
<td>405 (49.39%)</td>
</tr>
<tr>
<td>(d) Li-Ln Ach</td>
<td>109</td>
<td>415 (50.60%)</td>
</tr>
</tbody>
</table>

Total= 415 (50.60%) 405 (49.39%)

VIII Total invalidated Ss from the sample pupils selected randomly for the present study

IX Total pupils retained for the present study

415 (50.60%)
Research depends on the designing and developing of tools and techniques in accordance with the study at hand. The norms of a particular test are developed with specific aims in view; hence they can hardly be employed for investigating another problem. To maintain specificity, new instruments are developed keeping in view the objectives and aims of research undertaken. Since developing a new instrument is in itself a great task, the available instruments are used, if they are found appropriate.

The following instruments have been used in the study keeping in view the problems hypothesized. In the present study, no new psychological test has been standardized. Verbal intelligence and achievement motivation function, in this study, as independent variables whereas concept formation has been employed as a dependent variable. To measure these variables, standardized psychological tests have been employed. The former two independent variables function as criterion variables which have been measured by screening instruments; whereas concept formation has been employed for estimating the level of performance of the Ss. The specification of instruments used in this study has been sketched as under:
(a) **Independent Variables:**

I  Intelligence - P.S.M. Test of Verbal Intelligence

II  Achievement motivation - AMI (Achievement Motive Inventory) by Prayag Mehta.

(b) **Dependent Variables:**

I  Concept Formation Test by J.S. Bruner et al (1957)
   (i) selection problem, and
   (ii) inference problem

II  Post Experimental Questionnaire: (PEG)

The concepts involved in these instruments, their rationale for selection and their brief descriptions have been presented as under:

3.21 **Independent Variables:**

3.211 **Measuring Verbal Intelligence:**

3.2111 **Concept of Verbal Intelligence:**

Intelligence has been conceptualized as the most controversial psychological construct in the literature of psychology. No unanimous concept has been presented as yet. It covers from simple to most abstract thinking, from very simple social adaptation to very complex adaptability. Butcher (1970) has, therefore, remarked that it is a 'slippery' term; however, its existence and significance can not be denied. Researchers, to be on the safer side, therefore,
define 'intelligence' operationally. For the present study, it has been operationally defined as 'the total scores obtained by a subject on the PSM-Verbal Test of Intelligence constructed and standardized by PSM, Jabalpur, M.P."

3.2112 **Rationale for selecting the PSM Test of Verbal Intelligence:**

We have selected the PSM-Test of Verbal Intelligence on rationale that:

1. The test is standardized and validated on M.P. pupil population, hence it has its relevance in its use over the pupils under-study.

2. The PSM-Test of Verbal Intelligence is a valid and reliable tool and is, therefore, widely used over the pupil population of M.P. Its coefficients of reliability and validity are beyond doubt.

3. It is a group test and its administration and scoring are perfectly technical and standardised.

4. It can be conveniently used on Hindi knowing pupils. It has been standardized over Hindi knowing pupils of M.P.

5. It has been in use for the last 20 years giving very reliable results. It has been used in numerous research projects.

6. It is meant for secondary school pupils and is an objective measure of verbal intelligence.
(7) No other test of verbal intelligence could be more profitably applied than this, nor can they ensure better dependability than this.

In view of these plus points, the PSM Test of Verbal Intelligence has been employed in the present study.

3.2113 Description of the PSM Test of Verbal Intelligence:

The PSM Test of Verbal Intelligence (Appendix-I) is a group as well as individual test. It provides a measure of verbal intelligence to literate children and adults. It has been developed by PSM, Jabalpur about 20 years ago, and has been subsequently revised twice.

The PSM-Test consists of 6 subtests: They are:
(1) Analogies, (2) Classification, (3) Sentence Completion, (4) Similarities, (5) Number Series, and (6) Reasoning problems.

These six mental abilities are positively inter-related. The intercorrelations range from +.47 to +.64. The indices of positive and higher correlation suggest that these different mental abilities are measuring a common factor. This common factor has been called the 'G' factor. The correlation of the sub-tests with the 'G' factor has been computed by Spearman's technique. The 'G' saturation of the six sub-tests has been presented as under:
The reliability co-efficients of the test have been estimated by Test-Re-test and Split Half method. The self correlation after correction for restriction of range is .91. The Split-Half correlation of Spearman-Brown formula has been estimated to be .94.

The test is validated against the teachers' rating and examination marks. The contingency coefficient by teachers judgement is .41 and correlation on the examination marks obtained is .42. Using Freeman's correlation for attenuation resulted a coefficient of validity of .60.

3.212 Measuring Achievement Motivation:

3.2121 Concept of Achievement Motivation:

Motivation has been aptly emphasised as the guiding psychological force behind human action and
behave. The end of the 19th century saw two
distinct ideologies supporting the edifice of the
concept of 'motivation'. They are:

1. Human behaviour has a tendency to
   change by practice, and
2. Immediate environment is apt to
   provide clues; however insignificant
   to which an individual is sensitive.

These two factors influenced the direction, vigour and
persistence of human behaviour.

*Achievement motivation* expects the performance
to be evaluated in terms of some standard of excellence
which accounts for the determinants of the direction,
magnitude and persistence of behaviour. McClelland
et al (1953) have specified three criteria of achieve­
ment motivation. They are:

1) Success in competition with some standard
   of excellence,
2) Unique accomplishment, and
3) Long term involvement.

3.2122 *Rationale for the Selection of AMI:*

The projective technique invariably used for
measuring the *n Ach* lacks in specificity, reliabi­
liity and objectivity because of their structural
ambiguous stimulus characteristics. The Achievement
 motive Inventory (AMI) developed by Prayag Mehta
 (1969) on Indian conditions is a scientific measure
 which objectively measures the achievement motives.
 This AMI has been selected on the following rationales:

(1) The AMI is an objective measure of achievement
 motivation developed under Indian culture and condi-
tions which are significant variables of $n$ Ach.

(2) The AMI has been validated against Murrey's
 TAT Pictures (1938). Thus, it is a dependable as
 well as valid instrument.

(3) From the point of view of administration, it
 is more economical in terms of time and energy, and
 can be easily administered because of its being self-
 administered inventory.

(4) It does not present a language barrier for
 the 'Ss' and therefore, could be conveniently admi-
 nistered over the sample under-study.

(5) It is the only objective, reliable and valid
 test available for the measurement of $n$ Ach in India.
 No other scientific instrument for measuring achieve-
 ment motivation is available for Indian pupils.

(6) It is meant for the age group which has been
 taken up for the present study, and the norms prepared
 over the normative sample enhance its relevance and
 dependability.
3.2123 Description of the AMI:

The AMI is developed on TAT type pictorial cues and stories. They provide two distinct measures on:

1. An achievement related motive similar to test anxiety (Hander and Sarason |1952|, Sarason et al. |1958|, Atkinson and Litwin |1959|) or the motive to avoid failure (MAF), and

2. Achievement related values.

These two measures showed negative correlations with \( n_{ach} \), total school performance and self expected vocational success. The total AMI score showed positive correlations with external criteria of validation. This high confidence attached to the validity of the AMI ensures its high degree of reliability.

Murray's (1938) TAT type pictures have been invariably adopted by early researchers (McClelland et al., 1953, 1960, 1963; Atkinson, 1958; Heckhansen, 1963). The original scoring key was developed by McClelland et al. (1953).

The AMI (Appendix-II) by Prayag Mehta (1969) is an objective Hindi measure of estimating the \( n_{ach} \) of school children. It contains 22 descriptive statements of pictorial stimuli which were tried out in connection with the development of the thematic apperceptive measure of \( n_{ach} \). There are six alternatives to
each of the 22 items and the $S$ is required to check one out of these six response-options. Two are achievement related (AR), two task related (TR) and two unrelated (UR) to achievement. The response-options, for these twenty two items have been selected from the pupils responses of the pictorial cue-stories to about 50 TAT type pictures, after having coded them as either achievement related imagery (AI), task related (TI) or unrelated (UI) imagery. The six selected pictures, out of 50 picture cues, showed satisfactory discrimination and evokability for achievement imagery. These pictures contain culture-bound cues familiar to the normative sample.

The AMI provides four scores: AR, TR, UR and AMI score. The responses can be either AR, TR or UR. The scores of each $S$ are counted on the strength of the nature of the responses. The total AMI score is obtained by deducting the total UR scores from the total AR scores.

The AMI has been standardized over 1000 male pupils of grade IX of Delhi schools. It is a self administered inventory taking about 20 minutes. The norms have been developed with respect to school achievement status and socio-economic status.

3.22 Dependent Variable:

In the present study concept formation has been used as the dependent variable.
3.221 Measuring Concept Formation:

The problem of thought process has always been basic to psychology. W.E. Vinecke (1964) stresses that "the evolution of the ability to think inevitably led to a need to think about thinking itself".

3.2211 Concept of Concept Formation: Concept formation is basic to thinking process. There are two main theories based on the process of abstraction and generalization explaining the process of concept formation.

(a) Composite Photograph theory: It emphasizes abstraction. As stated by Woodworth (1938), the feature common to a class of objects summate their impressions on the observer who thus gradually acquires a picture in which the common features stand out strongly while the variable characteristics are washed out.

(b) The Active Research theory: By contrast, this theory emphasizes generalization. The concept is supposed to originate as hypothesis, which the 'S' proceeds to test by trying it on fresh specimen of the class.

(c) A Synthetic approach: Later researches combined the two viewpoints as mutually complementary
approaches to a situation. Heidbreder (1966) concludes that at the adult level, both the operations are involved. Concept formation involves analysis as well as synthesis. Concepts, thus, are complete systems of higher order responses in terms of which the more basic response patterns are organised. The basic function of concept formation is (1) to relate previous learning to current situation, and (2) to influence an organism's previous learning to present experience. Several terminologies as discussed in Chapter I have been coined on 'conceptual learning' of which concept formation being basal one. Some of these have been discussed there. To avoid duplication, their descriptions have been deleted here.

Bruner et al. (1956) have suggested three types of concepts. They are (i) conjunctive, (ii) disjunctive, and (iii) relational.

These concepts have been categorized from the points of view of their contents. They have also analysed the concepts from the points of view of the strategies by which these concepts are formed and acquired. An individual's receptive approach to concept formation process may be 'wholist' based on focussing or 'partist' based on scanning. Further, the subject may analyse and form the concept by employing either of the four process-oriented
analytic technique. They are: (i) simultaneous scanning, (ii) successive scanning, (iii) conservative focussing, and (iv) focus gambling.

The strategies in concept formation have been defined as the pattern-oriented decisions. "A strategy refers to a pattern of decisions in the acquisition, retention and utilization of information that serves to meet certain objectives. Such orderly, purposive and consistent patterns are called strategies. A strategy is a plan of search, a mode of approach or a technique adopted in solving a problem" (Bruner, et al., 1956).

3.2212 **Rationale for using the Concept Formation Tests (CFT) and the Post Experimental Questionnaire (PEC):**

The following rationale have been employed to select and use the Concept Formation Tests (Bruner, et al., 1956) and PEC:

(1) The CFT and PEC have been used extensively by previous researchers (Bruner, et al. 1956; Rao, 1971), in their studies on cognition and concept formation studies.

(2) It is a culture free test. Use of language is not a barrier here. The use of cards and colours gives it an objective base. The CFT can be widely used over a wide age range and in any situation.
(3) The administration of the test as well as its scoring procedure is economical, simple and convenient.

(4) It is a reliable and valid instrument for measuring concept formation. No other test is as dependable as this.

(5) The CFT has been widely used in various research projects; and has proved to be a very dependable tool in concept formation researches. It is an internationally known test standardized and used by eminent cognitive psychologists (e.g., Bruner, Goodnow and Austin, 1956). It has the world-wide application in researches.

3.2.2.13 Description of the Concept Formation Test:

Concept Formation Test as prepared and used by J. . . . Bruner, et al. (1956) in their studies on concept learning has been used in the present study.

The test consists of two sets of problems:

(1) Selection Test having two problems of increasing difficulty.

(2) Inference Test having two problems of increasing difficulty.

(a) Selection Test: It consists of an array of 81 cards of 3"x5" size with four varying attributes (Appendix - III). Each of the four attributes values has three dimensions as given below:
1. Colour of the figure: Red, Green, Black.
2. Shape of the figure: Cross, Circle, Square.
3. No. of figures: 1, 2, 3.
4. No. of Borders: 1, 2, 3.

The 81 cards represent all the possible combinations of the attribute values. The positive instances of the concepts carry within it the knowledge of correct steps used for concept formation. On the basis of the stimulus card, the 'S' was to give instances which according to his view, carry the concept. The positive instances and the negative instances were recorded after each card was shown. The knowledge whether it is a positive or negative card was told to the subject after each card. The test ends where the 'S' tells the correct concept.

The time and the number of trials taken are recorded on the data sheet (Appendix - IV). This test was administered individually by the investigator herself.

(b) Inference Test: It contains 12 cards with 50% positive and 50% negative instances. These cards have been presented alternatively to the 'S'.
The inference problem is restricted to 4 attributes and 3 values of each attribute. The number of dimensions and attribute values used in the inference problem are given as under:

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Value</th>
<th>1st Problem</th>
<th>2nd Problem</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Total no. of instances in the problem</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>2.</td>
<td>Total no. of attributes in each array of instances</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>3.</td>
<td>No. of values for each attribute</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>No. of attribute values determining the concept.</td>
<td>4</td>
<td>4-5</td>
</tr>
<tr>
<td>5.</td>
<td>No. of positive instances</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>6.</td>
<td>No. of negative instances</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>7.</td>
<td>Exposure for each card</td>
<td>20 sec</td>
<td>20 sec</td>
</tr>
</tbody>
</table>

The administration of the Inference Test differs in some respect from that of the Selection Test. They are:

(1) The 'S' has no control over the order of instances presented to them.

(2) Instead of the whole array being presented, the S is shown one card at a time; positive and negative alternatively.
The positive instances exemplify the concepts whereas the negative instances negate the existence of the concept.

3.222 **The Post Experimental Questionnaire: (PEC)** -

The PEC (Appendix - IV) consists of four questions serving the purpose of introspective report. Employing the technique of J.S. Bruner et al. (1955), four directive questions were asked to the Ss with a view to objectively evaluate the introspective data.

The PEC serves two main functions:

(i) **Self reporting** as regards the mental process involved in the formation of a concept.

(ii) **Introspective mental analysis** of the 'S' during the test.

The PEC helps in assessing the difficulty level of the problems, the various clues, strategies and key points, used in the formation of the concept. The 'how' and 'what' aspects of the formation of a concept could be known from the data so collected.

3.30 **Design of the Study:**

In the present study, verbal intelligence and achievement motivation functioned as independent variables whereas concept formation as a process and product has been employed as dependent variable.
The former two tests have been operated as criterion variables with a view to screen out and identify the extreme criterion groups on each of the two independent variables. Consequently, the probable interactions of the two extreme criterion groups on each of the two criterion variables led to the formation of a (2x2) factorial design for the treatment of nature, kind, form and extent of concept formation. Thus, four extreme criterion interacting groups, as presented below, have been formed.

<table>
<thead>
<tr>
<th>General Mental Ability (1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
</tr>
<tr>
<td>Achievement High</td>
</tr>
<tr>
<td>Motivation (m Ach) Low</td>
</tr>
</tbody>
</table>

In this formation of four extreme criterion interacting groups, we have employed the research design employed by Getzel and Jacksons (1958) in their studies on differences between 'highly creative' and 'highly intelligent' children.

3.40 METHODS AND PROCEDURES:

Methods and procedures include: (1) Administration of the tests, and (ii) Report and responses.
3.41 **Administration of the Tests:**

In the present study, as presented earlier in this Chapter, the selection of sample pupils for study proper, under-went through mainly three stages as described under 'Sampling Procedure'.

The testing programme has been executed into two stages:

1. **Screening Programme:**

   For identifying the pupils who could be classified in the extreme criterion groups on the tests of criterion variables, i.e. Test of Verbal Intelligence and Achievement Motive Inventory, PSM-Verbal Test of intelligence and AMI were administered as screening instruments over 620 pupils randomly selected from 10 higher secondary schools. Two extreme criterion groups, e.g. highly intelligent (Hi), and low intelligent (Li) on the tests of general mental ability; and another two extreme criterion groups, e.g. highly need motivated (Hn Ach) and low need motivated (Ln Ach) on the AMI were formed; which were subsequently converted into four interactional groups for treatment purposes. This led to the formation of (2x2) factorial design as presented under 'Design of the Study'. All screening tests were conducted collectively in group situations.
II Testing Proper:

Concept formation Tests (CfT) and Post-experimental questionnaire (PlQ) were administered to the finally selected subjects of the four extreme criterion treatment groups individually by the investigator herself.

For administering the various psychological tests, directions and instructions given in the manual of norms were strictly followed. Uniformity and consistency in the conduct of testing programmes at various testing sessions and situations were closely observed. The specification of the testing programme into various sessions has been presented as under:

**Specification of Testing Programmes**

<table>
<thead>
<tr>
<th>Kind of test</th>
<th>No. of sub-items</th>
<th>Tests</th>
<th>Time taken in minutes</th>
</tr>
</thead>
</table>

**Testing session I:**

**Screening Tests:**

(i) PSM Test of verbal intelligence

Group test: 5 147 50

(ii) AMI

Group test: - 22 20

Total: 80

**Testing session II:**

(iii) Concept Formation Test

Individual Test: Two problems:

1) Selection test: 81 cards
3.42 *Rapport and Responses*:

(a) **Rapport**:

The sample schools were contacted well in advance of the testing programme. The Principals and teachers were personally requested to extend their whole hearted cooperation in the research work. The class teachers were invariably requested to work as a proctor during the testing programme. Before the tests were administered, the pupils were briefly introduced the purpose and nature of the work they have to do. They were also requested to extend their active cooperation in giving true responses to their best. The time to be taken for the testing programme was also told to them. Before the answer-blanks were distributed, they were asked whether they have followed 'that they have to do?' and 'how they have to do?'. After having established satisfactory rapport with the pupils, the testing was started with a final probing question—"Is there any difficulty? Has anybody to ask anything?".

<table>
<thead>
<tr>
<th>Test</th>
<th>Individual</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>PEG</td>
<td>4 items</td>
<td>20 min</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>110 min</td>
</tr>
</tbody>
</table>
(b) Responses:

Responses on various tests employed in the study were scored by the investigator herself by making use of transparent stencil keys. Thus, hand-scoring keys were employed for all the tests. PSM Verbal Test of Intelligence, AMI and Concept Formation Tests were objectively scored on the strength of the scoring keys given in their respective 'Manual of Norms' whereas the 'introspective' reports collected from the responses on the PEC were partially subjectively scored. In the subjective scoring of process of concept formation as given in the introspective report of Ss, responses of Ss were coded and categorized in accordance with the types of strategies and kinds of concepts as suggested by Bruner et al. (1956) and followed in his research by Rao (1971). The scoring system employed for each of the tests has been presented as under:

3.43 Scoring System:

I. PSM Verbal Test of Intelligence: The 'Manual of Norms' of the PSM Verbal Test of Intelligence provides 'Correct answer key' for each of the items on the six sub-tests. One score has been given for a correct answer and zero for wrong answer. The total scores that can be obtained by a S is 147. The total raw scores on various sub-tests have been converted into percentile norms. Pupils above P75
and below $P_{25}$ were respectively categorized as upper and lower extreme criterion groups.

II. AML: The AML consisted of 22 items. Six alternate answers have been provided on each of the items. A subject is required to check only one out of these six answers. Out of these 6 alternatives, 2 are achievement related (AR), 2 are task related (TR), and 2 are unrelated (UR) to achievement.

The AML provides four scores: AR, TR, UR and AMI score. The scores of each 'S' are counted on the strength of the nature of the responses as specified in the manual. The total AMI is obtained by deducting the total UR score from the total AR Scores. The scores of AR range between 2 and 20, and TR and UR from 0 to 14.50% of the responses are AR with a mean at 11.40 and 50% remaining responses are TR and UR. The AML designer is silent on the processing system of negative scores. In the present study, all negative scores have been reduced to zero.

The raw scores obtained on the AML were converted into percentiles and pupils were screened, identified and classified into two extreme criterion groups on the strength of their extreme placement on the AML. Pupils who scored above $P_{75}$ were designated as 'highly need motivated' (HN Ach) whereas those who scored below $P_{25}$ were categorized as 'low need motivated' (LN Ach).
Ill. **Concept Formation Tests**

Concept formation Test consisted of two sub-tests:

(i) **Selection Test**

(ii) **Inference Test**

The former contains 81 Cards whereas the latter 12. The responses of the pupils on 'Selection problems' of the C.T for a correct concept formation have been scored in terms of 'Time Scores' and 'Trial Scores'. A concept is said to be attained by a subject when he successfully recalls a concept for 100% of its occurrence. For Inference Problems the cards shown by the S were recorded on the data sheet. For example, if the 'S' shows 3 black crosses with a border, it was recorded as 3B+. 1. When the concept was fully achieved, the time was noted down for each problem. Three sets of scores were obtained.

- (1) Trial scores
- (2) Time scores
- (3) Strategy score.

The computational processes of these scores have been given as under:

(a) **Computation of 'Time Index':** Mean time taken for inference problems was computed by the following formula:

\[
\text{Time Index} = \frac{\text{Time for Ist & IInd trial}}{\text{No. of trials}}
\]
(b) Computation of Trial Index: On the basis of the trials taken for the formation of concept, the Trial Index was obtained as:

Trial Index = Trial for Ist & IInd Problems
No. of tests

(c) Computation of Strategy Index: In the formation of concept, a definite strategy is followed on the basis of positive or negative instances. Number of positive instances confirming the focus card ascertained 'wholist' strategy, whereas deviation from the focus card tend to confirm 'partist' strategy. The Specification Index, Deviation score or the strategy score is obtained by the following formula:

Deviation in terms of attribute
\[ DS = \frac{\text{value from the focus card}}{\text{No. of trials}} \]

On 'Inference Problems' for the objective measurement of the deviation of strategy scores, Bruner et al. (1956) has distinguished four basic strategies for the selection of ideal instance category.

Strategy score (SS) is measured by the "Deviation of the successive card in terms of attribute values from the focus card in terms of attribute values from the focus card shown". The SS is obtained by using the following formula:

\[ SS = \frac{\text{No. of deviations from the ideal card}}{\text{No. of Trials}} \]
To evaluate the inference problem, two criteria have been used.

**Criterion I:** Difference in terms of attribute values of the given pattern from the ideal pattern.

**Criterion II:** Errors in terms of omission and commission of the attribute values in the successive instances. The relevant attributes omitted and irrelevant attributes included are considered as errors of omission and commission.

IV. **PEQ:**

The responses collected from introspection report based on PEQ were partially objective and partially subjective. Positive and negative answers were scored in terms of percentages on first two of the four items. These objective scores in terms of percentages were treated for $X^2$ tests.

The subjective responses on the latter two items were coded and classified in terms of: (i) (i) types of concepts (e.g. conjunctive, disjunctive and relational) and (ii) types of strategies (e.g. wholist and partist). Further, the instances classified under 'wholist' or 'partist' as types of strategies were analysed in terms of their operational analysis under four heads: (a) simultaneous scanning, (b) successive scanning, (c) conservative focusing, and (d) focus gambling. The nature, kind and form
of the "concept" formed by each of the four extreme criterion interacting groups were evaluated in terms of these qualitative criteria whereas the extent of concept formation has been estimated in terms of quantitative data collected from items 1 and 2 of P4.

The statistical treatments of responses on various tests have been undertaken on these raw scores by employing various scoring systems as discussed above.

3.50 DATA ANALYSIS AND PROCESSING:

3.51 Data analysis for Screening Process:

The data collected on criterion variables as screening instruments were analysed and processed in accordance with the design of the study. After having serially arranged all the answer sheets in descending order of the percentile scores obtained by 320 pupils individually on the tests of verbal intelligence and achievement motivation, the pupils scoring above $P_{75}$ and below $P_{25}$ were sorted out and retained for the present study leaving thereby pupils classified between $P_{26}$ and $P_{74}$ untreated.

As explained earlier, these four separate extreme criterion groups (e.g. Hi, Li, Hn Ach and Ln Ach) were then converted into four interacting extreme criterion groups (e.g. Hi-Hn Ach, Hi-Ln Ach, Li-Hn Ach and Li-Ln Ach) which were employed for treatment proper.
3.32 Data Analysis for Study Proper:

The data collected on these four interacting extreme criterion groups were analyzed and processed in accordance with the requirements of hypotheses formulated in Chapter I. Complicated data were processed for computerization. Simple data were treated by simple calculator. Data have been presented in tabular forms in Chapter IV.

Invariably, data were processed for significance of difference employing t value, $\chi^2$ test and $F$ ratio. Raw scores were converted into percentile norms. Introspective data were coded and classified in terms of types of concepts and the strategies.

3.60 STATISTICAL TREATMENT OF THE DATA:

Statistical methods employed in the present study follow the requirements inherent in the hypotheses, purpose of the study or design of the research. The following statistical techniques have been used.

(i) Percentile scores: Raw scores obtained on the criterion variables (i.e. verbal intelligence and achievement motivation) were converted into percentile scores which made the screening procedure more dependable.

(ii) t Value: Means, $\sigma$s and $t$ values were computed which indicated the level of significance in difference between two means. In all hypotheses on 'differential studies', $t$ values were applied.
(iii) \( \chi^2 \) test: In the non-parametric situations, \( \chi^2 \) test has been employed with a view to test the level of significance in difference between the observed responses and the expected responses. Responses collected on PEC as part of introspective report have been computed by \( \chi^2 \) test. This led to the discussion of nature, kind, form and extent of concept formation.

(iv) Analysis of Variance: The analysis of variance has been employed to verify hypothesis pertaining to 'Interactional Studies'. This statistical method has been used with a view to estimate the interactional effects of independent variables on dependent variable.

(v) Percentages: Results have been presented in terms of only percentages where other higher statistical techniques could not be employed. Results derived from the introspective reports on PEC have been treated by employing percentages.

(vi) Qualitative Treatment: Data obtained from introspective reports have been treated qualitatively since quantitative evaluation was not found appropriate. The nature, kind and form of concept formation have been coded and analysed qualitatively in terms of types of concepts and kinds of strategies.

The results arrived at by employing these statistical methods and qualitative analysis have been presented in the next Chapter.
CHAPTER IV

RESULTS, INTERPRETATIONS AND THEIR DISCUSSIONS

4.10 Introduction

4.20 Results on Differential Studies

4.21 Concept formation abilities of the Hi and Li groups (DH₁).

4.22 Concept formation abilities of the Hn Ach and Ln Ach groups (DH₂).

4.23 Concept formation abilities of the (Hi-Hn Ach) and (Li-Ln Ach) groups (DH₃).

4.24 Concept formation abilities of the (Hi-Ln Ach) and (Li-Hn Ach) groups (DH₄).

4.25 Sex differences in Concept formation abilities (DH₅).

4.30 Results on Interactional Studies.

4.31 Relative interaction of intelligence and achievement motivation on concept formation ability (IH₆).

4.40 Results on Correlational Studies.

4.41 Relationship between concept formation and verbal intelligence (CH₇-a) and achievement motivation (CH₇-b).

4.50 Results at a glance.

4.60 Discussions and Interpretations

4.61 Verbal Intelligence and Achievement Motivation as contributory to Concept formation.

4.62 Concept formation abilities of the (Hi-Hn Ach) and (Li-Ln Ach) groups.

4.63 Concept formation abilities of the (Hi-Ln Ach) and (Li-Hn Ach) groups.

4.64 Sex differences in concept formation abilities.