CHAPTER FOUR

STATISTICAL ANALYSIS AND INTERPRETATION
As mentioned in the previous chapters, the comparative nature of the present study needed a thorough control of variables to the maximum extent and thorough analysis of the results through rather sophisticated statistics. One-to-one matching could not be achieved due to the obvious need of having seven treatment groups. Group matching was also not feasible as the size of the treatment groups remained small and differed from school to school, n being 1 in two schools, 3 in one school, 4 in one school, 5 in five schools, and 6 in two schools. Under these conditions, it was decided to go for statistical control.

In the present investigation, the relative effectiveness of programme treatments was found on the following three criteria:

i) Immediate posttest;

ii) Percentage of retention; and

iii) Time taken to finish the programme.

The level of comprehension was taken as the number of correct answers given on the immediate posttest rather than taking pretest-posttest differences. As mentioned by Lewis (1969), the pretest-posttest design has its own disadvantage and sources of errors. The limitations of
pretest-posttest design, and the advantages of randomization are given by Lewis (1969) as follows:

...It is well to remind ourselves therefore that a pretest is not an essential ingredient in design. Often indeed a suitable pretest is difficult to conceive. If the posttest, or a parallel form of it, is also administered as a pretest, the element of artificiality would be apparent from the predominance of zero or near-zero scores that result.

...An equality of groups on a pre-test is no substitute for randomisation. The prime merit of randomisation is the control it exerts not just on one variable, but on all variables unrelated to the treatment(s) under investigation.

...The mere taking of the pretest might affect the posttest scores. A related possibility is that it would sensitise the experimental group to the treatment it subsequently receives. A higher posttest score would then be an effect of the pretest by treatment interaction rather than a main effect of the treatment itself."

The school-to-school variations were taken care through the application of the special method of covariance, called "Analysis of Covariance in Duplicate Experiments in Randomly Selected Schools" (Lindquist, 1970).
In short, the seven treatment groups were analysed in terms of the immediate posttest scores, retention scores and the time taken to finish the programme. The distribution of scores on the immediate posttest, percentage of retention and the time taken to finish the programme are given in the following pages, where

A stands for the Linear Overt Form
B stands for the Linear Covert Form
C stands for the Response Prompt Overt Form (Copying)
D stands for the Response Prompt Covert Form (Reading)
E stands for the Skip programme Form
F stands for the Branching Form
G stands for the Hybrid Form.
<table>
<thead>
<tr>
<th>SCORE</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
</tr>
</thead>
<tbody>
<tr>
<td>40</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>39</td>
<td>4</td>
<td>2</td>
<td>4</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>38</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>37</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>4</td>
<td>2</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>36</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>35</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>34</td>
<td>2</td>
<td>2</td>
<td>4</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>33</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>4</td>
<td>5</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>32</td>
<td>4</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>31</td>
<td>5</td>
<td>6</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>29</td>
<td>7</td>
<td>6</td>
<td>13</td>
<td>3</td>
<td>5</td>
<td>8</td>
<td>3</td>
</tr>
<tr>
<td>28</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>3</td>
<td>6</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>27</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>26</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>25</td>
<td></td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>24</td>
<td>2</td>
<td>1</td>
<td>4</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>18</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>14</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>
### Table No. 4.2

**Distribution of Scores of the Seven Treatment Groups on the Retention Test**

<table>
<thead>
<tr>
<th>SCORE</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
</tr>
</thead>
<tbody>
<tr>
<td>40</td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>39</td>
<td></td>
<td></td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>38</td>
<td>1</td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>37</td>
<td>2</td>
<td></td>
<td>3</td>
<td>1</td>
<td></td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>36</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>35</td>
<td>2</td>
<td>4</td>
<td>2</td>
<td>4</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>34</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>33</td>
<td>1</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>2</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>32</td>
<td>6</td>
<td>4</td>
<td>4</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>31</td>
<td>2</td>
<td>4</td>
<td>2</td>
<td>4</td>
<td>6</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>30</td>
<td>10</td>
<td>4</td>
<td>6</td>
<td>4</td>
<td>8</td>
<td>4</td>
<td>9</td>
</tr>
<tr>
<td>29</td>
<td>3</td>
<td>5</td>
<td>6</td>
<td>4</td>
<td>2</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>28</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>27</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>26</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>24</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>4</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>6</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>22</td>
<td>1</td>
<td>4</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>1</td>
<td>1</td>
<td>5</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Frequency Distribution of the Seven Treatment Groups in terms of the Time taken to finish (Time in Mts.)

<table>
<thead>
<tr>
<th>Class intervals (mts.)</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
</tr>
</thead>
<tbody>
<tr>
<td>170 - 179</td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>160 - 169</td>
<td>2</td>
<td>2</td>
<td></td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>150 - 159</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>140 - 149</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>130 - 139</td>
<td>4</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>120 - 129</td>
<td>5</td>
<td>2</td>
<td>10</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>110 - 119</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>5</td>
<td>8</td>
<td>4</td>
</tr>
<tr>
<td>100 - 109</td>
<td>8</td>
<td>6</td>
<td>4</td>
<td>2</td>
<td>10</td>
<td>9</td>
<td>7</td>
</tr>
<tr>
<td>90 - 99</td>
<td>6</td>
<td>6</td>
<td>3</td>
<td>12</td>
<td>11</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>80 - 89</td>
<td>4</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td>2</td>
<td>2</td>
<td>9</td>
</tr>
<tr>
<td>70 - 79</td>
<td>8</td>
<td>12</td>
<td>4</td>
<td>3</td>
<td>4</td>
<td>10</td>
<td>9</td>
</tr>
<tr>
<td>60 - 669</td>
<td>6</td>
<td>6</td>
<td>8</td>
<td>4</td>
<td>5</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>50 - 59</td>
<td>2</td>
<td>6</td>
<td>1</td>
<td></td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>40 - 49</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>30 - 39</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
In the table given below are shown the means of the seven treatment groups on the immediate posttest, retention test, percentage of retention and the time taken to finish.

Table No. 4.4

Mean Scores of the Seven Treatment Groups on Immediate Posttest, Retention Test, Percentage of retention and Time

<table>
<thead>
<tr>
<th>Forms</th>
<th>Immediate Posttest</th>
<th>Retention Test</th>
<th>'Loss'</th>
<th>% of Retention</th>
<th>Time (in Minutes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Linear Overt Form</td>
<td>28.36</td>
<td>25.84</td>
<td>1.52</td>
<td>94.64</td>
<td>106.63</td>
</tr>
<tr>
<td>B. Linear Covert Form</td>
<td>30.39</td>
<td>27.15</td>
<td>3.24</td>
<td>89.34</td>
<td>91.19</td>
</tr>
<tr>
<td>C. Response Prompt Overt Form (Copying)</td>
<td>28.10</td>
<td>25.69</td>
<td>2.41</td>
<td>91.42</td>
<td>99.23</td>
</tr>
<tr>
<td>D. Response Prompt Covert Form (Reading)</td>
<td>31.19</td>
<td>25.00</td>
<td>3.19</td>
<td>89.77</td>
<td>84.91</td>
</tr>
<tr>
<td>E. Skip Programme Form</td>
<td>28.78</td>
<td>25.60</td>
<td>3.18</td>
<td>88.95</td>
<td>95.21</td>
</tr>
<tr>
<td>F. Branching Form</td>
<td>27.43</td>
<td>25.36</td>
<td>2.07</td>
<td>92.45</td>
<td>91.95</td>
</tr>
<tr>
<td>G. Hybrid Form</td>
<td>28.56</td>
<td>26.50</td>
<td>2.06</td>
<td>92.79</td>
<td>96.41</td>
</tr>
</tbody>
</table>
OBSERVATIONS

1 Of all the seven forms tried out, the Response Prompt Covert Form (D) seems to be relatively better in effectiveness, both on the immediate posttest and the retention test.

2 Of all the seven forms tried out, the Branching Form (F) seems to be relatively less effective both on the immediate posttest and the retention test.

3 When the percentage of retention is considered, the Response Prompt Covert Form (D) no longer retains its superiority; its 'loss' is 3.19 points, next to the Linear Covert Form (B) whose 'loss' is 3.24 points.

4 The Skip programme Form (E), though third in order of achievement on the immediate posttest, is also the one with considerable 'loss' of 3.18 points.

5 Of all the seven forms tried out, the Linear Overt Form (A) requires the maximum time, while the Response Prompt Covert Form (D) requires the minimum time.

6 The Linear Covert Form (B) also requires shorter time, next only to the Response Prompt Covert Form (D) in this regard.
Comparison of the group means gives a general picture of differences, but does not tell whether the differences are significant. In order to know the statistical significance, the technique of analysis of covariance in duplicate experiment, in randomly selected schools (Lindquist, 1970) is followed. Analysis of covariance takes care of any possibility of the initial differences (for example, intelligence in the present study) influencing the final scores. This method of analysis is adopted because the groups were not matched in terms of initial scores. The method also gives a quantitative picture by revealing the levels at which these differences exist (.01 or .05 levels). The special feature of this design of duplicate experiments is that the class/school variations are also given due consideration so that the inferences cannot mask the effects of classes (i.e., classes selected from different schools).

Analysis of Covariance in Duplicate Experiments: Analysis of the Initial Scores (Intelligence)

In the present investigation, intelligence was taken as an initial measure and the seven treatment groups were randomly formed. The size of the groups differed from school to school; but in any particular school, the seven treatment groups were equal in size.
Where, GT stand for Grand Total  
Tc stands for Glass Total  
The To of 473 in the first cell is got by adding the individual IQs. of four students (as in school 'a' is 4) i.e. = 130+123+117+113 = 473  
T stands for School Total, got by adding the Tc from the seven groups S(i.e. 3341 = 473+485+460+476+494+489+458).  
T^ stands for treatmentwise totals.

### Totals and Means on Initial Scores (Intelligence)

<table>
<thead>
<tr>
<th>Treatments</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>Ts</th>
<th>Ts^2</th>
<th>nc</th>
<th>n</th>
<th>Ts^2/n</th>
<th>Ts/n</th>
<th>Means</th>
</tr>
</thead>
<tbody>
<tr>
<td>Schools</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a</td>
<td>473</td>
<td>485</td>
<td>466</td>
<td>476</td>
<td>494</td>
<td>489</td>
<td>458</td>
<td>3344</td>
<td>11162291</td>
<td>4</td>
<td>25</td>
<td>398652.89</td>
<td>119.32</td>
<td></td>
</tr>
<tr>
<td>b</td>
<td>611</td>
<td>611</td>
<td>605</td>
<td>591</td>
<td>591</td>
<td>590</td>
<td>595</td>
<td>4194</td>
<td>17590536</td>
<td>5</td>
<td>35</td>
<td>502561.03</td>
<td>119.83</td>
<td></td>
</tr>
<tr>
<td>c</td>
<td>595</td>
<td>624</td>
<td>619</td>
<td>619</td>
<td>615</td>
<td>534</td>
<td>590</td>
<td>4196</td>
<td>17606816</td>
<td>5</td>
<td>35</td>
<td>503040.46</td>
<td>119.89</td>
<td></td>
</tr>
<tr>
<td>d</td>
<td>337</td>
<td>350</td>
<td>347</td>
<td>324</td>
<td>345</td>
<td>361</td>
<td>350</td>
<td>2421</td>
<td>5861241</td>
<td>3</td>
<td>21</td>
<td>279106.61</td>
<td>115.29</td>
<td></td>
</tr>
<tr>
<td>e</td>
<td>627</td>
<td>602</td>
<td>723</td>
<td>685</td>
<td>692</td>
<td>696</td>
<td>725</td>
<td>4855</td>
<td>23371025</td>
<td>6</td>
<td>42</td>
<td>561214.88</td>
<td>115.59</td>
<td></td>
</tr>
<tr>
<td>f</td>
<td>616</td>
<td>591</td>
<td>551</td>
<td>507</td>
<td>583</td>
<td>630</td>
<td>599</td>
<td>4187</td>
<td>17530969</td>
<td>5</td>
<td>35</td>
<td>500884.83</td>
<td>119.63</td>
<td></td>
</tr>
<tr>
<td>g</td>
<td>711</td>
<td>747</td>
<td>735</td>
<td>753</td>
<td>750</td>
<td>729</td>
<td>745</td>
<td>5169</td>
<td>26718561</td>
<td>6</td>
<td>42</td>
<td>56156.21</td>
<td>123.07</td>
<td></td>
</tr>
<tr>
<td>h</td>
<td>611</td>
<td>613</td>
<td>586</td>
<td>600</td>
<td>619</td>
<td>617</td>
<td>623</td>
<td>4295</td>
<td>18224381</td>
<td>5</td>
<td>35</td>
<td>520696.03</td>
<td>121.97</td>
<td></td>
</tr>
<tr>
<td>i</td>
<td>621</td>
<td>582</td>
<td>585</td>
<td>593</td>
<td>605</td>
<td>581</td>
<td>596</td>
<td>4135</td>
<td>17096225</td>
<td>5</td>
<td>35</td>
<td>486520.71</td>
<td>118.14</td>
<td></td>
</tr>
<tr>
<td>j</td>
<td>120</td>
<td>118</td>
<td>106</td>
<td>114</td>
<td>126</td>
<td>116</td>
<td>125</td>
<td>825</td>
<td>680625</td>
<td>1</td>
<td>7</td>
<td>97232.14</td>
<td>117.86</td>
<td></td>
</tr>
<tr>
<td>k</td>
<td>118</td>
<td>125</td>
<td>117</td>
<td>108</td>
<td>126</td>
<td>115</td>
<td>126</td>
<td>835</td>
<td>697225</td>
<td>1</td>
<td>7</td>
<td>99503.57</td>
<td>119.28</td>
<td></td>
</tr>
<tr>
<td>Total (T^c)</td>
<td>5480</td>
<td>5515</td>
<td>5444</td>
<td>5483</td>
<td>5541</td>
<td>5457</td>
<td>5504</td>
<td>38427</td>
<td>322</td>
<td>4587569.46</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Means

<table>
<thead>
<tr>
<th></th>
<th>113.32</th>
<th>119.96</th>
<th>113.83</th>
<th>119.29</th>
<th>120.46</th>
<th>118.63</th>
<th>119.65</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total of Means</td>
<td>835.38</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Where, 
GT stands for Grand Total  
Tc stands for Class Total  
The To of 473 in the first cell is got by adding the individual IQs. of four students (as in school 'a' is 4) i.e. = 120+123+117+113 = 473  
The To of 473 in the first cell is got by adding the Tc from the seven groups  
T^ stands for treatment wise totals.
In the following pages are given the computation of sum of Squares for Methods, Classes and Schools and also MxS for Intelligence Scores.

**Step 1:** Compulation of the total and mean for each class, for each school and for each method for the initial scores (Intelligence) Table No. 4.5

**Step 2:** Sums of squares for M, S and C and MxS for the initial scores (Intelligence).

On the basis of the calculations shown in the table, the following computations are done:

i) \[ GT = 38427 \; ; \; N = 322 \]
\[ \frac{(GT)^2}{N} = \frac{(38427)^2}{322} = 4585820.89 \]

ii) \[ \text{Sum of Squares for Schools} \]
\[ \sum \left( \frac{T^2}{n} \right) = 4587669.46 \]
\[ \frac{(GT)^2}{N} = 4585820.89 \]
\[ \text{S.S. for Schools: 1848.57} \]

iii) \[ \text{Sum of Squares for Methods} \]
\[ \sum T^2_m = 5480^2 + 5518^2 + 5444^2 + 5483^2 + 5541^2 + 5457^2 + 5504^2 = 210954695 \]
\[ \sum T^2_{hm} = 210954695 \]
\[ \frac{(GT)^2}{N} = 4585820.89 \]
\[ \text{S.S. for Methods} \; 150.74 \]
Computation of Sum of Squares for Classes for the initial scores (Intelligence)

<table>
<thead>
<tr>
<th>Schools</th>
<th>Treatment</th>
<th>a</th>
<th>b</th>
<th>c</th>
<th>d</th>
<th>e</th>
<th>f</th>
<th>g</th>
<th>h</th>
<th>i</th>
<th>j</th>
<th>k</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td></td>
<td>223729</td>
<td>373321</td>
<td>354025</td>
<td>113509</td>
<td>444889</td>
<td>379456</td>
<td>505571</td>
<td>.375321</td>
<td>.386451</td>
<td>.14400</td>
<td>17974</td>
</tr>
<tr>
<td>B</td>
<td></td>
<td>235225</td>
<td>373321</td>
<td>389376</td>
<td>122500</td>
<td>498244</td>
<td>361201</td>
<td>558000</td>
<td>375769</td>
<td>33824</td>
<td>13924</td>
<td>15225</td>
</tr>
<tr>
<td>C</td>
<td></td>
<td>217155</td>
<td>366025</td>
<td>383161</td>
<td>12100</td>
<td>525625</td>
<td>303601</td>
<td>540225</td>
<td>343396</td>
<td>34223</td>
<td>11236</td>
<td>13689</td>
</tr>
<tr>
<td>D</td>
<td></td>
<td>226576</td>
<td>349281</td>
<td>383161</td>
<td>111557</td>
<td>473344</td>
<td>388449</td>
<td>567000</td>
<td>360000</td>
<td>35164</td>
<td>12996</td>
<td>11654</td>
</tr>
<tr>
<td>E</td>
<td></td>
<td>244036</td>
<td>349281</td>
<td>373225</td>
<td>115600</td>
<td>479864</td>
<td>339899</td>
<td>325000</td>
<td>381516</td>
<td>366625</td>
<td>15875</td>
<td>15225</td>
</tr>
<tr>
<td>F</td>
<td></td>
<td>239131</td>
<td>346100</td>
<td>285156</td>
<td>130021</td>
<td>484416</td>
<td>396900</td>
<td>529934</td>
<td>380889</td>
<td>337561</td>
<td>13455</td>
<td>13225</td>
</tr>
<tr>
<td>G</td>
<td></td>
<td>209764</td>
<td>354025</td>
<td>348100</td>
<td>122500</td>
<td>525625</td>
<td>355801</td>
<td>555024</td>
<td>388129</td>
<td>322624</td>
<td>15625</td>
<td>15876</td>
</tr>
</tbody>
</table>

**Totals**

<table>
<thead>
<tr>
<th>( \sum T_e^2 )</th>
<th>1595907</th>
<th>2513354</th>
<th>2521204</th>
<th>837947</th>
<th>3371907</th>
<th>2503927</th>
<th>3818273</th>
<th>2804465</th>
<th>2444449</th>
<th>97313</th>
<th>99879</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \Sigma T_e^2 / \text{nc} )</td>
<td>389901.75</td>
<td>502670.50</td>
<td>504240.50</td>
<td>279228.33</td>
<td>561334.00</td>
<td>501359.40</td>
<td>636376.83</td>
<td>320883</td>
<td>488889.60</td>
<td>97513</td>
<td>99879</td>
</tr>
</tbody>
</table>

\( \sum (\Sigma T_e^2 / \text{nc}) = 4592145.21 \)
Computations

Using the value of $\sum (x Tc^2/nc)$ the sum of squares for Classes is computed as follows:

**Sum of Squares for Classes**

$$\sum (x Tc^2/nc) = 4592143.21$$

$$\frac{(GT)^2}{N} = \frac{4585820.89}{6322.32}$$

S.S. for Classes $6322.32$

The sum of Squares for MxS is computed by subtracting the S.S. values for schools and methods from that of classes:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>S.S. for Classes</td>
<td>6322.32</td>
</tr>
<tr>
<td>S.S. for Schools</td>
<td>1848.57</td>
</tr>
<tr>
<td></td>
<td>4473.75</td>
</tr>
<tr>
<td>S.S. for Methods</td>
<td>150.74</td>
</tr>
<tr>
<td>S.S. for MxS</td>
<td>4323.01</td>
</tr>
</tbody>
</table>

1) Analysis of the final Scores - Immediate Posttest scores -

As one of the indices of relative effectiveness, the scores on immediate posttest were taken as the final scores while intelligence was taken as the initial score.

The following pages illustrate the computation of Sum of Squares for Methods, Schools, Classes, and for (MxS) for the immediate posttest scores.
Where,
GT stands for Grant Total
Tc stands for Class Total

To on treatments

<table>
<thead>
<tr>
<th>Treatments</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>Ts</th>
<th>$T_s^2$</th>
<th>nc</th>
<th>n</th>
<th>$T_s^2/n$</th>
<th>Means ($T_s/n$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Schools</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a</td>
<td>07</td>
<td>12</td>
<td>113</td>
<td>119</td>
<td>117</td>
<td>110</td>
<td></td>
<td>116</td>
<td>635200</td>
<td>4</td>
<td>28</td>
<td>22885.04</td>
<td>22.46</td>
</tr>
<tr>
<td>b</td>
<td>155</td>
<td>150</td>
<td>139</td>
<td>127</td>
<td>134</td>
<td>145</td>
<td>151</td>
<td>1002</td>
<td>1004004</td>
<td>5</td>
<td>35</td>
<td>28685.83</td>
<td>28.62</td>
</tr>
<tr>
<td>c</td>
<td>139</td>
<td>170</td>
<td>159</td>
<td>168</td>
<td>148</td>
<td>129</td>
<td>141</td>
<td>1053</td>
<td>1108509</td>
<td>5</td>
<td>35</td>
<td>31080.26</td>
<td>30.09</td>
</tr>
<tr>
<td>d</td>
<td>86</td>
<td>79</td>
<td>66</td>
<td>80</td>
<td>94</td>
<td>84</td>
<td>72</td>
<td>560</td>
<td>313600</td>
<td>3</td>
<td>21</td>
<td>14933.33</td>
<td>26.66</td>
</tr>
<tr>
<td>e</td>
<td>196</td>
<td>19</td>
<td>194</td>
<td>222</td>
<td>153</td>
<td>184</td>
<td>196</td>
<td>1375</td>
<td>889625</td>
<td>5</td>
<td>42</td>
<td>20814.90</td>
<td>32.73</td>
</tr>
<tr>
<td>f</td>
<td>147</td>
<td>150</td>
<td>131</td>
<td>112</td>
<td>141</td>
<td>155</td>
<td>158</td>
<td>1021</td>
<td>1042441</td>
<td>5</td>
<td>35</td>
<td>29784.02</td>
<td>29.17</td>
</tr>
<tr>
<td>g</td>
<td>136</td>
<td>173</td>
<td>127</td>
<td>202</td>
<td>182</td>
<td>144</td>
<td>179</td>
<td>1163</td>
<td>1352569</td>
<td>6</td>
<td>42</td>
<td>32204.02</td>
<td>27.69</td>
</tr>
<tr>
<td>h</td>
<td>155</td>
<td>175</td>
<td>182</td>
<td>158</td>
<td>157</td>
<td>127</td>
<td>1103</td>
<td>1216509</td>
<td>5</td>
<td>35</td>
<td>32700.26</td>
<td>31.51</td>
<td></td>
</tr>
<tr>
<td>i</td>
<td>121</td>
<td>155</td>
<td>130</td>
<td>145</td>
<td>124</td>
<td>87</td>
<td>112</td>
<td>584</td>
<td>729316</td>
<td>5</td>
<td>35</td>
<td>20537.60</td>
<td>24.40</td>
</tr>
<tr>
<td>j</td>
<td>14</td>
<td>28</td>
<td>26</td>
<td>30</td>
<td>28</td>
<td>26</td>
<td>34</td>
<td>186</td>
<td>35344</td>
<td>1</td>
<td>7</td>
<td>5049.14</td>
<td>26.55</td>
</tr>
<tr>
<td>k</td>
<td>29</td>
<td>30</td>
<td>29</td>
<td>19</td>
<td>36</td>
<td>28</td>
<td>34</td>
<td>215</td>
<td>46225</td>
<td>1</td>
<td>7</td>
<td>6603.57</td>
<td>30.71</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Treat</th>
<th>1305</th>
<th>1398</th>
<th>1293</th>
<th>1435</th>
<th>1324</th>
<th>1262</th>
<th>1314</th>
<th>9331</th>
<th>322</th>
<th>272238.95</th>
</tr>
</thead>
<tbody>
<tr>
<td>GT</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$T_s^2$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$T_s^2/n$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Means</td>
<td>29.36</td>
<td>30.39</td>
<td>28.10</td>
<td>34.49</td>
<td>28.76</td>
<td>27.43</td>
<td>28.56</td>
<td>202.81</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Where,
GT stands for Grant Total
Tc stands for Class Total
The Tc of 107 in the first cell is got by adding the individual scores of four students (nc in school 'a' is 4) i.e. 30+33+29+15 = 107
Tc stands for School Total, got by adding the Tc from the seven groups i.e. 797 = 107+114+122+108+119+117+110.
As a next step, the Sum of Products were computed taking intelligence as initial scores and immediate posttest scores as final scores.

The details of the computations are given in the following pages.

**Step 1:** Computation of the total and mean for each class, for each school and for each method, for the final scores (immediate posttest) Table No. 4

**Step 2:** Computation of Sum of Squares for M, S and C and MxS for the final Scores (Immediate posttest)

On the basis of the calculations shown in the table, the following computations are done:

1) GT = 9331; N=322
   Therefore, \( \frac{(GT)^2}{N} = \frac{(9331)^2}{322} = 270396.15 \)

2) Sum of Squares for Schools
   \[ \sum (T_{s}^2/n) = 272238.95 \]
   \[ \frac{(GT)^2}{N} = 270396.15 \]
   S.S. for Schools = 1542.60

3) Sum of Squares for Methods
   \[ \sum T_{m}^2 = (1305)^2+(1398)^2+(1293)^2+(1435)^2+ \]
   \[ (1324)^2+(1262)^2+(1314)^2 = 12460719 \]
   \[ \sum T_{m/nm}^2 = 12460719 \div 46 = 270885.19 \]
   \[ \sum T_{m/nm}^2 = 270885.19 \]
   \[ \frac{(GT)^2}{N} = 270396.15 \]
   S.S. for Methods = 480.04
Computation of Sum of Squares for classes for the final scores
(Immediate Posttest)

<table>
<thead>
<tr>
<th>Schools</th>
<th>Treatment</th>
<th>a</th>
<th>b</th>
<th>c</th>
<th>d</th>
<th>e</th>
<th>f</th>
<th>g</th>
<th>h</th>
<th>i</th>
<th>j</th>
<th>k</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.</td>
<td></td>
<td>11440</td>
<td>24025</td>
<td>19321</td>
<td>7396</td>
<td>38415</td>
<td>21609</td>
<td>24336</td>
<td>24425</td>
<td>14041</td>
<td>196</td>
<td>841</td>
</tr>
<tr>
<td>B.</td>
<td></td>
<td>12996</td>
<td>22500</td>
<td>28900</td>
<td>6241</td>
<td>37836</td>
<td>22500</td>
<td>29929</td>
<td>30625</td>
<td>18225</td>
<td>784</td>
<td>900</td>
</tr>
<tr>
<td>C.</td>
<td></td>
<td>1484</td>
<td>19321</td>
<td>25281</td>
<td>4225</td>
<td>37636</td>
<td>17161</td>
<td>16129</td>
<td>28581</td>
<td>16900</td>
<td>784</td>
<td>841</td>
</tr>
<tr>
<td>D.</td>
<td></td>
<td>11664</td>
<td>16129</td>
<td>26224</td>
<td>6400</td>
<td>49284</td>
<td>29584</td>
<td>40804</td>
<td>25244</td>
<td>21025</td>
<td>900</td>
<td>361</td>
</tr>
<tr>
<td>E.</td>
<td></td>
<td>14151</td>
<td>17956</td>
<td>21904</td>
<td>8336</td>
<td>35721</td>
<td>12544</td>
<td>33124</td>
<td>34964</td>
<td>15376</td>
<td>784</td>
<td>1296</td>
</tr>
<tr>
<td>F.</td>
<td></td>
<td>13589</td>
<td>21216</td>
<td>16384</td>
<td>7056</td>
<td>33856</td>
<td>22801</td>
<td>20736</td>
<td>24849</td>
<td>7569</td>
<td>676</td>
<td>1444</td>
</tr>
<tr>
<td>G.</td>
<td></td>
<td>12100</td>
<td>22801</td>
<td>19881</td>
<td>5184</td>
<td>38416</td>
<td>24964</td>
<td>32041</td>
<td>16129</td>
<td>12544</td>
<td>1156</td>
<td>1155</td>
</tr>
<tr>
<td>Totals</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>90943</td>
<td>144048</td>
<td>159895</td>
<td>45338</td>
<td>270965</td>
<td>151163</td>
<td>197099</td>
<td>175197</td>
<td>106280</td>
<td>5280</td>
<td>6839</td>
</tr>
</tbody>
</table>

\[ \sum T_c^2 / nc \]

<table>
<thead>
<tr>
<th>nc</th>
<th>4</th>
<th>5</th>
<th>5</th>
<th>3</th>
<th>6</th>
<th>5</th>
<th>6</th>
<th>5</th>
<th>5</th>
<th>1</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ \sum (\sum T_c^2 / nc) = 275294.67 ]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\[ \sum (\sum T_c^2 / nc) = 275294.67 \]
Computations

Using the value of $x(xTc / ne)$, the sum of squares for classes is computed as follows:

**Sum of Square for Classes**

\[
\sum (xTc^2 / nc) = 275394.67 \\
(\text{GT})^2 / N = 270396.15 \\
\text{S.S. for classes} = 4898.52
\]

The sum of squares for MxS is computed by subtracting the S.S. values for schools and methods from that of classes, as shown below:

- S.S. for Classes = 4898.52
- S.S. for Schools = 1842.80
- 3055.72
- S.S. for Methods = 489.04
- S.S. for MxS = 2566.68

**Step 3: Computation of Sum of Products for Methods, Schools and Classes (Intelligence and Immediate Posttest)**

Grand Total of IQ, that is, $(GT_x) = 38427$

Grand Mean of Immediate Posttest, $(GM_y) = 28.98$

\[
\therefore (GT_x) . (GM_y) = (38427) \times (28.98) \\
= 1113614.46
\]
Sum of Products for Methods

Sum of Products for methods is computed using the treatmentwise IQ totals and the treatmentwise immediate posttest means as follows:

\[
\sum_{M} (T_x, M_y) = (T_{Ax}, M_{Ay}) + (T_{Bx}, M_{By}) + (T_{Gx}, M_{Gy})
\]

\[
= (5480), (28.36) + (5518), (30.39) + (5444), (28.10) \times (5483), (31.19) + ... (3341), (28.46) + (4194), (28.62) + (4196), (30.08) + (2421), (26.66) + (4855), (32.73) + (4187), (29.17) + (5169), (27.69) + (4269), (31.51) + (4135), (24.40) + (825), (26.85) + (835), (30.71) = 1113445.72
\]

\[
\sum_{M} (T_x, M_y) = 1113445.72
\]

\[
(GTx), (GMy) = 1113614.46
\]

Sum of Products for Methods \[= -168.74 \]

Sum of Products for Schools

Sum of Products for Schools is computed using the schoolwise IQ totals and the Schoolwise immediate posttest means as follows:

\[
\sum_{s} (T_x, M_y) = (T_{Ax}, M_{Ay}) + (T_{Bx}, M_{By}) + ... (T_{Gx}, M_{Gy})
\]

\[
= (3341), (28.46) + (4194), (28.62) + (4196), (30.08) + (2421), (26.66) + (4855), (32.73) + (4187), (29.17) + (5169), (27.69) + (4269), (31.51) + (4135), (24.40) + (825), (26.85) + (835), (30.71) = 1113249.52
\]

\[
\sum_{s} (T_x, M_y) = 1113249.52
\]

\[
(GTx), (GMy) = 1113614.46
\]

Sum of Products for Schools \[= -364.94 \]
### Sum of Products for Classes

Sum of Products for Classes is computed using the schoolwise IQ totals and the schoolwise immediate posttest means as follows:

**Method A**

\[
\sum_A (T_{cx})(M_{cy}) = (T_{cax})(M_{cay}) + (T_{cbx})(M_{cby}) + \ldots + (T_{cx})(M_{cky})
\]

\[

\[
= 155244.99
\]

**Method B**

\[
\]

\[
= 167775.47
\]

**Method C**

\[
\]

\[
= 153081.39
\]

**Method D**

\[
\]

\[
= 171358.02
\]

**Method E**

\[
\]

\[
= 159624.60
\]
(630)(30.2) + (728)(24) + (617)(31.4) + (581)(17.4) + (116)(26) +
(115)(38) = 150016.21

(599)(31.6) + (745)(29.83) + (523)(25.4) + (568)(22.4) + (125)(34) +
(126)(34) = 157513.65

\[ \sum(x(Tex).Mey) = 155244.99 + 167775.47 + 153081.39 + 171358.02 + 159624.60 +
150016.21 + 157513.65 = 1114614.33 \]

\[ \sum(x(Tex).Mey) = 1114614.33 \]

GTex,GMy = 1113614.46

\[ \text{Sum of Products for Classes} = 999.87 \]

\[ \text{====} \]
Step 4: Computation of Sum of Products for MxS (Intelligence and Immediate Post test)

Sum of Products for MxS is computed as below:

Sum of Products for Classes = 999.87
Sum of Products for Schools = (−364.94) 1364.81
Sum of Products for Methods = (−168.74)
Sum of Products for MxS = 1533.55

Step 5: Computation of M+(MxS)

\[
\begin{array}{ccc}
\sum x^2 & \sum xy & \sum y^2 \\
M & 150.74 & -168.74 & 480.04 \\
MxS & 4323.01 & 1533.55 & 2566.68 \\
M+(MxS) & 4473.75 & 1364.81 & 3055.72 \\
\end{array}
\]

Step 6: Adjusted Sum of Squares for MxS

\[
\sum y^2 - \frac{(\sum xy)^2}{\sum x^2} \quad \text{(for MxS)}
\]

\[
= 2566.68 - \frac{(1533.55)^2}{4323.01} = 2022.67
\]

Step 7: Adjusted Sum of Squares for M+(MxS)

\[
\sum y^2 - \frac{(\sum xy)^2}{\sum x} \quad \text{(for M+(MxS))}
\]

\[
= 3055.72 - \frac{(1364.81)^2}{4473.75} = 2639.36
\]
Step 8: Reduced Sum of Squares for M

This is obtained by subtracting Step 6 from Step 7.

\[ 2639.36 - 2022.67 = 616.69 \]

Step 9: Reduced METHODS Variance

Reduced Methods Variance = \( \frac{\text{reduced Sum of squares for M}}{\text{df for M}} \)

\[ = \frac{616.69}{6} = 102.78 \]

Step 10: Adjusted MxS (error) Variance

Adjusted MxS Variance = \( \frac{\text{Adjusted sum of Squares for MxS}}{\text{d.f. for adjusted MxS}} \)

\[ = \frac{2022.67}{59} = 34.28 \]

Step 11: Computation of F

\[ F = \frac{\text{Reduced Methods Variance}}{\text{Adjusted MxS Variance}} = \frac{102.78}{34.28} = 2.99 \]

F is significant at .05 level.

The table in the following page shows the analysis of Covariance and the F calculated for the immediate posttest, taking intelligence as the initial score.
Table No. 4.9

Analysis of Covariance of the Immediate Posttest Scores for the Seven Treatment Groups (Taking Intelligence as the Initial Score)

<table>
<thead>
<tr>
<th></th>
<th>$\sum x^2$</th>
<th>$\sum xy$</th>
<th>$\sum y^2$</th>
<th>S.S.</th>
<th>df</th>
<th>F</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>M</td>
<td>150.74</td>
<td>-168.74</td>
<td>489.04</td>
<td>616.69</td>
<td>6</td>
<td>2.99</td>
<td>Significant at .05 level</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(reduced S.S.)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MxS</td>
<td>4333.01</td>
<td>1533.55</td>
<td>2566.68</td>
<td>2022.67</td>
<td>59</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(adjusted S.S.)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M+(MxS)</td>
<td>4473.75</td>
<td>1364.81</td>
<td>3055.72</td>
<td>2639.36</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(adjusted S.S.)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
OBSERVATIONS

It can be seen that the overall differences between the seven treatment means are significant at .05 level. As the differences among the schools have been statistically controlled by 'analysis of covariance in duplicate experiments in randomly selected schools', (Lindquist, 1970) it can be inferred that the differences among the treatment groups are true differences and are neither due to initial differences in intelligence which are indicated by the negative value of the sum of products for methods as -168.74, nor due to school to school variations.

Hence we can safely reject the null hypothesis, and can attribute the differences to the variations in the effectiveness of the programme forms.

Analysis of covariance does not tell us which one treatment is significantly different from others. In such cases, the analysis can further be continued using other derived techniques. The Least Significant Difference (LSD) Test is one such technique using a pooled error variance computed in the analysis of covariance.
The formula for LSD is:

\[ \text{LSD} = \sqrt{\frac{2 \text{MSW}}{n}} \quad \text{with df = 59} \]

where \( \text{MSW} \) = error variance

\( n = \text{no. of subjects in each treatment group (46)} \).

LSD at 5% = \( t_{0.5} \times \sqrt{\frac{2 \text{MSW}}{n}} \)

\[ = (2.00) \times \sqrt{\frac{2 \times 34.28}{46}} = 2.4414 \]

LSD at 1% = \( t_{0.1} \times \sqrt{\frac{2 \text{MSW}}{n}} \)

\[ = (2.66) \times \sqrt{\frac{2 \times 34.28}{46}} = 3.24706 \]
### Table 4.10
Significance of Difference between Means of any Two Treatments on the Immediate Posttest (Using the technique of L.S.D.)

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Difference between Means</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>A &amp; B</td>
<td>2.03</td>
<td>Not significant</td>
</tr>
<tr>
<td>A &amp; C</td>
<td>0.26</td>
<td>Not significant</td>
</tr>
<tr>
<td>A &amp; D</td>
<td>2.83</td>
<td>Significant at .05 level</td>
</tr>
<tr>
<td>A &amp; E</td>
<td>0.42</td>
<td>Not significant</td>
</tr>
<tr>
<td>A &amp; F</td>
<td>0.93</td>
<td>Not significant</td>
</tr>
<tr>
<td>A &amp; G</td>
<td>0.20</td>
<td>Not significant</td>
</tr>
<tr>
<td>B &amp; C</td>
<td>2.29</td>
<td>Not significant</td>
</tr>
<tr>
<td>B &amp; D</td>
<td>0.80</td>
<td>Not significant</td>
</tr>
<tr>
<td>B &amp; E</td>
<td>1.61</td>
<td>Not significant</td>
</tr>
<tr>
<td>B &amp; F</td>
<td>2.96</td>
<td>Significant at .05 level</td>
</tr>
<tr>
<td>B &amp; G</td>
<td>1.83</td>
<td>Not significant</td>
</tr>
<tr>
<td>C &amp; D</td>
<td>3.09</td>
<td>Significant at .05 level</td>
</tr>
<tr>
<td>C &amp; E</td>
<td>0.68</td>
<td>Not significant</td>
</tr>
<tr>
<td>C &amp; F</td>
<td>0.67</td>
<td>Not significant</td>
</tr>
<tr>
<td>C &amp; G</td>
<td>0.46</td>
<td>Not significant</td>
</tr>
<tr>
<td>D &amp; E</td>
<td>2.41</td>
<td>Not significant</td>
</tr>
<tr>
<td>D &amp; F</td>
<td>3.76</td>
<td>Significant at .01 level</td>
</tr>
<tr>
<td>D &amp; G</td>
<td>2.63</td>
<td>Significant at .05 level</td>
</tr>
<tr>
<td>E &amp; F</td>
<td>1.35</td>
<td>Not significant</td>
</tr>
<tr>
<td>E &amp; G</td>
<td>0.22</td>
<td>Not significant</td>
</tr>
<tr>
<td>F &amp; G</td>
<td>1.13</td>
<td>Not significant</td>
</tr>
</tbody>
</table>
OBSERVATIONS

i) The differences between the following forms are significant at .01 level
   - The Response Prompt Covert Form (Form D) and the Branching Form (Form F)

ii) The differences between the following forms are significant at .05 level
   - The Response Prompt Covert Form (Form D) and the Linear Overt Form (Form A)
   - The Response Prompt Covert Form (Form D) and the Response Prompt Overt Form (Form C)
   - The Response Prompt Covert Form (Form D) and the Hybrid Form (Form G)
   - The Branching Form (Form F) and the Linear Covert Form (Form B).

In short, the differences between the Response Prompt Covert Form and four other forms are significant.
ii) **Analysis of the Final Scores - Percentage of Retention**

In the following pages are given the analysis of covariance using the percentage of retention as the final score and intelligence as the initial score. The details of the computation include the Sum of Squares for Methods, Classes, Schools and MxS. The Sum of Products are computed as before and the F value is deduced.

The details of the computation involved the following steps:

**Step 1. Computation of the totals and means for each class, for each school, and for each method for the final scores (percentage of retention)** Table No. 4.11
GT stands for Grand Total
To stands for Class Total/
The Te of 393.94 in the first cell is got by adding the individual
i.e. 2478.28 = 393.94+362.11+352.12+302.35+57.74+396.97+313.05

<table>
<thead>
<tr>
<th>Treatment</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>Ts</th>
<th>$T_s^2$</th>
<th>$T_s^2/n$</th>
<th>Means $T_s/n$</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>393.94</td>
<td>362.11</td>
<td>352.12</td>
<td>302.35</td>
<td>357.74</td>
<td>300.97</td>
<td>313.05</td>
<td>2478.28</td>
<td>6141871.75</td>
<td>28</td>
<td>219352.55</td>
</tr>
<tr>
<td>b</td>
<td>453.55</td>
<td>395.15</td>
<td>386.19</td>
<td>492.80</td>
<td>35.14</td>
<td>380.55</td>
<td>457.92</td>
<td>2984.30</td>
<td>8906046.49</td>
<td>35</td>
<td>254458.47</td>
</tr>
<tr>
<td>c</td>
<td>428.75</td>
<td>401.68</td>
<td>445.52</td>
<td>364.36</td>
<td>400.03</td>
<td>389.74</td>
<td>382.21</td>
<td>2812.49</td>
<td>7910100.00</td>
<td>35</td>
<td>226602.83</td>
</tr>
<tr>
<td>d</td>
<td>237.76</td>
<td>257.59</td>
<td>300.00</td>
<td>293.64</td>
<td>248.80</td>
<td>296.67</td>
<td>300.00</td>
<td>1934.45</td>
<td>3742096.80</td>
<td>21</td>
<td>178195.09</td>
</tr>
<tr>
<td>e</td>
<td>513.33</td>
<td>513.54</td>
<td>556.98</td>
<td>531.75</td>
<td>499.16</td>
<td>503.17</td>
<td>557.36</td>
<td>3675.29</td>
<td>13307756.58</td>
<td>42</td>
<td>321613.35</td>
</tr>
<tr>
<td>f</td>
<td>457.15</td>
<td>462.72</td>
<td>455.73</td>
<td>454.26</td>
<td>441.89</td>
<td>419.27</td>
<td>3139.76</td>
<td>9358032.85</td>
<td>35</td>
<td>251659.79</td>
<td>89.70</td>
</tr>
<tr>
<td>g</td>
<td>560.92</td>
<td>555.61</td>
<td>569.42</td>
<td>530.38</td>
<td>550.48</td>
<td>555.65</td>
<td>550.16</td>
<td>3931.82</td>
<td>15156209.31</td>
<td>42</td>
<td>368076.33</td>
</tr>
<tr>
<td>h</td>
<td>477.02</td>
<td>434.35</td>
<td>411.02</td>
<td>453.91</td>
<td>336.12</td>
<td>364.79</td>
<td>411.11</td>
<td>2938.22</td>
<td>8638136.76</td>
<td>35</td>
<td>246661.05</td>
</tr>
<tr>
<td>i</td>
<td>450.08</td>
<td>459.74</td>
<td>458.74</td>
<td>484.66</td>
<td>500.00</td>
<td>472.41</td>
<td>449.71</td>
<td>3273.24</td>
<td>10721979.05</td>
<td>35</td>
<td>308491.34</td>
</tr>
<tr>
<td>j</td>
<td>100.00</td>
<td>100.00</td>
<td>64.29</td>
<td>100.00</td>
<td>57.14</td>
<td>100.00</td>
<td>97.06</td>
<td>618.49</td>
<td>3235209.88</td>
<td>7</td>
<td>54647.12</td>
</tr>
<tr>
<td>k</td>
<td>100.00</td>
<td>93.33</td>
<td>55.17</td>
<td>57.89</td>
<td>91.67</td>
<td>97.37</td>
<td>100.00</td>
<td>596.43</td>
<td>354536.83</td>
<td>7</td>
<td>50648.12</td>
</tr>
</tbody>
</table>

$t_treat^{2} = 4173.40$ $4037.91$ $4037.19$ $4077.67$ $3950.54$ $3999.21$ $4097.85$ $29882.77$ $GT$

$\sum (T_s/n)$

Mean $90.72$ $87.78$ $87.76$ $88.64$ $96.09$ $86.93$ $89.08$ $617.00$

Where,
GT stands for Grand Total
To stands for Class Total
The To of 393.94 in the first cell is got by adding the individual
percentages of retention of four students (nc in school 'a' is 4)
i.e., $393.94 = 100 + 93.94 + 100 + 100.$
$T_s$ stands for School Total, got by adding the To from seven groups
i.e. $2478.28 = 393.94 + 362.11 + 352.12 + 302.35 + 57.74 + 396.97 + 313.05$
Step 2: Computation of the Sum of Squares for M, S and C and MxS for the final Scores (Percentage of retention)

On the basis of the values shown in the table, the following computations are made:

i) \( \text{GT} = 28383.77; \ N = 322 \)

Therefore \( \frac{(\text{GT})^2}{N} = \frac{(28383.77)^2}{322} = 2501982.60 \)

ii) Sum of Squares for Schools

\[
\sum \left( \frac{T^2}{n} \right) = 2507606.02 \\
\frac{(\text{GT})^2}{N} = 2501982.60 \\
\text{S.S. for Schools} = 5823.42
\]

iii) Sum of Squares for Methods

\[
\sum T^2_m = (4173.40)^2 + (4037.91)^2 + (4037.19)^2 + \\
(4077.67)^2 + (3960.54)^2 + (3999.21)^2 + \\
(4097.85)^2 = 115120212.76 \\
\frac{\sum T^2_m}{nm} = \frac{115120212.76}{46} = 2502613.32 \\
\sum T^2_m/nm = 2502613.32 \\
\frac{(\text{GT})^2}{N} = 2501982.60 \\
\text{S.S. for Methods} = 630.72
\]
### TABLE NO. 4.12

Computation of Sum of Squares for Classes for the final scores

Percentage of Retention

<table>
<thead>
<tr>
<th>Schools</th>
<th>Treatment</th>
<th>a</th>
<th>b</th>
<th>c</th>
<th>d</th>
<th>e</th>
<th>f</th>
<th>g</th>
<th>h</th>
<th>i</th>
<th>j</th>
<th>k</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td></td>
<td>155188.72</td>
<td>205707.30</td>
<td>158326.56</td>
<td>50529.81</td>
<td>263507.69</td>
<td>208988.12</td>
<td>314031.24</td>
<td>237548.08</td>
<td>203382.96</td>
<td>10000.00</td>
<td>10000.00</td>
</tr>
<tr>
<td>B</td>
<td></td>
<td>131123.65</td>
<td>158523.42</td>
<td>161507.53</td>
<td>66347.45</td>
<td>263723.33</td>
<td>214109.79</td>
<td>306704.62</td>
<td>188573.06</td>
<td>210442.38</td>
<td>10000.00</td>
<td>8710.48</td>
</tr>
<tr>
<td>C</td>
<td></td>
<td>123958.49</td>
<td>149142.71</td>
<td>194389.07</td>
<td>90000.00</td>
<td>310226.72</td>
<td>192482.76</td>
<td>323101.29</td>
<td>189937.44</td>
<td>10000.00</td>
<td>8710.48</td>
<td></td>
</tr>
<tr>
<td>D</td>
<td></td>
<td>94115.52</td>
<td>124251.84</td>
<td>132758.20</td>
<td>86224.44</td>
<td>282758.06</td>
<td>216904.43</td>
<td>281615.13</td>
<td>208634.28</td>
<td>234895.31</td>
<td>10000.00</td>
<td>3351.25</td>
</tr>
<tr>
<td>E</td>
<td></td>
<td>127977.90</td>
<td>148332.81</td>
<td>160924.00</td>
<td>61901.44</td>
<td>249160.70</td>
<td>268352.14</td>
<td>336957.03</td>
<td>145088.65</td>
<td>250000.00</td>
<td>3264.97</td>
<td>8403.38</td>
</tr>
<tr>
<td>F</td>
<td></td>
<td>157885.18</td>
<td>144818.30</td>
<td>151897.36</td>
<td>88013.08</td>
<td>253180.04</td>
<td>195866.77</td>
<td>308746.92</td>
<td>133071.74</td>
<td>223171.20</td>
<td>10000.00</td>
<td>9480.91</td>
</tr>
<tr>
<td>G</td>
<td></td>
<td>98000.30</td>
<td>238065.92</td>
<td>146084.48</td>
<td>90000.00</td>
<td>310650.16</td>
<td>175787.33</td>
<td>336585.62</td>
<td>159011.43</td>
<td>202239.08</td>
<td>9420.64</td>
<td>10000.00</td>
</tr>
</tbody>
</table>

**Totals**

|         | a     | b     | c     | d     | e     | f     | g     | h     | i     | j     | k     |
|---------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
|         | 885279.76 | 1287442.60 | 1134586.10 | 539016.22 | 19390006.53 | 2210239.70 | 1242264.65 | 1572473.31 | 56618.81 | 52989.74 | 52989.74 |

**\(\Sigma e^2\)**

|         | 5     | 5     | 5     | 5     | 5     | 5     | 5     | 5     | 5     | 5     |
|---------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
|         | 1     | 1     | 1     | 1     | 1     | 1     | 1     | 1     | 1     | 1     | 1     |

**\(\Sigma e^2/nc\)**

|         | 221319.94 | 257488.52 | 22617.22 | 179672.07 | 322201.11 | 261979.67 | 365373.28 | 248452.93 | 305914.66 | 56618.81 | 52989.74 |

**\(\Sigma (e^2/nc)\)** = 2533128.15
Using the value of $\sum \left( \frac{\sum T^2}{nc} \right)$, the sum of Squares for Classes is computed as below:

**Sum of Squares for Classes**

$$\sum \left( \frac{\sum T^2}{nc} \right) = 2523128.15$$

$$\frac{(GT)^2}{N} = 2501982.60$$

$$= 21145.55$$

The sum of squares for MxS is computed by subtracting the S.S. values for Schools and Methods from that of Classes.

S.S. for Classes = 21145.55
S.S. for Schools = 5823.42
S.S. for Methods = 630.72
S.S. for MxS = 14691.41

**Step 3: Computation of Sum of Products for Methods, Schools and Classes (Intelligence and Percentage of retention)**

Grand Total of IQ ($GT_x$) = 38427

Grand Mean Percentage of Retention ($GM_z$) = 88.14

\[ \therefore (GT_x)(GM_z) = 38427 \times 88.14 = 3386955.78 \]

**Sum of Products for Methods**

Sum of Products for methods is computed using the treatmentwise Intelligence totals and the treatmentwise percentage of retention as follows:
$\sum_{M} (T_x M_z) = (T_{ax})(M_{az}) + (T_{bx})(M_{bz}) + \ldots$ 
\[\ldots (T_{gx})(M_{gz})\]

\[= (5480)(90.72) + (5518)(87.78) +
(5441)(87.76) + (5483)(88.64) +
(5541)(86.09) + (5457)(86.93) +
(5504)(89.08) = 3386992.22\]

$\sum_{S} (T_x M_z) = 3386992.22$

GT$_x$GM$_z$ = 3386955.78

Sum of Products for Methods = 3644

**Sum of Products for Schools**

Sum of Products for Schools is computed using the school-wise Intelligence totals and the schoolwise percentage of retention immediate posttest means as follows:

$\sum_{S} (T_x M_z) = (T_{ax})(M_{az}) + (T_{bx})(M_{bz}) + \ldots$ 
\[\ldots (T_{kx})(M_{kz})\]

\[= (3341)(88.51) + (4194)(85.26) +
(4196)(80.35) + (2421)(92.11) +
(4855)(87.5) + (4187)(89.7) +
(5169)(93.61) + (4269)(83.94) +
(4135)(93.57) + (825)(88.35) +
(835)(85.06) = 3386861.41\]

$\sum_{S} (T_x M_z) = 3386861.41$

GT$_x$GM$_z$ = 3386955.78

Sum of Products for Schools = 94.37
Sum of Products for Classes (Intelligence and Percentage of retention)

Sum of Products for Classes is computed using the schoolwise Intelligence totals and
the schoolwise mean percentage of retention.

Method A = \[ \sum A(T_{cx}, M_{cz}) = (T_{cax}, M_{eaz}) + (T_{chx}, M_{cbz}) + \ldots + (T_{ckx}, M_{ckz}) \]

\[ = (473, 98.49) + (611, 90.71) + (595, 85.75) + (337, 79.25) + (667, 85.55) + \]
\[ + (616, 91.43) + (711, 93.48) + (611, 95.4) + (621, 90.19) + (120, 100) + \]
\[ + (118, 100) = 497682.48 \]

Method B = \( (485, 90.52) + (611, 79.63) + (624, 80.37) + (350, 85.86) + (662, 85.59) + \)
\[ + (601, 92.54) + (747, 92.6) + (613, 86.85) + (582, 91.74) + (118, 100) + \]
\[ + (125, 93.33) = 484305.31 \]

Method C = \( (466, 88.03) + (605, 77.23) + (619, 89.10) + (349, 100) + (725, 92.83) + \)
\[ + (551, 87.74) + (735, 94.74) + (556, 82.20) + (595, 91.74) + (106, 64.29) \]
\[ + (117, 55.17) = 478196.15 \]

Method D = \( (476, 75.58) + (591, 98.56) + (619, 72.87) + (334, 97.88) + (688, 88.62) + \)
\[ + (607, 93.14) + (753, 88.43) + (600, 90.78) + (593, 98.03) + (114, 100) + \]
\[ + (108, 57.89) = 485717.43 \]
Method E = (494)(89.43) + (591)(77.02) + (615)(80) + (340)(82.93) + (692)(83.19) + (583)(90.85) + (750)(96.74) + (619)(77.22) + (605)(100) + (126)(91.67) = 477230.71


Method G = (458)(78.26) + (595)(97.58) + (590)(76.44) + (350)(100) + (725)(92.89) + (599)(83.85) + (745)(96.69) + (623)(82.22) + (568)(89.94) + (125)(97.06) + (126)(100) = 490649.71

\[ \sum (\sum (T_{ex})(M_{oz})) = 497682.48 + 484305.31 + 478186.15 + 485717.43 + 477230.71 + 474905.55 + 490649.71 = 33,88,677.34 \]

\[ \sum (\sum (T_{ex})(M_{oz})) = 338677.34 \]  

\[ GT_x GM_z = 3386955.78 \]

Sum of Products for Classes = 1,721,565
Step 4: Computation of Sum of Products for MxS (Intelligence and Percentage of retention)

Sum of Products for MxS is computed as below:

- Sum of Products for Classes = 1721.56
- Sum of Products for Schools = -94.37
  - 1915.93
- Sum of Products for Methods = -36.44
- Sum of Products for MxS = 1779.49

Step 5: Computation of \( M(\text{MxS}) \)

\[
\begin{array}{ccc}
\Sigma x^2 & \Sigma xz & \Sigma z^2 \\
M & 150.74 & -36.44 & 630.72 \\
MxS & 4323.01 & 1779.49 & 14691.41 \\
M+(\text{MxS}) & 4473.75 & 1743.05 & 15322.13 \\
\end{array}
\]

Step 6: Adjusted Sum of Squares for MxS

\[
\Sigma z^2 - \frac{(\Sigma xz)^2}{\Sigma x^2} \quad \text{(for MxS)}
\]

\[
14691.41 - \frac{(1779.49)^2}{4323.01} = 13958.92
\]

Step 7: Adjusted Sum of Squares for \( M+(\text{MxS}) \)

\[
\Sigma z^2 - \frac{(\Sigma xz)^2}{\Sigma x^2} \quad \text{(for } M+(\text{MxS}) \text{)}
\]

\[
= 15322.13 - \frac{(1743.05)^2}{4473.75} = 14643.01
\]
Step 8: Reduced Sum of Squares for M

This is obtained by subtracting step 6 from step 7.

\[ 14643.01 - 13958.92 = 684.09 \]

Step 9: Reduced METHODS Variance

Reduced Methods Variance = \( \frac{\text{Reduced Sum of Squares for } M}{\text{df for } M} \)

\[ = \frac{684.09}{6} = 114.01 \]

Step 10: Adjusted (MxS) error variance

Adjusted sum of squares for M = \( \frac{13958.92}{59} \)

\[ = 236.59 \]

Step 11: Computation of F

\[ F = \frac{\text{Reduced Methods Variance}}{\text{Adjusted MxS Variance}} \]

\[ = \frac{114.01}{236.59} = 0.48 \]

F is not significant

The table in the following page shows the analysis of covariance and the F calculated for the percentage of retention, taking intelligence as the initial score.
### Analysis of Covariance of the Percentage of Retention Scores for the Seven Treatment Groups (Taking Intelligence as the Initial Score)

<table>
<thead>
<tr>
<th></th>
<th>$\Sigma x^2$</th>
<th>$\Sigma xz$</th>
<th>$\Sigma z^2$</th>
<th>S.S.</th>
<th>df</th>
<th>F</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>$M$</td>
<td>150.74</td>
<td>-36.44</td>
<td>630.72</td>
<td>684.09</td>
<td>6</td>
<td>0.48</td>
<td>Not significant</td>
</tr>
<tr>
<td></td>
<td>(reduced S.S.)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$MxS$</td>
<td>4323.01</td>
<td>1779.49</td>
<td>14691.41</td>
<td>13958.92</td>
<td>59</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(adjusted S.S.)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$M+(MxS)$</td>
<td>4473.75</td>
<td>1743.05</td>
<td>15322.13</td>
<td>14643.01</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(adjusted S.S.)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
OBSERVATIONS

It can be seen that the overall differences between the seven treatment means are not significant even at .05 level. As the differences among the schools have been statistically controlled by the design used, and as school variations are also controlled, it can be safely inferred that there are no true differences among the treatments in terms of the percentage retained.

Hence the null hypothesis is retained indicating that the programme forms do not differ statistically in terms of the percentage of retention.

LSD is also calculated using the formula:

$$\text{LSD at } 5\% = t_{0.5} \times \sqrt{\frac{2\times MSW}{n}}$$

$$= 2.00 \times \sqrt{\frac{2 \times 236.59}{46}}$$

$$= 6.4144$$

$$\text{LSD at } 1\% = t_{0.1} \times \sqrt{\frac{2\times MSW}{n}}$$

$$= 2.66 \times \sqrt{\frac{2 \times 236.59}{46}}$$

$$= 8.53115$$
### Table No. 4.14

**Significance of Difference Between Means of any Two Treatments on the Percentage of Retention**

(Using the technique of L.S.D.)

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Difference between Means</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>A &amp; B</td>
<td>5.30</td>
<td>Not significant</td>
</tr>
<tr>
<td>A &amp; C</td>
<td>3.22</td>
<td>Not significant</td>
</tr>
<tr>
<td>A &amp; D</td>
<td>4.87</td>
<td>Not significant</td>
</tr>
<tr>
<td>A &amp; E</td>
<td>5.69</td>
<td>Not significant</td>
</tr>
<tr>
<td>A &amp; F</td>
<td>2.19</td>
<td>Not significant</td>
</tr>
<tr>
<td>A &amp; G</td>
<td>1.85</td>
<td>Not significant</td>
</tr>
<tr>
<td>B &amp; C</td>
<td>2.08</td>
<td>Not significant</td>
</tr>
<tr>
<td>B &amp; D</td>
<td>0.43</td>
<td>Not significant</td>
</tr>
<tr>
<td>B &amp; E</td>
<td>0.39</td>
<td>Not significant</td>
</tr>
<tr>
<td>B &amp; F</td>
<td>3.11</td>
<td>Not significant</td>
</tr>
<tr>
<td>B &amp; G</td>
<td>3.45</td>
<td>Not significant</td>
</tr>
<tr>
<td>C &amp; D</td>
<td>1.65</td>
<td>Not significant</td>
</tr>
<tr>
<td>C &amp; E</td>
<td>2.47</td>
<td>Not significant</td>
</tr>
<tr>
<td>C &amp; F</td>
<td>1.03</td>
<td>Not significant</td>
</tr>
<tr>
<td>C &amp; G</td>
<td>1.37</td>
<td>Not significant</td>
</tr>
<tr>
<td>D &amp; E</td>
<td>0.82</td>
<td>Not significant</td>
</tr>
<tr>
<td>D &amp; F</td>
<td>2.68</td>
<td>Not significant</td>
</tr>
<tr>
<td>D &amp; G</td>
<td>3.02</td>
<td>Not significant</td>
</tr>
<tr>
<td>E &amp; F</td>
<td>3.50</td>
<td>Not significant</td>
</tr>
<tr>
<td>E &amp; G</td>
<td>3.84</td>
<td>Not significant</td>
</tr>
<tr>
<td>F &amp; G</td>
<td>0.34</td>
<td>Not significant</td>
</tr>
</tbody>
</table>
From the table for L.S.D., it is seen that the differences between any two treatments are not significant as far as the percentage of retention is concerned. Thus, whatever differences existed on the immediate posttest disappeared after six weeks.

As the differences between the means of the seven treatment groups are not significant, the Null hypothesis is retained.

Analysis of the Final Scores –
Time taken to finish the programme

The effectiveness of a programme form is also judged in terms of the time taken by the seven treatment groups. The time (in minutes) taken by each individual pupil was noted down to calculate the average time taken by each class, by each school and by each treatment group.

The following pages show the computation of the Sum of Squares and Sum of Products for Methods, Schools and MxS.

Step 1: Computation of the total and mean for each class, for each school and for each method, for final score (Time taken to finish) – Table No. 4;15
## Totals and Means on Final Scores - Time taken to finish

<table>
<thead>
<tr>
<th>School</th>
<th>Treatment</th>
<th>Total Time (s)</th>
<th>Mean Time (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>490</td>
<td>143.57</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>465</td>
<td>139.81</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>420</td>
<td>131.57</td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>390</td>
<td>127.50</td>
<td></td>
</tr>
<tr>
<td>E</td>
<td>350</td>
<td>116.25</td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>315</td>
<td>105.86</td>
<td></td>
</tr>
<tr>
<td>G</td>
<td>280</td>
<td>98.71</td>
<td></td>
</tr>
</tbody>
</table>

Note: GT stands for Grant Total, Tc stands for Class Total, Ts stands for School Total, and $T_{n}$ stands for the sum of the individual times of four students in the school.

### Calculations:
- **GT** = 143.57
- **Tc** = 143.57
- **Ts** = 143.57
- **$T_{n}$** = 143.57

**Means**:
- $\bar{X}_0 = 6.63$ (Mean of $T_{n}$)
- $\bar{X}_1 = 91.19$ (Mean of $T_{n}$)
- $\bar{X}_2 = 99.23$ (Mean of $T_{n}$)
- $\bar{X}_3 = 84.91$ (Mean of $T_{n}$)
- $\bar{X}_4 = 95.21$ (Mean of $T_{n}$)
- $\bar{X}_5 = 91.95$ (Mean of $T_{n}$)
- $\bar{X}_6 = 95.41$ (Mean of $T_{n}$)

**Treatments**:
- A: 490
- B: 465
- C: 420
- D: 390
- E: 350
- F: 315
- G: 280

**Observations**:
- $n$ = 4 students

**Additional Calculations**:
- $\sum T_{n} = 143.57$
- $\sum T_{n}^2 = 143.57$
- $\sum T_{n}^3 = 143.57$
- $\sum T_{n}^4 = 143.57$
- $\sum T_{n}^5 = 143.57$
- $\sum T_{n}^6 = 143.57$

**Further Analysis**:
- By adding the $T_{n}$ from the seven groups.
Step 2: Computation of the Sum of Squares for M, S and C and MxS for final scores (Time)

On the basis of the calculations shown in the table, the following computations are done:

i) \( GT = 30616; \quad N = 322 \)
Therefore \( \frac{(GT)^2}{N} = \frac{(30616)^2}{322} = 2910992.09 \)

ii) Sum of squares for schools
\[ \sum (T_{s}^2/n) = 3020694.97 \]
\[ \frac{(GT)^2}{N} = \frac{2910992.09}{109702.88} \]
S.S. for Schools = 109702.88

iii) Sum of Squares for Methods
\[ \sum T_{m}^2 = (4905)^2 + (4195)^2 + (3906)^2 + (4380)^2 + (4230)^2 + (4435)^2 \]
\[ \sum T_{m}^2 = 134499636 \]
\[ \sum T_{m/nn}^2 = \frac{134499636}{46} = 2923905.13 \]
\[ \frac{(GT)^2}{N} = \frac{2910992.09}{109702.88} \]
S.S. for Methods = 12913.04
### Computation of Sum of Squares for Classes for Final Scores

(Time taken to finish the programme) **TABU**

<table>
<thead>
<tr>
<th>Schools</th>
<th>Treatment</th>
<th>a</th>
<th>b</th>
<th>c</th>
<th>d</th>
<th>e</th>
<th>f</th>
<th>g</th>
<th>h</th>
<th>i</th>
<th>j</th>
<th>k</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td></td>
<td>37s225</td>
<td>308025</td>
<td>270400</td>
<td>62500</td>
<td>324900</td>
<td>375225</td>
<td>270400</td>
<td>297025</td>
<td>250000</td>
<td>13225</td>
<td>10000</td>
</tr>
<tr>
<td>B</td>
<td></td>
<td>354025</td>
<td>245025</td>
<td>178400</td>
<td>55725</td>
<td>134025</td>
<td>230800</td>
<td>173225</td>
<td>203500</td>
<td>275625</td>
<td>10000</td>
<td>5625</td>
</tr>
<tr>
<td>C</td>
<td></td>
<td>324900</td>
<td>270400</td>
<td>26525</td>
<td>38025</td>
<td>354025</td>
<td>348100</td>
<td>141400</td>
<td>216325</td>
<td>297025</td>
<td>7225</td>
<td>11035</td>
</tr>
<tr>
<td>D</td>
<td></td>
<td>384000</td>
<td>193800</td>
<td>152100</td>
<td>52400</td>
<td>106900</td>
<td>706995</td>
<td>197541</td>
<td>207025</td>
<td>205902</td>
<td>8100</td>
<td>4225</td>
</tr>
<tr>
<td>E</td>
<td></td>
<td>297025</td>
<td>275825</td>
<td>220900</td>
<td>34225</td>
<td>422300</td>
<td>295225</td>
<td>159025</td>
<td>156025</td>
<td>235025</td>
<td>12100</td>
<td>7225</td>
</tr>
<tr>
<td>F</td>
<td></td>
<td>240100</td>
<td>216225</td>
<td>190625</td>
<td>30625</td>
<td>384000</td>
<td>302500</td>
<td>211600</td>
<td>115600</td>
<td>291600</td>
<td>10000</td>
<td>4225</td>
</tr>
<tr>
<td>G</td>
<td></td>
<td>342225</td>
<td>260100</td>
<td>12125</td>
<td>62125</td>
<td>313600</td>
<td>261225</td>
<td>324900</td>
<td>172225</td>
<td>250000</td>
<td>13225</td>
<td>5625</td>
</tr>
</tbody>
</table>

**Total**

\[ \Sigma T_c^2 = 2320900 \]

\[ \Sigma T_c^2/nc = \begin{array}{cccccccccccc}
4 & 5 & 5 & 3 & 6 & 5 & 6 & 5 & 5 & 1 & 1 \\
550225 & 333300 & 283350 & 105166.86 & 350058.33 & 309540 & 280198.50 & 273325 & 365035 & 73875 & 47950
\end{array} \]

\[ \Sigma(\Sigma T_c^2/nc) = 3061723.49 \]
Computations

Using the value of $\sum Tc^2/nc$, the sum of squares for classes is computed as follows:

**Sum of Squares for Classes**

\[ \sum (\sum Tc^2/nc) = 3061723.49 \]
\[ (GT)^2/N = 2910992.09 \]
\[ S.S. for Classes = 150731.40 \]

The sum of squares for MxS is computed by subtracting the S.S. values for schools and methods from that of classes.

\[ S.S. for Classes = 150731.40 \]
\[ S.S. for Schools = 109702.88 \]
\[ S.S. for Methods = 12913.04 \]
\[ S.S. for MxS = 28115.48 \]

**Step 3: Computation of Sum of Products for Methods, Schools and Classes (Intelligence and Time)**

Grand Total of IQ\(^+\) that is, \((GT_x) = 38427\)

Grand Mean Time that is, \((GM_t) = 95.08\)

\[ \therefore (GT_x)(GM_t) = 38427 \times 95.08 = 3653639.16 \]

**Sum of Products for Methods**

Sum of products for methods is computed using the treatmentwise Intelligence totals and the treatmentwise meantime, as follows:
\[
\sum M(T_X, M_t) = (T_{Ax})(M_{at}) + (T_{bX})(M_{bt}) + \ldots + (T_{kX})(M_{kt})
\]

\[
= (5480)(106.63) + (5518)(91.19) + (5444)(99.23) + (5483)(84.91) + (5541)(95.21) + (5457)(91.95) + (5504)(96.41) = 3653258.87
\]

\[
\sum M(T_X, M_t) = 3653258.87
\]

\[
G_T, G_M = 3653639.16
\]

Sum of Products for Methods

Sum of Products for Schools is computed using the schoolwise Intelligence totals and the schoolwise meantime as follows:

\[
\sum s(T_X, M_t) = (T_{ax})(M_{at}) + (T_{bX})(M_{bt}) + \ldots + (T_{kX})(M_{kt})
\]

\[
= (3341)(143.57) + (4194)(10028) + (4196)(89.42) + (2421)(70.0) + (4855)(89.76) + (4187)(104.85) + (5169)(74.07) + (4269)(87.57) + (4135)(102.42) + (825)(102.14) + (835)(81.42) = 3652171.82
\]

\[
\sum s(T_X, M_t) = 3652171.82
\]

\[
(G_T)(G_M) = 3653639.16
\]

Sum of Products for Schools

\[
\sum s(T_X, M_t) = 3652171.82
\]

\[
(G_T)(G_M) = 3653639.16
\]

Sum of Products for Schools

\[
\sum s(T_X, M_t) = 3652171.82
\]

\[
(G_T)(G_M) = 3653639.16
\]

Sum of Products for Schools

\[
\sum s(T_X, M_t) = 3652171.82
\]

\[
(G_T)(G_M) = 3653639.16
\]

Sum of Products for Schools

\[
\sum s(T_X, M_t) = 3652171.82
\]

\[
(G_T)(G_M) = 3653639.16
\]

Sum of Products for Schools

\[
\sum s(T_X, M_t) = 3652171.82
\]

\[
(G_T)(G_M) = 3653639.16
\]

Sum of Products for Schools

\[
\sum s(T_X, M_t) = 3652171.82
\]

\[
(G_T)(G_M) = 3653639.16
\]

Sum of Products for Schools

\[
\sum s(T_X, M_t) = 3652171.82
\]

\[
(G_T)(G_M) = 3653639.16
\]

Sum of Products for Schools

\[
\sum s(T_X, M_t) = 3652171.82
\]

\[
(G_T)(G_M) = 3653639.16
\]

Sum of Products for Schools

\[
\sum s(T_X, M_t) = 3652171.82
\]

\[
(G_T)(G_M) = 3653639.16
\]

Sum of Products for Schools

\[
\sum s(T_X, M_t) = 3652171.82
\]

\[
(G_T)(G_M) = 3653639.16
\]

Sum of Products for Schools

\[
\sum s(T_X, M_t) = 3652171.82
\]

\[
(G_T)(G_M) = 3653639.16
\]

Sum of Products for Schools
Sum of Products for Classes

Sum of Products for Classes is computed using the schoolwise Intelligence totals and the schoolwise meantime.

Method A: \( \sum A(T_{ox})(M_{ct}) = (T_{ox})(M_{ct}) + (T_{cbx})(M_{cbt}) + \ldots \) + \( (T_{cx})(M_{ckt}) \)


Method B: \( (485)(148.75) + (611)(99) + (624)(84) + (350)(78.33) + (662)(67.5) + (601)(96.0) + (747)(69.17) + (613)(90.0) + (582)(105.0) + (118)(100.0) + (125)(75.0) = 503970.24 \]

Method C: \( (466)(142.5) + (605)(104) + (619)(103.0) + (349)(65.0) + (725)(99.17) + (551)(118.0) + (735)(63.33) + (586)(93.0) + (585)(109.0) + (106)(85.0) + (117)(105.0) = 538788.80 \]

Method D: \( (476)(155.0) + (511)(88.0) + (619)(78.0) + (334)(60.0) + (688)(61.66) + (607)(91.0) + (753)(61.83) + (600)(91.0) + (593)(94.0) + (114)(90.0) + (108)(65.0) = 465949.07 \)
Method E: 
\[(494 \cdot 136.25) + (591 \cdot 105.0) + (615 \cdot 94.0) + (340 \cdot 61.66) + (992 \cdot 108.33) + (583 \cdot 103.0) + (750 \cdot 55.83) + (619 \cdot 79.0) + (605 \cdot 101.0) + (126 \cdot 110.0) + (126 \cdot 85.0) = 527098.76\]

Method F: 
\[(489 \cdot 122.5) + (590 \cdot 93.0) + (534 \cdot 85.0) + (361 \cdot 58.33) + (696 \cdot 103.33) + (630 \cdot 110.0) + (728 \cdot 76.66) + (617 \cdot 68.0) + (581 \cdot 108.0) + (116 \cdot 100.0) + (115 \cdot 65.0) = 502024.79\]

Method G: 
\[(458 \cdot 146.25) + (595 \cdot 102.0) + (590 \cdot 78.0) + (350 \cdot 83.33) + (725 \cdot 93.33) + (599 \cdot 93.0) + (745 \cdot 95.0) + (623 \cdot 83.0) + (568 \cdot 100.0) + (125 \cdot 115.0) + (126 \cdot 75.0) = 529338.25\]

\[\sum (\Sigma (T_{cx} \cdot (M_{ct})) = 585554.22 + 503970.24 + 538788.90 + 465949.07 + 527098.76 + 502024.79 + 529338.25 = 3652724.13\]

\[\sum (\Sigma (T_{cx} \cdot (M_{ct})) = 3652724.13\]

\[(GT_x \cdot (GM_{t})) = 3653639.16\]

Sum of Products for Classes = 915.03
Step 4: Computation of Sum of Products for MxS (Intelligence and Time)

Sum of Products for MxS is computed as below:

Sum of Products for Classes = -915.03
Sum of Products for Schools = 41467.34
522.31
Sum of Products for Methods = -(-380.29)
Sum of Products for MxS = 932.80

Step 5: Computation of M+(MxS)

\[
\begin{array}{ccc}
\Sigma x^2 & \Sigma xt & \Sigma t^2 \\
M & 150.74 & -380.29 & 12913.04 \\
MxS & 4323.01 & 932.60 & 28115.48 \\
M+(MxS) & 4473.75 & 552.31 & 41028.52 \\
\end{array}
\]

Step 6: Adjusted Sum of Squares for MxS

\[
\Sigma t^2 - \frac{(\Sigma xt)^2}{\Sigma x^2} \quad \text{... (for MxS)}
\]

28115.48 - \frac{(932.60)^2}{4323.01} = 27914.30

Step 7: Adjusted Sum of Squares for M+(MxS)

\[
\Sigma t^2 - \frac{(\Sigma xt)^2}{\Sigma x^2} \quad \text{... (for M+(MxS)}
\]

41028.52 - \frac{(552.31)^2}{4473.75} = 40960.34
Step 8: Reduced Sum of Squares for M

This is obtained by subtracting step 6 from step 7.

\[ 40960.34 - 27914.30 = 13046.04 \]

Step 9: Reduced METHODS Variance

\[
\text{Reduced Methods Variance} = \frac{\text{Reduced sum of squares for } M}{d.f. \text{ for } M}
\]

\[ = \frac{13046.04}{6} = 2174.34 \]

Step 10: Adjusted MxS (error) Variance

\[
\text{Adjusted MxS (error) Variance} = \frac{\text{Adjusted Sum of Squares for MxS}}{d.f. \text{ for adjusted MxS}}
\]

\[ = \frac{27914.30}{59} = 473.12 \]

Step 11: Computation of F

\[
F = \frac{\text{Reduced Methods Variance}}{\text{Adjusted MxS Variance}}
\]

\[ = \frac{2174.34}{473.12} = 4.59 \]

F is significant at 1% level.
### Analysis of Covariance of the Time (in Minutes) Required by the Seven Treatment Groups to Finish the Programme (Taking intelligence as the Initial Score)

<table>
<thead>
<tr>
<th></th>
<th>$\sum x^2$</th>
<th>$\sum XT$</th>
<th>$\sum T^2$</th>
<th>S.S.</th>
<th>df</th>
<th>F</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>M</td>
<td>150.74</td>
<td>-380.29</td>
<td>12913.04</td>
<td>13046.04</td>
<td>6</td>
<td>4.59</td>
<td>Significant at .01 level</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(reduced S.S.)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MxS</td>
<td>4323.01</td>
<td>932.60</td>
<td>28115.48</td>
<td>27914.30</td>
<td>59</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(adjusted S.S.)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M+(MxS)</td>
<td>4473.75</td>
<td>552.31</td>
<td>41028.52</td>
<td>40960.34</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(adjusted S.S.)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
OBSERVATION

It can be seen that the overall differences between the time taken by the seven treatment groups are significant at .01 level. As the differences among the schools have been statistically controlled by 'analysis of covariance in duplicate experiments in randomly selected schools' (Lindquist, 1970) it can be inferred that the differences among the treatment groups are true differences, neither due to initial differences in intelligence which are indicated by the negative value of the sum of products for method as -380.29, nor due to school to school variations.

Hence we can safely reject the null hypothesis and can attribute the differences to the variations in effectiveness of the programme forms.

LSD is also calculated using the formula

$$\sqrt{\frac{2\text{MSW}}{n}}$$

with df 59 as done for the immediate posttest and for the percentage of retention.

LSD at 5% = $t_{.05} \times \sqrt{\frac{2\times473.12}{46}}$

= 2.00 $\times \sqrt{\frac{2\times473.12}{46}}$ = 9.070

LSD at 1% = $t_{.01} \times \sqrt{\frac{2\text{MSW}}{n}}$

= 2.66 $\times \sqrt{\frac{2\times473.12}{46}}$ = 12.0631

= 12.0631

The table below shows the significance of difference between any two means (L.S.D.).
Table No. 4.18

Significance of Difference between Means of Any Two Treatments on the Time taken to finish the programme (Using the technique of L.S.D.)

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Difference between Means</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>A &amp; B</td>
<td>15.44</td>
<td>Significant at .01 level</td>
</tr>
<tr>
<td>A &amp; C</td>
<td>7.40</td>
<td>Not significant</td>
</tr>
<tr>
<td>A &amp; D</td>
<td>21.72</td>
<td>Significant at .01 level</td>
</tr>
<tr>
<td>A &amp; E</td>
<td>11.42</td>
<td>Significant at .05 level</td>
</tr>
<tr>
<td>A &amp; F</td>
<td>14.68</td>
<td>Significant at .01 level</td>
</tr>
<tr>
<td>A &amp; G</td>
<td>10.22</td>
<td>Significant at .05 level</td>
</tr>
<tr>
<td>B &amp; C</td>
<td>8.04</td>
<td>Not significant</td>
</tr>
<tr>
<td>B &amp; D</td>
<td>6.28</td>
<td>Not significant</td>
</tr>
<tr>
<td>B &amp; E</td>
<td>4.02</td>
<td>Not significant</td>
</tr>
<tr>
<td>B &amp; F</td>
<td>0.76</td>
<td>Not significant</td>
</tr>
<tr>
<td>B &amp; G</td>
<td>5.22</td>
<td>Not significant</td>
</tr>
<tr>
<td>C &amp; D</td>
<td>14.32</td>
<td>Significant at .01 level</td>
</tr>
<tr>
<td>C &amp; E</td>
<td>4.02</td>
<td>Not significant</td>
</tr>
<tr>
<td>C &amp; F</td>
<td>7.28</td>
<td>Not significant</td>
</tr>
<tr>
<td>C &amp; G</td>
<td>2.82</td>
<td>Not significant</td>
</tr>
<tr>
<td>D &amp; E</td>
<td>10.30</td>
<td>Significant at .05 level</td>
</tr>
<tr>
<td>D &amp; F</td>
<td>7.04</td>
<td>Not significant</td>
</tr>
<tr>
<td>D &amp; G</td>
<td>11.50</td>
<td>Significant at .05 level</td>
</tr>
<tr>
<td>E &amp; F</td>
<td>3.26</td>
<td>Not significant</td>
</tr>
<tr>
<td>E &amp; G</td>
<td>1.20</td>
<td>Not significant</td>
</tr>
<tr>
<td>F &amp; G</td>
<td>4.46</td>
<td>Not significant</td>
</tr>
</tbody>
</table>
OBSERVATIONS ON TIME

i) The differences between the following forms are significant at .01 level

- The Linear Overt Form (Form A) and the Linear Covert Form (Form B)
- The Linear Overt Form (Form A) and the Response Prompt Covert Form (Form D)
- The Linear Overt Form (Form A) and the Branching Form (Form F)
- The Response Prompt Covert Form (Form D) and the Response Prompt Overt Form (Form C)

ii) The differences between the following are significant at .05 level

- The Linear Overt Form (Form A) and the Skip programme Form (Form E)
- The Linear Overt Form (Form A) and the Hybrid Form (Form G)
- The Response Prompt Covert Form (Form D) and the Skip programme Form (Form E)
- The Response Prompt Covert Form (Form D) and the Hybrid Form (Form G)

The results of the present study do not support the superiority of the overt response mode both in terms of immediate posttest and time as shown in the following summary table. Holland (1960) asserts that only covert responses suitably reinforced are learned and
that the students must 'write' the programme. The results have shown that the Response Prompt Covert Form, in which the correct responses are already given, is significantly better than other forms both on the immediate posttest and the time taken to finish the programme. The F value for the immediate posttest is significant at .05 level, and for the time taken, it is significant at .01 level. But the differences on the percentage of retention are not significant.

In Shah's study (1970), the pupils responded either overtly or covertly. Each group was further divided into a group making constructed responses and a group reading the frames with answers already filled in. Significance differences were found on the immediate test scores but not on the retention scores. The covert response prompt group showed an appreciable time saving, and the results have shown that covert responding is at least as effective, if not more, as overt responding from the viewpoint both of immediate and delayed test scores. In the present study, however, the relatively better effectiveness of the Response Prompt Covert Form in comparison with the Linear Overt Form is seen (significant at .05 level).

Leith and Gahman (1966) asserted that 'being aware of the answer before making a try does not necessarily lead to poor learning'. The results of the present study
Table showing the Results of Different Statistical Analyses on the Three Criteria of Effectiveness

<table>
<thead>
<tr>
<th>Criteria of Effectiveness</th>
<th>Analysis of Covariance</th>
<th>Significance</th>
<th>Significance of Difference Between Any Two Means (LSD test)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Immediate Posttest</td>
<td>2.99</td>
<td>Significant at .05 level</td>
<td>Significant at .01 level</td>
</tr>
<tr>
<td>B. Percentage of Retention</td>
<td>0.48</td>
<td>Not significant</td>
<td>4.59 Significant at .05 level</td>
</tr>
<tr>
<td>C. Time (in minutes)</td>
<td>4.59</td>
<td>Significant at .01 level</td>
<td>4.19 Significant at .05 level</td>
</tr>
</tbody>
</table>

*In LSD Column, the relatively more effective forms are written first, e.g., A. i) Response Prompt Covert (C) and Linear Overt (A).

Covert (D) is relatively more effective than the Linear Overt (A).
support this contention. Skinner's emphasis on overt and active responding does not seem to be tenable after surveying the results of many studies including the present one.

In the Indian context, the effectiveness of Response Prompt Covert Responding has much significance. It is often alleged that programmes prove to be costly. Experts advocate the use of separate answer sheets in order to bring down the cost. As the Response Prompt Covert mode does not require even the answer sheet or big margins for responses etc., it is less expensive and time saving also. Also, it frees one from the alleged fears of 'cheating'.
REFERENCES


3 Lewis; D.G. "The role of the pretest in experimental design", Research in Education, No. 2, November 1969.
