Chapter V
Analysis of Data and Interpretation of Results
CHAPTER V
ANALYSIS OF DATA AND INTERPRETATION OF RESULTS

In the proceeding chapters the problem of the study, the objectives, hypotheses, tools used and the method of study were discussed. The present chapter deals with the analysis of the data, interpretation and discussion of the results.

The data obtained from the experiment have been analysed under the following sub heads:

5.1 Analysis criterion scores.
5.2 Analysis of achievement scores
5.3 Analysis of retention scores
5.4 Analysis of scores on study habits
5.5 Discussion of results

5.1 ANALYSIS OF CRITERION SCORES

In general, information provided by the test results can be used to evaluate various aspects of instructional process and its outcome. It can help in determining the extent to which instructional objectives were realistic, whether the methods and materials of instruction were appropriate, and how well the learning experiences were organized. Test results reveal not only the weakness of instruction, they can also reveal learning weakness of individual students.

The student responses to the test and the discussion of the results provide clues to the learning difficulties and the corrective steps that can thereby be taken. The obtained scores on the post-test were used for the analysis of the criterion scores.
TABLE 5.1
Frequency distribution of post test criterion scores of the Treatment and Control Groups

<table>
<thead>
<tr>
<th>Class Interval</th>
<th>Lower limits</th>
<th>Total</th>
<th>High intelligence</th>
<th>Average Intelligence</th>
<th>Lower Intelligence</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>(T_{T_1})</td>
<td>(T_{T_1})</td>
<td>(T_{T_1})</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(T_{T_1})</td>
<td>(T_{T_1})</td>
<td>(T_{T_1})</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(T_{T_1})</td>
<td>(T_{T_1})</td>
<td>(T_{T_1})</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(T_{T_1})</td>
<td>(T_{T_1})</td>
<td>(T_{T_1})</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th>(f)</th>
<th>(c_{f})</th>
<th>(c_{f})%</th>
<th>(f)</th>
<th>(c_{f})</th>
<th>(c_{f})%</th>
<th>(f)</th>
<th>(c_{f})</th>
<th>(c_{f})%</th>
<th>(f)</th>
<th>(c_{f})</th>
<th>(c_{f})%</th>
<th>(f)</th>
<th>(c_{f})</th>
<th>(c_{f})%</th>
<th>(f)</th>
<th>(c_{f})</th>
<th>(c_{f})%</th>
<th>(f)</th>
<th>(c_{f})</th>
<th>(c_{f})%</th>
<th>(f)</th>
<th>(c_{f})</th>
<th>(c_{f})%</th>
</tr>
</thead>
<tbody>
<tr>
<td>101-110</td>
<td>110.5</td>
<td>12</td>
<td>12</td>
<td>6.67</td>
<td>0.5</td>
<td>0.02</td>
<td>2</td>
<td>0.1</td>
<td>0.01</td>
<td>1</td>
<td>0.5</td>
<td>0.04</td>
<td>0.2</td>
<td>0.08</td>
<td>0.04</td>
<td>0.05</td>
<td>0.25</td>
<td>0.03</td>
<td>0.05</td>
<td>0.25</td>
<td>0.03</td>
<td>0.05</td>
<td>0.25</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>91-100</td>
<td>99.5</td>
<td>25</td>
<td>37</td>
<td>29.56</td>
<td>0.07</td>
<td>0.12</td>
<td>60</td>
<td>0.06</td>
<td>0.08</td>
<td>40</td>
<td>0.04</td>
<td>0.05</td>
<td>25</td>
<td>0.03</td>
<td>0.04</td>
<td>0.05</td>
<td>0.25</td>
<td>0.03</td>
<td>0.05</td>
<td>0.25</td>
<td>0.03</td>
<td>0.05</td>
<td>0.25</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>81-90</td>
<td>80.5</td>
<td>33</td>
<td>70</td>
<td>39.69</td>
<td>0.06</td>
<td>0.18</td>
<td>50</td>
<td>0.02</td>
<td>0.14</td>
<td>70</td>
<td>0.07</td>
<td>0.15</td>
<td>75</td>
<td>0.06</td>
<td>0.19</td>
<td>50</td>
<td>0.06</td>
<td>0.18</td>
<td>75</td>
<td>0.06</td>
<td>0.19</td>
<td>50</td>
<td>0.06</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>71-80</td>
<td>70.5</td>
<td>34</td>
<td>104</td>
<td>57.78</td>
<td>0.02</td>
<td>0.20</td>
<td>100</td>
<td>0.04</td>
<td>0.18</td>
<td>50</td>
<td>0.03</td>
<td>0.18</td>
<td>90</td>
<td>0.04</td>
<td>0.16</td>
<td>80</td>
<td>0.05</td>
<td>0.19</td>
<td>90</td>
<td>0.04</td>
<td>0.16</td>
<td>80</td>
<td>0.05</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>61-80</td>
<td>60.5</td>
<td>45</td>
<td>149</td>
<td>82.76</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>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>51-60</td>
<td>50.5</td>
<td>24</td>
<td>173</td>
<td>96.72</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>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>41-50</td>
<td>40.5</td>
<td>16</td>
<td>160</td>
<td>100</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>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Fig. 5.1 Cumulative frequency curve for the high intelligence treatment groups
Fig. 5.2 Cumulative frequency curve for the average intelligence treatment groups
Fig. 5.3 Cumulative frequency curve for the low intelligence treatment groups.
**Performance criterion**

The post test scores of the two experimental and one control groups were depicted through cumulative percentage curve viz., high intelligence group, average intelligence group and low intelligence group with respect to the total scores obtained by the entire treatment groups.

It may be observed from fig 5.1, 5.2 and 5.3 that about 90 percent of the high intelligence group obtained 82 percent or more marks when taught by pre graphic organizer instruction, 76 percent or more marks when taught by rest graphic organizer instruction and 70.5 percent or more marks when taught by traditional instruction about 90 percent of the average intelligence group obtained 67.5 percent marks or more when taught by pre graphic organizer instruction, by percent or more marks when taught by post graphic organizer instruction and 55 percent about 90 percent of the low intelligence group obtained 61.5 percent or more marks when taught by pre graphic organizer instruction, 49 percent or more marks when taught by post graphic organizer instruction and 43 percent or more marks when taught by traditional instruction as against 57 percent marks obtained by the total group. About 80 percent of high intelligence students obtained 85 percent or more marks when taught by pre graphic organizer instruction, 7 percent or more marks when taught by post graphic organizer instruction, 75 percent or more marks when taught by traditional instruction. About 80 percent of average intelligence students obtained 70.5 percent or more marks when taught by pre graphic organizer instruction, 65 percent or more marks when taught by post graphic organizer instruction, 62.5 percent or more marks when taught by traditional instruction. About 80 percent of low intelligence students obtained 69 percent or more marks when taught by pre graphic organizer instruction and 52 percent or more marks when taught by post graphic organizer instruction and 49 percent or more marks when taught by traditional instruction as against 65 percent marks obtained by the total group.

About 70 percent of high intelligence students obtained 89 percent or more marks when taught by pre graphic organizer instruction, 83 percent or more
marks when taught by post graphic organizer instruction, and 79 percent or more marks when taught by traditional instruction.

About 70 percent of average students obtained 73 percent or more marks when taught by pre graphic organizer instruction, 67 percent or more marks when taught by post graphic organizer instruction and 61.5 percent or more marks when taught by traditional instruction.

About 70 percent of low intelligence students obtained 68 percent or more marks when taught by pre graphic organizer instruction, 55 percent or more marks when taught by post graphic organizer instruction and 49 percent, or more marks when taught by traditional instruction. As against 68 percent marks obtained by the total group.

5.2 ANALYSIS OF ACHIEVEMENT SCORES

The analysis of variance as the primary technique of statistical analysis in experimental design was first used by R.A. fisher (1935). F. yates, G.E.P. Box, R.C. Bose, O. Kemphorne and W.G. Cochran (Montgomery, 1984) advanced the technique as it can greatly increase the efficiency of an experiment and often strengthen the conclusions so obtained. A carefully designed experiment will undoubtedly lead to relatively straight forward analysis.

Selection of the statistical technique - its justification

The present study employed a 3x3x3 factorial design. The information obtained from a factorial design experiment is more complete than that obtained from a series of single factor experiments, in the same that evaluation of interaction effects can be made. Apart from it, the estimates of the effect of the independent variables is also practically more as those estimates are obtained by averaging over a relatively broad range of other relevant experimental variables.

In the case of factorial experiments the population to which inference can be made is more inclusive than the corresponding population for a single factor experiment (Winer, 1971). In addition to information about how the experimental
variables operate in relative isolation, the experimenter can predict what will happen when two or more variables are used in combination.

Following the selection of the statistical technique appropriate for data analysis, it was decided to employ a 3 way analysis of variance with one repeated measure. The factorial experiments in which the same experiment unit (usually a subject) is observed under more than one treatment conditions are referred to as those in which there are repeated measures. The primary purpose of repeated measures on the same elements is the control that this kind of design provides over individual differences between experimental units. Another advantage is in turns of the economy of subjects. By having each subject serve as his own control, the experimenter attempts to work with smaller sample size (Winer, 1971).

**Preliminary Data Handling**

The scores were first processed. The gain as measured by the difference of post test and pre-test scores were calculated for each student. The obtained gain were subjected to the analysis of variance. The present factorial design deviated from simple experimental design in its special provision for the variables of categories of objectives viz., knowledge, comprehension and application categories. The variable of categories of objectives was repeated variables. The deviation in the design was reflected in its special calculation for the error variance component.

**Three Way Analysis of Variance on Gain Scores of Achievement in Social Studies**

H₁ The time instructional treatments yield comparable mean gain on achievement scores in social studies.

H₂ The high, average and low intelligence groups yield comparable mean gain on achievement scores.

H₃ Comparable mean gains on achievement scores are yielded by the students at knowledge, comprehension and application category of objectives.
H₄ There is no significant interaction between instructional treatments and levels of intelligence.

H₅ There is no significant interaction between treatments and categories of objectives.

H₆ There is no significant interaction between levels of intelligence and categories of objectives.

H₇ The three instructional groups of three levels of intelligence exhibit comparable mean gain on achievement scores at knowledge, comprehension and application categories of objectives.

The means and S.D.'s of different sub samples were calculated and have been presented in Table 5.2 and the summary of ANOVA for 3x3x3 design for gain scores in achievement in Table 5.3. The data was treated according to the specifications of Winer (1971).

<table>
<thead>
<tr>
<th>Table 5.2</th>
<th>Means and S.D.'s of Sub Samples of 3x3x3 design for gain scores in achievement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intelligence</td>
<td>Objectives</td>
</tr>
<tr>
<td>I₁</td>
<td>O₁</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>O₂</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>O₃</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>I₂</td>
<td>O₁</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>O₂</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>O₃</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>I₃</td>
<td>O₁</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>O₂</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>O₃</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
TABLE 5.3
Summary of 3x3x3 ANOVA for gain scores in achievement

<table>
<thead>
<tr>
<th>Source of variation</th>
<th>SS</th>
<th>df</th>
<th>MSS</th>
<th>f</th>
<th>Levels of significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between</td>
<td>12392.6</td>
<td>179</td>
<td>69.23</td>
<td>3.45</td>
<td>$S^{**}$</td>
</tr>
<tr>
<td>T</td>
<td>3874.04</td>
<td>2</td>
<td>1937.02</td>
<td>96.65</td>
<td>$S^{**}$</td>
</tr>
<tr>
<td>I</td>
<td>4878.24</td>
<td>2</td>
<td>2439.12</td>
<td>1219.56</td>
<td>$S^{**}$</td>
</tr>
<tr>
<td>TxI</td>
<td>212.96</td>
<td>4</td>
<td>53.24</td>
<td>2.65</td>
<td>$S^{*}$</td>
</tr>
<tr>
<td>Error between Subjects</td>
<td>3427.36</td>
<td>171</td>
<td>20.04</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Within subjects</td>
<td>149752.34</td>
<td>180</td>
<td>831.96</td>
<td>19.96</td>
<td>$S^{**}$</td>
</tr>
<tr>
<td>O</td>
<td>141095.36</td>
<td>2</td>
<td>70547.68</td>
<td>16.93</td>
<td>$S^{**}$</td>
</tr>
<tr>
<td>TxO</td>
<td>332.01</td>
<td>4</td>
<td>83.1</td>
<td>1.99</td>
<td>NS</td>
</tr>
<tr>
<td>IxO</td>
<td>1160.68</td>
<td>4</td>
<td>290.17</td>
<td>6.96</td>
<td>$S^{**}$</td>
</tr>
<tr>
<td>TxIxO</td>
<td>414.96</td>
<td>8</td>
<td>51.87</td>
<td>1.24</td>
<td>NS</td>
</tr>
<tr>
<td>Error within groups</td>
<td>6749.34</td>
<td>162</td>
<td>41.67</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

S – Significant
NS – Not significant
* - Significant at 0.05 level of confidence
** - Significant at 0.01 level of confidence

MAIN EFFECTS

(Treatment T)

The F-ratio for the difference in the mean scores of the three treatment groups was found to be significant at 0.01 level of confidence leading to the inference that the three instructional treatments yielded different mean gains on achievement scores in social studies.

An examination of means indicates that there is a difference in the mean gain scores of the three groups. Thus, $H_i$ was rejected as students taught by
different instructional treatments, viz. pre graphic organizer instruction, post graphic organizer instruction and traditional instruction exhibited different mean gains. Further t-ratios were computed.

To investigate further the difference between different treatments, t-ratios were computed to test the following hypotheses:

H$_{11}$ Pre graphic organizer instruction and post graphic organizer instruction yield comparable mean gain on achievement scores.

H$_{12}$ Pre graphic organizer instruction and traditional instruction yield comparable mean gain on achievement scores.

H$_{13}$ Post graphic organizer instruction and traditional instruction yield comparable mean gains on achievement scores.

The t-ratio for the difference in the means of gain scores in achievement of the three treatment groups have been placed in table 5.4.

**TABLE 5.4**

<table>
<thead>
<tr>
<th>t-ratios for achievement gain scores between different treatments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group means</td>
</tr>
<tr>
<td>---------------------------------------------------------------</td>
</tr>
<tr>
<td>$T_1$ M = 31.18 n = 180</td>
</tr>
<tr>
<td>$T_2$ M = 29.5 n = 180</td>
</tr>
<tr>
<td>$T_3$ M = 24.85 n = 180</td>
</tr>
</tbody>
</table>

* - Significant at 0.05 level of confidence
** - Significant at 0.01 level of confidence
The above table 5.4 reveals that:

• Students taught through pre graphic organizer instruction exhibited better mean gains as compared to those taught through post organizer instruction as is evident from the value ‘t’ (2.01) which is significant at 0.05 level of confidence. Thus, $H_{11}$ was rejected.

• Student taught through pre graphic organizer instruction exhibited better mean gains as compared to the traditional instruction as is evident from the value ‘t’ (7.56) which is significant at 0.01 level of confidence. Thus $H_{12}$ has rejected.

• Student taught through post graphic organizer instruction exhibited better mean gains as compared to the traditional instruction as is evident from the value ‘t’ (5.56) which is significant at 0.01 level of confidence. Thus, $H_{13}$ was rejected.

**Intelligence (I)**

F-ratio for the difference in the mean gains of the three intelligence groups was found to be highly significant at 0.01 level of confidence. An examination of means of the three groups reveals that the means of high intelligence group were superior to that of average and low intelligence group. Thus, $H_2$ was also rejected.

To investigate further, the difference between different intelligence groups $t$-ratios were computed to test the following hypothesis:

$H_{21}$ High and average intelligence groups yield comparable mean gain on achievement scores.

$H_{22}$ High and low intelligence groups yield comparable mean gain on achievement scores.

$H_{23}$ Average and low intelligence groups yield comparable mean gain on achievement scores.
The t-ratios for the difference in the means of gain scores in achievement of the three intelligence groups have been placed in Table 5.5.

**TABLE 5.5**

<table>
<thead>
<tr>
<th>Group means</th>
<th>T₁</th>
<th>T₂</th>
<th>T₃</th>
</tr>
</thead>
<tbody>
<tr>
<td>M = 29.15</td>
<td>-</td>
<td>0.203</td>
<td>5.41 **</td>
</tr>
<tr>
<td>n = 180</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M = 28.98</td>
<td>-</td>
<td></td>
<td>5.21 **</td>
</tr>
<tr>
<td>n = 180</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M = 24.62</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>n = 180</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Note:** - Significant at 0.01 level

The table 5.5 reveals that:

- High and average intelligence group yield comparable mean gain on achievement scores as the t-value (0.203) was found to be not significant even at 0.05 level of confidence. Thus H₂₁ was retained.

- High intelligence group exhibited better mean gains an achievement as compared to the low intelligence groups as is evident from the value `t` (5.41) which is significant at 0.01 level of confidence. Thus, H₂₂ was rejected.

- Average intelligence group exhibited better mean gain on achievement as compared to the low intelligence group as in evident from the value (5.21) which is significant at 0.01 level of confidence. Thus, H₂₃ was rejected.
Categories of objectives (O)

F-ratio for the difference in means of the three categories of objectives was found to be significant at 0.01 level of confidence. An examination of the means for learning at knowledge, comprehension and application categories leads to the inference that performance at knowledge, comprehension and application categories was different at different categories. Thus $H_3$ was rejected. The gain means of the three main effects have been shown through bar diagrams in Fig.5.4.
Fig. 5.4 Bar diagram showing Means Gain corresponding to the three main effects of achievement scores.
To investigate further the difference between the mean gain at the three categories of objectives, t-ratio were computed to test the following hypotheses:

$H_{31}$ Comparable mean gains exhibited by student at knowledge and comprehension category of objectives.

$H_{32}$ Comparable mean gains exhibited by student at knowledge and application category of objectives.

$H_{33}$ Comparable mean gains exhibited by student at comprehension and application category of objectives.

| TABLE 5.6 |
| t-ratios for achievement gain scores between different categories of objectives |
| Group means | $O_1$ | $O_2$ | $O_3$ |
| | $M = 43.37$ | $M = 31.12$ | $M = 6.03$ |
| | $n = 180$ | $n = 180$ | $n = 180$ |
| $O_1$ | - | 14.64 ** | 44.61 ** |
| $M = 43.37$ | $n = 180$ | | |
| $O_2$ | - | - | 29.3 ** |
| $M = 31.12$ | $n = 180$ | | |
| $O_3$ | - | - | - |
| $M = 6.03$ | $n = 180$ | | |

** Significant at 0.01 level of confidence.

The table 5.6 reveals that:

- Mean gain scores were exhibited better at knowledge category of objectives as compared to the comprehension category of objectives as is evident from the value ‘t’ (14.64) which is significant at 0.01 level of confidence. Thus $H_{31}$ was rejected.

- The mean gain scores on knowledge category of objectives were better as compared to the application category of objectives as is evident from the
value ‘t’ (44.61) which is significant at 0.01 level of confidence. Thus, $H_{302}$ was rejected.

- The mean gain scores on comprehension category of objectives were better as compared to the application category of objectives as is evident from the value ‘t’ (29.3) which is significant at 0.01 level of confidence. Thus $H_{303}$ was rejected.

**INTERACTION EFFECTS**

**Treatment and Intelligence (Txl)**

The F-ratio for the interaction between treatment and intelligence was found to be significant at 0.01 level of confidence, leading to the inference that the two variables interact with each other. Thus, $H_4$ was rejected.

To investigate further, the t-ratios were computed to test the following hypotheses:

$H_{41}$ For high intelligence students mean gains for:

(a) Pre graphic organizer instruction and post graphic organizer instruction are not different.

(b) Pre graphic organizer instruction and traditional instruction are not different.

(c) Post graphic organizer instruction and traditional instruction are not different.

$H_{42}$ For average intelligence students mean gains for:

(a) Pre graphic organizer instruction and post graphic organizer instruction are not different.

(b) Pre graphic organizer instruction and traditional instruction are not different.

(c) Post graphic organizer instruction and traditional instruction are not different.

$H_{43}$ For low intelligence students mean gains for:
(a) Pre graphic organizer instruction and post graphic organizer instruction are not different.

(b) Pre graphic organizer instruction and traditional organizer instruction are not different.

(c) Post graphic organizer instruction and traditional organizer instruction are not different.

**H₄₄** When taught by pre graphic organizer instruction mean gains for :

(a) High and average intelligence student are not different.

(b) High and low intelligence students are not different.

(c) Average and low intelligence students are not different.

**H₄₅** When taught by post graphic organizer instruction mean gains for :

(a) High and average intelligence students are not different.

(b) High and low intelligence students are not different.

(c) Average and low intelligence students are not different.

**TABLE 5.7**

**t-ratio for different combination of T x I for Mean Achievement Scores**

<table>
<thead>
<tr>
<th>Group Means</th>
<th>T₁, M=34.34 n = 60</th>
<th>T₂, M=31.02 n = 60</th>
<th>T₃, M=28.07 n = 60</th>
<th>T₄, M=29.89 n = 60</th>
<th>T₅, M=26.75 n = 60</th>
<th>T₆, M=26.05 n = 60</th>
<th>T₇, M=19.75 n = 60</th>
</tr>
</thead>
<tbody>
<tr>
<td>T₁</td>
<td>2.29*</td>
<td>4.34**</td>
<td>1.22</td>
<td>3.68**</td>
<td>5.75**</td>
<td>3.87**</td>
<td>5.73**</td>
</tr>
<tr>
<td>T₂</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>3.45**</td>
<td>3.67**</td>
<td>7.8**</td>
</tr>
<tr>
<td>T₃</td>
<td>-</td>
<td>-</td>
<td>3.15**</td>
<td>1.28</td>
<td>0.49</td>
<td>1.39</td>
<td>5.75**</td>
</tr>
<tr>
<td>T₄</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1.86</td>
<td>4.52**</td>
<td>2.65**</td>
<td>4.51**</td>
</tr>
<tr>
<td>T₅</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2.68**</td>
<td>0.78</td>
<td>2.65**</td>
</tr>
<tr>
<td>T₆</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1.87</td>
<td>0.066</td>
</tr>
<tr>
<td>T₇</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1.86</td>
</tr>
<tr>
<td>T₈</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>4.36</td>
</tr>
<tr>
<td>T₉</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

The interaction between treatment and intelligence for mean gain scores on achievement has been presented in Fig. 5.5.
Fig. 5.5 Interaction between treatment and intelligence of man gain achievement scores
Table 5.7 reveals that:

- **High intelligence students**
  - taught by pre graphic organizer instruction and post graphic organizer instruction yield comparable mean gain scores on achievement \((t=1.22)\). Thus \(H_{41a}\) was retained as the t value insignificant even at 0.05 level of confidence.
  
  - taught by pre graphic organizer instruction attained better mean scores on achievement than those taught by traditional instruction \((t=3.87)\). Thus, \(H_{41b}\) was rejected, as t-value was significant at 0.01 level.
  
  - taught by post graphic organizer instruction attained better mean scores on achievement than those taught by traditional instruction \((t=2.65)\). Thus, \(H_{41c}\) was rejected, as t value was significant at 0.01 level.

- **Average intelligence students**
  - taught by pre graphic organizer instruction and post graphic organizer instruction yield comparable mean gain scores on achievement \((t=0.78)\). Thus \(H_{42a}\) was retained as the t-value was insignificant even at 0.05 level of confidence.
  
  - taught by Pre graphic organizer instruction attained better mean scores on achievement than those taught by traditional instruction \((t=3.44)\). Thus \(H_{42b}\) was rejected, as the t value was significant at 0.01 level of confidence.
  
  - taught by Post graphic organizer instruction attained better mean scores on achievement than those taught by traditional instruction \((t=2.65)\). Thus \(H_{42c}\) was rejected, as the t-value was significant at 0.01 level of confidence.
Low intelligence students

- taught by Pre graphic organizer instruction and Post graphic organizer instruction yield comparable mean gain scores on achievement ($t=1.40$). Thus, $H_{4,3a}$ was retained as the $t$-value was insignificant at 0.05 level of confidence.

- taught by Pre graphic organizer instruction attained better mean scores on achievement than those taught by traditional instruction ($t=5.75$). Thus, $H_{4,3b}$ was rejected as the $t$-value was significant at 0.01 level of confidence.

- taught by Post graphic organizer instruction attained better mean scores on achievement than those taught by traditional instruction ($t=4.32$). Thus, $H_{4,3c}$ was rejected, as the value was significant at 0.01 level of confidence.

When taught by pre graphic organizer instruction

- High intelligence students attained better mean gains than the average intelligence students ($t=2.29$). Thus, $H_{4,4a}$ was rejected, as $t$-value was significant at 0.05 level of confidence.

- High intelligence students attained better mean gains than the low intelligence student ($t=4.34$). Thus $H_{4,4b}$ was rejected, as $t$ value was significant at 0.01 level of confidence.

- Average intelligence students attained better mean gains than the low intelligence students ($t=2.04$). Thus, $H_{4,4c}$ was rejected, as $t$-value was significant at 0.05 level of confidence.

When taught by post graphic organizer instruction

- High intelligence students and average intelligence students attained yield comparable mean gains achievement ($t=1.86$). Thus, $H_{4,5a}$ was retained, as $t$ value was insignificant at 0.05 level of confidence.
- High intelligence students attained better mean gain than low intelligence students \((t=4.52)\). Thus, \(H_{65b}\) was rejected, as t value was significant at 0.01 level of confidence.

- Average intelligence students attained better mean gain than low intelligence students \((t=2.68)\). Thus \(H_{6.5 \ (C)}\) was rejected, as t-value was significant at 0.01 level of confidence.

**Treatment and Categories of Objectives (TxO)**

The F-ratio for the interaction between treatment and categories of objectives was found to be not significant even at 0.05 level of confidence. Thus \(H_5\) was retained as the two variables were found to be independent of one another.

**Intelligence and Categories of Objectives (IxO)**

The F-ratio for the interaction between intelligence and categories of objectives was found to be significant at 0.01 level of confidence leading to the inference that the two variables interact with each other. Thus \(H_6\) was rejected.

To investigate further, the interaction between intelligence and categories of objectives, the t-ratios were computed to test the following hypotheses:

\(H_{61}\) For high intelligence students, mean gains at:
(a) Knowledge and comprehension categories of objectives are not different.
(b) Knowledge and application categories of objectives are not different.
(c) Comprehension and application categories of objectives are not different.

\(H_{62}\) For average intelligence students, mean gains at:
(a) Knowledge and comprehension categories of objectives are not different.
(b) Knowledge and comprehension category of objectives are not different.
(c) Comprehension and application category of objectives are not different.

**H₆₃**  For low intelligence students mean gains at:
(a) Knowledge and comprehension category of objectives are different.
(b) Knowledge and application category of objectives are not different.
(c) Comprehension and application category of objectives are not different.

**H₆₄**  At knowledge categories of objective the mean gains of:
(a) High and average intelligence students are not different.
(b) Average and low intelligence students are not different.

**H₆₅**  At comprehension categories of objectives, the mean gains of:
(a) High and average intelligence students are not different.
(b) Average and low intelligence students are not different.

**H₆₆**  At application categories of objectives, the mean gains of:
(a) High and average intelligence students are not different.
(b) Average and low intelligence students are not different.

The t-ratios have placed in table 5.8 and the interaction has been presented through Fig. 5.6.
TABLE 5.8

t-ratio for Intelligence and category of objectives on mean gains achievement scores (Ixo)

<table>
<thead>
<tr>
<th>Group</th>
<th>T0_1</th>
<th>T0_2</th>
<th>T0_3</th>
<th>T0_4</th>
<th>T0_5</th>
<th>T0_6</th>
<th>T0_7</th>
<th>T0_8</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M=47.37, n=60</td>
<td>M=41.12, n=60</td>
<td>M=7.32, n=60</td>
<td>M=43.63, n=60</td>
<td>M=37.2, n=60</td>
<td>M=6.12, n=60</td>
<td>M=39.14, n=60</td>
<td>M=4.68, n=60</td>
</tr>
<tr>
<td>T0_1</td>
<td>0.692</td>
<td>27.72**</td>
<td>2.59*</td>
<td>7.04**</td>
<td>28.65**</td>
<td>5.76**</td>
<td>12.0**</td>
<td>29.54**</td>
</tr>
<tr>
<td>T0_2</td>
<td>23.40**</td>
<td>1.73</td>
<td>2.71**</td>
<td>24.22**</td>
<td>1.37</td>
<td>7.67**</td>
<td>25.22**</td>
<td></td>
</tr>
<tr>
<td>T0_3</td>
<td>20.13**</td>
<td>-</td>
<td>-</td>
<td>20.67**</td>
<td>-</td>
<td>0.830</td>
<td>22.02**</td>
<td>15.72**</td>
</tr>
<tr>
<td>T0_4</td>
<td>4.45**</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>21.50**</td>
<td>1.34</td>
<td>4.95**</td>
<td>22.50**</td>
</tr>
<tr>
<td>T0_5</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>4.06**</td>
<td>-</td>
<td>16.55**</td>
<td>0.99</td>
</tr>
<tr>
<td>T0_6</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>6.29**</td>
<td>23.76**</td>
</tr>
<tr>
<td>T0_7</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>17.55**</td>
<td></td>
</tr>
<tr>
<td>T0_8</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

* Significant at 0.05 level of confidence
** Significant at 0.01 level of confidence
Fig. 5.6 Interaction between intelligence and categories of objectives for mean gain achievement scores.
The table 5.8 reveals that:

- For high intelligence students mean gains at:
  - Knowledge categories of objectives and comprehension categories of objectives were comparable (t=0.692). Thus, \( H_{6,1a} \) was retained, as t-value was insignificant even at 0.05 level of confidence.
  - Knowledge categories of objectives was better than that at application categories of objectives (t=27.72). Thus, \( H_{6,1b} \) was rejected, as t-value was significant at 0.01 level of confidence.
  - Comprehension category of objectives was better than that at application category of objectives (t=23.40). Thus, \( H_{6,1c} \) was rejected, as t-value was significant at 0.01 level of confidence.

- For average intelligence students mean gains at:
  - Knowledge category of objectives was better than that at comprehension category of objectives (t=4.45). Thus, \( H_{6,2a} \) was rejected, as t-value was significant at 0.01 level of confidence.
  - Knowledge category of objective was better than application category of objectives (t=21.50). Thus, \( H_{6,2b} \) was rejected, t-value was significant at 0.01 level of confidence.
  - Comprehension category of objectives was better than application category of objectives (t=25.93). Thus \( H_{6,2c} \) was rejected, as t-value was significant at 0.01 level of confidence.

- For low intelligence students, mean gain at:
  - Knowledge category of objectives was better than that at comprehension category of objectives (t=2.29) Thus, \( H_{6,3a} \) was rejected, as t-value was significant at 0.01 level of confidence.
- Knowledge category of objectives was better than that at application category of objectives (t=23.76). Thus, H63b was rejected, as t-value was significant at 0.01 level of confidence.

- Comprehension category of objectives was better than that at application category of objectives (t=17.55). Thus, H63c was rejected, as t-value was significant at 0.01 level of confidence.

- At knowledge categories of objectives:
  - High intelligence students attained better mean gains than average intelligence students (t=2.59). Thus, H64a was rejected, as t-value was significant at 0.05 level of confidence.
  - Average intelligence students attained better mean gains than low intelligence students (t=3.11). Thus, H64b was rejected, as t-value was significant at 0.01 level of confidence.

- At comprehension categories of objectives:
  - High intelligence students attained better mean gains than average intelligence students (t=2.71). Thus, H65a was rejected, t-value was significant at 0.01 level.
  - Average intelligence students attained better mean gains than low intelligence students (t=4.95). Thus, H65b was rejected, as t-value was significant at 0.01 level.

- At Application categories at objectives, the mean gains of:
  - High intelligence and average intelligence students attained comparable mean gains (t=0.83). Thus, H66a was retained, t-value was insignificant even at 0.05 level.
  - Average intelligence students and low intelligence students attained comparable mean gains (t=0.99). Thus, H66b was retained, as t value was insignificant even at 0.05 level.
Treatment, Intelligence and Categories of Objectives (T\textsubscript{x}I\textsubscript{x}O)

The F-ratio for the interaction among the three variables was not found to be significant even at 0.05 level of confidence. This indicates that treatment, intelligence and categories of objectives do not interact with each other. So, \( H_7 \) was retained.

5.3 ANALYSIS OF RETENTION SCORES

Retention scores are the scores obtained by the students twenty days after the administration of post test. For each student, the retention scores were obtained after subtracting pre-test scores from his/her retention test scores. The obtained scores were subjected to 3x3x3 analysis of variance.

The following set of null hypotheses were tested through this analysis.

\( H_8 \) Retention is independent of instructional treatment.

\( H_9 \) Retention is independent of levels of intelligence.

\( H_{10} \) Retention is independent of categories of objectives.

\( H_{11} \) Students of high, average and low intelligence retain comparably, when taught social studies through different instructional treatments.

\( H_{12} \) Students taught through different instructional treatments attain comparable retention scores at knowledge, comprehension and application categories of objectives.

\( H_{13} \) Students of high average and low intelligence retain comparably at knowledge, comprehension and application categories of objectives.

\( H_{14} \) Students of high average and low intelligence retain comparably at knowledge, comprehension and application categories of objectives, when taught through different instructional treatments.

The means and S.D.'s of different sub-samples were calculated and have been presented in Table 5.9 and Summary of ANOVA for 3x3x3 design for retention scores in social studies in the table 5.10.
### TABLE 5.9
Mean and S.D’s. of sub-samples of 3x3x3 design for retention scores

<table>
<thead>
<tr>
<th>Group</th>
<th>Means</th>
<th>(T_1) (Experimental Group I)</th>
<th>(T_2) (Experimental Group-II)</th>
<th>(T_3) (Control Group)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(I_1)</td>
<td>(O_1)</td>
<td>M = 22.35(\bar{X}) n = 20 SD = 4.28</td>
<td>M = 20 n = 20 SD = 3.64</td>
<td>M = 15.25 n = 20 SD = 4.43</td>
</tr>
<tr>
<td>(I_2)</td>
<td>(O_2)</td>
<td>M = 17.15(\bar{X}) n = 20 SD = 2.26</td>
<td>M = 18.45 n = 20 SD = 3.96</td>
<td>M = 17.50 n = 20 SD = 3.44</td>
</tr>
<tr>
<td>(I_3)</td>
<td>(O_3)</td>
<td>M = 5.3(\bar{X}) n = 20 SD = 1.92</td>
<td>M = 5.45 n = 20 SD = 1.96</td>
<td>M = 1.55 n = 20 SD = 1.45</td>
</tr>
<tr>
<td>(I_4)</td>
<td>(O_1)</td>
<td>M = 16.4(\bar{X}) n = 20 SD = 3.72</td>
<td>M = 13.25 n = 20 SD = 4.35</td>
<td>M = 11.5 n = 20 SD = 1.25</td>
</tr>
<tr>
<td>(I_5)</td>
<td>(O_2)</td>
<td>M = 15.5(\bar{X}) n = 20 SD = 3.00</td>
<td>M = 16.15 n = 20 SD = 4.24</td>
<td>M = 15.55 n = 20 SD = 4.16</td>
</tr>
<tr>
<td>(I_6)</td>
<td>(O_3)</td>
<td>M = 5.1(\bar{X}) n = 20 SD = 1.81</td>
<td>M = 4.9 n = 20 SD = 1.78</td>
<td>M = 1.35 n = 20 SD = 0.96</td>
</tr>
<tr>
<td>(I_7)</td>
<td>(O_1)</td>
<td>M = 15.65(\bar{X}) n = 20 SD = 3.22</td>
<td>M = 9.95 n = 20 SD = 2.60</td>
<td>M = 11.55 n = 20 SD = 2.87</td>
</tr>
<tr>
<td>(I_8)</td>
<td>(O_2)</td>
<td>M = 16.6(\bar{X}) n = 20 SD = 2.18</td>
<td>M = 15.8 n = 20 SD = 2.93</td>
<td>M = 14.35 n = 20 SD = 3.21</td>
</tr>
<tr>
<td>(I_9)</td>
<td>(O_3)</td>
<td>M = 3.1(\bar{X}) n = 20 SD = 1.449</td>
<td>M = 3.7 n = 20 SD = 1.80</td>
<td>M = 1.65 n = 20 SD = 1.23</td>
</tr>
</tbody>
</table>
### TABLE 5.10

Summary of 3x3x3 ANOVA for retention scores

<table>
<thead>
<tr>
<th>Source of variation</th>
<th>SS</th>
<th>df</th>
<th>MSS</th>
<th>F-value</th>
<th>Level of significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between subjects</td>
<td>3951.25</td>
<td>179</td>
<td>22.07</td>
<td>2.036</td>
<td>-</td>
</tr>
<tr>
<td>T (Treatment)</td>
<td>826.848</td>
<td>2</td>
<td>413.424</td>
<td>38.142</td>
<td>S**</td>
</tr>
<tr>
<td>I (Intelligence)</td>
<td>1162.137</td>
<td>2</td>
<td>581.068</td>
<td>53.609</td>
<td>S**</td>
</tr>
<tr>
<td>TxI (Treat. &amp; Int.)</td>
<td>108.674</td>
<td>4</td>
<td>27.168</td>
<td>2.506</td>
<td>S*</td>
</tr>
<tr>
<td>Error subjects</td>
<td>1853.58</td>
<td>171</td>
<td>10.839</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Within subjects</td>
<td>21714.33</td>
<td>180</td>
<td>120.635</td>
<td>7.94</td>
<td>-</td>
</tr>
<tr>
<td>O (Objectives)</td>
<td>17904.67</td>
<td>2</td>
<td>8952.335</td>
<td>589.75</td>
<td>S**</td>
</tr>
<tr>
<td>TxO (Treat. x Obj.)</td>
<td>483.274</td>
<td>4</td>
<td>120.818</td>
<td>7.95</td>
<td>S**</td>
</tr>
<tr>
<td>IxO (Int. &amp; Obj.)</td>
<td>669.152</td>
<td>4</td>
<td>167.288</td>
<td>11.02</td>
<td>S**</td>
</tr>
<tr>
<td>TxIxO (Treat. x Int. x Obj.)</td>
<td>198.471</td>
<td>8</td>
<td>24.80</td>
<td>1.6333</td>
<td>NS</td>
</tr>
<tr>
<td>Error within groups</td>
<td>2458.76</td>
<td>162</td>
<td>15.18</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

S – Significant
NS – Not significant
** Significant at 0.01 level of confidence.
* Significant at 0.05 level of confidence.
MAIN EFFECTS

Treatment (T)

F-ratio for the difference in the retention scores of the two treatment groups was found to be highly significant at 0.01 level of confidence leading to the influence that the three instructional treatments yielded different retention scores in science.

An examination of means indicates that there is a difference in the retention scores of three groups. Thus, $H_0$ was rejected, as students taught by graphic organizer instruction exhibited better retention as compared to those taught by traditional instruction. Further, t-ratio were computed as:

In investigate further, the difference between different treatment, t-ratios were computed to test following hypotheses:

$H_{a1}$ Student taught by pre graphic organizer instruction and post graphic organizer instruction yield comparable retention scores.

$H_{a2}$ Students taught by Pre graphic organizer instruction and traditional instruction yield comparable retention scores.

$H_{a3}$ Students taught by post graphic organizer instruction and traditional instruction yield comparable retention scores.

The t-ratios for the difference in the means of gain scores in retention of the three treatment groups have been placed in table 5.11.
TABLE 5.11

t-ratios for retention scores between different treatments

<table>
<thead>
<tr>
<th>Group means</th>
<th>$T_1$</th>
<th>$T_2$</th>
<th>$T_3$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$M = 13.01$</td>
<td>2.04*</td>
<td>5.92**</td>
<td></td>
</tr>
<tr>
<td>$n = 180$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$M = 11.98$</td>
<td>-</td>
<td>-</td>
<td>3.87**</td>
</tr>
<tr>
<td>$n = 180$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$M = 10.03$</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>$n = 180$</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Significant at 0.05 level of confidence
** Significant at 0.01 level of confidence

The above table 5.11 reveals that

- Students taught through pre graphic organizer instruction exhibited better retention as compared to the post graphic organizer instruction as is evident from the value ‘t’ (2.04) which is significant at 0.05 level of confidence. Thus $H_{801}$ was rejected.

- Students taught through pre graphic organizer instruction exhibited better retention as compared to the traditional instruction as is evident from the value ‘t’ (5.42) which is significant at 0.01 level of confidence. Thus $H_{802}$ was rejected.

- Students taught through post graphic organizer instruction exhibited better retention as compared to the traditional instruction as is evident from the value ‘t’ (3.87) which is significant at 0.01 level of confidence. Thus, $H_{803}$ was rejected.
Intelligence (I)

F-ratios for the difference in the retention scores of the three intelligence groups was found to be highly significant at 0.01 level of confidence. Thus, \( H_9 \) was also rejected.

To investigate further, the difference between retention exhibited by different intelligence groups, t-ratios were computed to test the following hypotheses.

- \( H_{9,1} \): High and average intelligence groups yield comparable retention scores.
- \( H_{9,2} \): High and low intelligence groups yield comparable retention scores.
- \( H_{9,3} \): Average and low intelligence groups yield comparable retention scores.

The t-ratios for the difference in the retention scores of the three intelligence groups have been placed in Table 5.12.

**TABLE 5.12**

<table>
<thead>
<tr>
<th>t-ratios for retention scores between different intelligence groups</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Group means</strong></td>
</tr>
<tr>
<td>M = 13.7</td>
</tr>
<tr>
<td>n = 180</td>
</tr>
<tr>
<td>I₁ M = 13.7</td>
</tr>
<tr>
<td>n = 180</td>
</tr>
<tr>
<td>I₂ M = 11.98</td>
</tr>
<tr>
<td>n = 180</td>
</tr>
<tr>
<td>I₃ M = 10.26</td>
</tr>
<tr>
<td>n = 180</td>
</tr>
</tbody>
</table>

* Significant at 0.05 level of confidence
** Significant at 0.01 level of confidence

The table 5.12 reveals that:
• High Intelligence group exhibited better retention scores as compared to the average intelligence group as is evident from the value ‘t’ (3.41) which is significant at 0.01 level of confidence. Thus, \( H_{a1} \) was rejected.

• High intelligence group exhibited better retention scores as compared to the low intelligence group as is evident from the value ‘t’ (6.83) which is significant at 0.01 level of confidence. Thus, \( H_{a2} \) was rejected.

• Average intelligence group exhibited better mean gains as compared to the low intelligence groups as is evident from the value ‘t’ (3.41) which is significant at 0.01 level of confidence. Thus, \( H_{a3} \) was rejected.

Categories of Objectives (O)

F-ratio for the difference is the retention scores at the three categories of objectives was found to be significant at 0.01 level of confidence. An examination of the means for learning at knowledge, comprehension and application categories. Thus, \( H_{10} \) was rejected.

The mean retention scores of three main effects have been shown through Bar diagrams in Fig. 5.7.

To investigate further, the difference between three categories of objectives t-ratios were computed to test the following hypotheses.

\( H_{10.1} \) Comparable retention scores were obtained by students at category of objectives.

\( H_{10.2} \) Comparable retention scores were obtained by students at knowledge and application category of objectives.

\( H_{10.3} \) Comparable retention scores were obtained by students at comprehension and application category of objectives.

The t-ratios for the difference in the means of gain scores in retention of the three categories of objectives have placed in Table 5.13.
Fig. 5.7 Bar diagram showing means of retention scores corresponding to the three main effects

Intelligence Categories of objectives
Table 5.13 reveals that:

- Students exhibited better retention at comprehension category of objectives compared to the knowledge category of objectives as evident from the value of ‘t’ (2.42) which is significant at 0.05 level of confidence. Thus, $H_{10.1}$ was rejected.

- Student exhibited better retention at knowledge category of objectives as compared to the application category of objectives as evident from the value of ‘t’ (22.96) which is significant at 0.01 level of confidence. Thus $H_{10.2}$ was rejected.

- Students exhibited better retention at knowledge category of objectives as compared to the application category of objectives as evident from the value of ‘t’ (25.38) which is significant at 0.01 level of confidence. Thus, $H_{10.3}$ was rejected.
INTERACTION EFFECTS

Treatment and Intelligence (TXI)

The F-ratio of the interaction between treatment and intelligence was found to be significant at 0.01 level of confidence, leading to the influence that three variables interact with each other. Thus, $H_{11}$ was rejected.

To investigate further, the t-ratios were computed to test the following hypotheses:

$H_{11.1}$ For high intelligence students, retention scores for:

a) Pre graphic organizer instruction and post graphic organizer instruction are not different.

b) Pre graphic organizer instruction and traditional instruction are not different.

c) Post graphic organizer instruction and traditional instruction are not different.

$H_{11.2}$ For average intelligence students, retention score for:

a) Pre graphic organizer instruction and post graphic organizer instruction are not different.

b) Pre graphic organizer instruction and traditional instruction are not different.

c) Post graphic organizer instruction and traditional instruction are not different.

$H_{11.3}$ For low intelligence students, retention score for:

a) Pre graphic organizer instruction and post graphic organizer instruction are not different.

b) Pre graphic organizer instruction and traditional instruction are not different.
c) Post graphic organizer instruction and traditional instruction are not different.

**Hₜ₄** When taught by Pre graphic organizer instruction retention score for:

a) High and average intelligence students are not different.

b) High and low intelligence students are not different.

c) Average and low intelligence students are not different.

**Hₜ₅** When taught by Post graphic organizer instruction retention score for:

a) High and average intelligence students are not different.

b) High and low intelligence students are not different.

c) Average and low intelligence students are not different.

Mean gain scores on retention have been presented in Fig. 5.8.

**TABLE 5.14**

t-ratio of treatments and intelligence on retention scores (Txl)

<table>
<thead>
<tr>
<th></th>
<th>T₂I₁</th>
<th>T₁I₂</th>
<th>T₁I₃</th>
<th>T₂I₂</th>
<th>T₂I₃</th>
<th>T₁I₁</th>
<th>T₂I₁</th>
<th>T₁I₂</th>
<th>T₂I₂</th>
<th>T₁I₃</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M=14.94 n=60</td>
<td>M=12.34 n=60</td>
<td>M=11.78 n=60</td>
<td>M=14.72 n=60</td>
<td>M=14.44 n=60</td>
<td>M=9.82 n=60</td>
<td>M=11.45 n=60</td>
<td>M=9.47 n=60</td>
<td>M=9.18 n=60</td>
<td></td>
</tr>
<tr>
<td><strong>T₁I₁</strong></td>
<td>-</td>
<td>2.98</td>
<td>3.64</td>
<td>3.69**</td>
<td>4.01**</td>
<td>5.87**</td>
<td>4.0**</td>
<td>6.13**</td>
<td>6.6**</td>
<td></td>
</tr>
<tr>
<td><strong>T₂I₁</strong></td>
<td>-</td>
<td>-</td>
<td>0.642</td>
<td>2.72**</td>
<td>1.03</td>
<td>2.89**</td>
<td>1.02</td>
<td>3.29**</td>
<td>3.62**</td>
<td></td>
</tr>
<tr>
<td><strong>T₁I₂</strong></td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>3.37**</td>
<td>0.39</td>
<td>2.24*</td>
<td>0.37</td>
<td>2.65**</td>
<td>2.98**</td>
<td></td>
</tr>
<tr>
<td><strong>T₂I₂</strong></td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>3.76**</td>
<td>5.61**</td>
<td>3.75**</td>
<td>6.02**</td>
<td>6.35**</td>
<td></td>
</tr>
<tr>
<td><strong>T₁I₃</strong></td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1.86</td>
<td>3.01**</td>
<td>2.25*</td>
<td>2.59*</td>
<td></td>
</tr>
<tr>
<td><strong>T₂I₃</strong></td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1.86</td>
<td>0.40</td>
<td>0.73</td>
<td></td>
</tr>
<tr>
<td><strong>T₁I₁</strong></td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2.27</td>
<td>2.61**</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>T₂I₁</strong></td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0.33</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>T₁I₂</strong></td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
</tbody>
</table>

* Significant at 0.05 level of significance
** Significant at 0.01 level of significance
The table 5.14 reveals that

- High intelligence students:
  - taught by pre graphic organizer instruction attained better retention scores than those who taught by post graphic organizer instruction ($t=3.69$). Thus $H_{11a}$ was rejected, as t-value was significant at 0.01 level of confidence.

- taught by pre graphic organizer instruction attained better retention scores than those who taught by traditional instruction ($t=4.0$). Thus, $H_{11b}$ was rejected, as t-value was significant at 0.01 level of confidence.
Fig. 5.8 Interaction between treatment and intelligence for retention scores
- taught by post graphic organizer instruction attained better retention scores than those who taught by traditional instruction (t=3.75). Thus, H_{11} was rejected, as t-value was significant at 0.01 level of confidence.

- Average intelligence students:
  - taught by pre graphic organizer instruction and post graphic organizer instruction yield comparable retention scores (t=1.03). Thus, H_{12a} was rejected as ‘t’ value was insignificant at 0.05 level of confidence.
  - taught by pre graphic organizer instruction attained better retention scores than traditional instruction (t=3.29). Thus, H_{13b} was retained, as t-value was significant at 0.01 level of confidence.
  - taught by post graphic organizer instruction attained better retention scores than traditional instruction (t=2.25). Thus H_{12c} was significant at 0.05 level of confidence.

- Low intelligence students:
  - taught by Pre graphic organizer instruction attained better retention scores than post graphic organizer instruction (t=2.24). Thus, H_{11a} was rejected, as t-value was significant at 0.05 level of confidence.
  - taught by pre graphic organizer instruction attained better retention scores than traditional instruction (t=2.98). Thus, H_{13b} was rejected at t-value was significant at 0.01 level of confidence.
  - taught by post graphic organizer instruction and traditional instruction yield comparable (t=0.73). Thus, H_{12c} was retained, as t-value was insignificant at 0.05 level of confidence.

- When taught by pre graphic organizer instruction:
- High intelligence students attained better retention scores than average intelligence students \((t=2.98)\). Thus, \(H_{1.4.a}\) was rejected, as \(t\) value was significant at 0.01 level of confidence.

- High intelligence students attained better retention scores than low intelligence students \((t=3.64)\). Thus, \(H_{1.4.b}\) was rejected, as \(t\) value was significant at 0.01 level of confidence.

- Average intelligence students and low intelligence students yield comparable \((t=0.642)\). Thus \(H_{1.4.c}\) was retained, as \(t\)-value was insignificant at 0.05 level.

- When taught by post graphic organizer instruction:
  - High intelligence students attained better retention scores than average intelligence students \((t=3.76)\). Thus \(H_{1.5.a}\) was rejected, as \(t\)-value was significant at 0.01 level of confidence.
  
  - High intelligence students attained better retention scores than low intelligence students \((t=5.61)\). Thus \(H_{1.5.b}\) was rejected, as \(t\) value was significant at 0.01 level of confidence.

  - Average intelligence students attained better retention scores than low intelligence students \((t=2.59)\). Thus, \(H_{1.5.c}\) was rejected, as \(t\)-value was significant at 0.01 level of confidence.

**Treatment and Categories of Objectives (TxO)**

F-ratio for the interaction between treatment and categories of objectives was found to be significant at 0.01 level of confidence, leading to the influence that the two variables interact with each other. Thus, \(H_{1.2}\) was rejected.

To investigate further, the interaction between treatment and the categories of objectives, the \(t\)-ratios were computed to test the following hypotheses:

\(H_{1.1.1}\) At knowledge category of objectives students taught by:
a) Pre graphic organizer instruction and post graphic organizer instruction yield comparable retention scores.

b) Pre graphic organizer instruction and traditional instruction yield comparable retention scores.

c) Post graphic organizer instruction and traditional instruction yield comparable retention scores.

$H_{11.2}$ At comprehension category of objectives students taught by:

a) Pre graphic organizer instruction and post graphic organizer instruction yield comparable retention scores.

b) Pre graphic organizer instruction and traditional instruction yield comparable retention scores.

c) Post graphic organizer instruction and traditional instruction yield comparable retention scores.

$H_{11.3}$ At application category of objectives students taught by:

a) Pre graphic organizer instruction and post graphic organizer instruction yield comparable retention scores.

b) Pre graphic organizer instruction and traditional instruction yield comparable retention scores.

c) Post graphic organizer instruction and traditional instruction yield comparable retention scores.

$H_{12.4}$ When taught by pre graphic organizer instruction, the students retained comparably at:

a) Knowledge and comprehension category of objectives.

b) Knowledge and application category of objectives.

c) Comprehension and application category of objectives.
When students taught by post graphic organizer instruction, the student retained comparably at:

a) Knowledge and comprehension category of objectives.

b) Knowledge and application category of objectives.

c) Comprehension and application category of objectives.

Mean gain scores on retention have been presented in Fig. 5.9. The t-ratios have been placed in Table 5.15.

### Table 5.15

t-ratio for different combination of T x O for retention scores

<table>
<thead>
<tr>
<th>Group Means</th>
<th>T1O1 M=18.14 n=60</th>
<th>T2O2 M=16.42 n=60</th>
<th>T3O3 M=4.5 n=60</th>
<th>T4O4 M=14.48 n=60</th>
<th>T5O5 M=16.8 n=60</th>
<th>T6O6 M=4.68 n=60</th>
<th>T7O7 M=12.77 n=60</th>
<th>T8O8 M=15.82 n=60</th>
<th>T9O9 M=1.52 n=60</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1O1 M=18.14 n=60</td>
<td>1.46</td>
<td>15.84**</td>
<td>4.2**</td>
<td>1.33</td>
<td>15.43**</td>
<td>6.16**</td>
<td>2.66*</td>
<td>19.05**</td>
<td></td>
</tr>
<tr>
<td>T2O2 M=16.42 n=60</td>
<td>-</td>
<td>13.67**</td>
<td>2.22*</td>
<td>0.435</td>
<td>13.46**</td>
<td>4.18**</td>
<td>0.688</td>
<td>17.08**</td>
<td></td>
</tr>
<tr>
<td>T3O3 M=4.5 n=60</td>
<td>-</td>
<td>-</td>
<td>11.44**</td>
<td>14.10**</td>
<td>0.206</td>
<td>9.48**</td>
<td>12.98**</td>
<td>3.42**</td>
<td></td>
</tr>
<tr>
<td>T4O4 M=14.48 n=60</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2.68**</td>
<td>11.23**</td>
<td>1.961*</td>
<td>1.536</td>
<td>14.86**</td>
<td></td>
</tr>
<tr>
<td>T5O5 M=16.8 n=60</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>13.89**</td>
<td>4.62**</td>
<td>1.123</td>
<td>17.52**</td>
<td></td>
</tr>
<tr>
<td>T6O6 M=4.68 n=60</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>9.27**</td>
<td>12.78**</td>
<td>3.62**</td>
<td></td>
</tr>
<tr>
<td>T7O7 M=12.77 n=60</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>3.50**</td>
<td>12.90**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>T8O8 M=15.82 n=60</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>16.40**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>T9O9 M=1.52 n=60</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Significant at 0.05 level of confidence.

** Significant at 0.01 level of confidence.
Table 5.15 reveals that:

- At knowledge category of objectives:
  - students taught by pre graphic organizer instruction better than those taught by post graphic organizer instruction ($t=4.2$). Thus $H_{12.1(a)}$ was rejected, as $t$ value was significant at 0.01 level of confidence.
  - students taught by pre graphic organizer instruction better than those taught by traditional instruction ($t=6.16$). Thus, $H_{12.16}$ was rejected, as $t$ value was significant at 0.01 level of confidence.
Fig. 5.9 Interaction between treatment and categories of objectives for retention scores.
students taught by post graphic organizer instruction retained better than those taught by traditional instruction $(t=1.961)$. Thus, $H_{12.1c}$ was rejected, as t value was significant at 0.05 level of confidence.

- At comprehension category of objectives:
  - students taught by pre graphic organizer instruction and post graphic organizer instruction yielded comparable retention scores $(t=0.435)$. Thus, $H_{12.2a}$ was insignificant even at 0.05 level of confidence.
  - students taught by traditional instruction pre graphic organizer instruction and yielded comparable retention scores $(t=0.6888)$, thus, $H_{12.2b}$ was retained, as t value was insignificant at 0.05 level of confidence.
  - students taught by post graphic organizer instruction and traditional instruction yielded comparable retention scores $(t=1.123)$. Thus, $H_{12.2c}$ was retained, as t value was insignificant at 0.05 level of confidence.

- At application category of objectives:
  - students taught by pre graphic organizer instruction and post graphic organizer instruction yield comparable retention scores $(t=0.206)$. Thus, $H_{12.3a}$ was retained, as t value was insignificant at 0.05 level of confidence.
  - students taught by pre graphic organizer instruction attained the retention scores than those taught by traditional instruction $(t=3.42)$. Thus $H_{12.3b}$ was rejected, as t-value was significant at .001 level of confidence.
  - students taught by post graphic organizer instruction attained better retention scores than traditional instruction $(t=3.62)$. Thus, $H_{12.3c}$ was rejected, as t value was significant at 0.01 level of confidence.
• When taught by pre graphic organizer instruction students retained:
  - comparably at knowledge and comprehension category of objectives (t=1.46). Thus H_{12.4a} was retained, as t value was in significant even at 0.05 level of confidence letter at knowledge category of objectives than application category of objectives (t=15.64), thus H_{12.4b} was rejected, as t-value was significant at 0.01 level of confidence.
  - better at comprehension category of objectives than application category of objectives (t=13.67). Thus, H_{12.4c} was found to be significant at 0.01 level of confidence.

• When taught by post graphic organizer instruction, students retained:
  - better at comprehension category of objectives than knowledge category of objectives (t=2.68). Thus, H_{12.5a} was rejected, as t value was significant at 0.01 level of confidence.
  - better at knowledge category of objectives than application category of objectives, (t=11.23). Thus, H_{12.4b} was rejected, as t value was significant at 0.01 level of confidence.
  - better at comprehension category of objectives than application category of objectives (t=13.89). Thus, H_{12.4c} was rejected, as t value was significant at 0.01 level of confidence.

**Intelligence and categories of objectives (IxO)**

The F-ratio for the interaction between intelligence and categories of objectives was found to be significant at 0.01 level of confidence leading to the inference that the three variables interact with each other. Thus H_{13} was rejected.

To investigate further, the interaction between intelligence and categories of objectives, the t-ratios were computed to test the following hypotheses:

H_{13.1} For high intelligence students, retention at:

(a) Knowledge and comprehension category of objectives is not different.
(b) Knowledge and application category of objectives is not different.
(c) Comprehension and application category of objectives is not different.

**H_{13.2}** For average intelligence students retention at:
   (a) Knowledge and comprehension category of objectives is not different.
   (b) Knowledge and application category of objectives is not different.
   (c) Comprehension and application category of objectives is not different.

**H_{13.3}** For low intelligence students retention at:
   (a) Knowledge and comprehension category of objectives is not different.
   (b) Knowledge and application category of objectives is not different.
   (c) Comprehension and application category of objectives is not different.

**H_{13.4}** At knowledge categories of objectives.
   (a) High and average intelligence students retain comparables.
   (b) Average and low intelligence students retain comparables.

**H_{13.5}** At comprehension categories at objectives.
   (a) High and average intelligence students retain comparables.
   (b) Average and low intelligence students retain comparables.

**H_{13.6}** At application categories of objectives.
   (a) High and average intelligence students retain comparables.
   (b) Average and low intelligence students retain comparables.
<table>
<thead>
<tr>
<th>$I_1 O_3$</th>
<th>$I_2 O_3$</th>
<th>$I_3 O_1$</th>
<th>$I_1 O_2$</th>
<th>$I_2 O_2$</th>
<th>$I_3 O_2$</th>
<th>$I_1 O_1$</th>
<th>$I_2 O_1$</th>
<th>$I_3 O_1$</th>
<th>$I_1 O_0$</th>
</tr>
</thead>
<tbody>
<tr>
<td>M=19.28</td>
<td>M=17.72</td>
<td>M=13.72</td>
<td>M=15.74</td>
<td>M=3.84</td>
<td>M=12.38</td>
<td>M=12.25</td>
<td>M=2.17</td>
<td></td>
<td></td>
</tr>
<tr>
<td>n=60</td>
<td>n=60</td>
<td>n=60</td>
<td>n=60</td>
<td>n=60</td>
<td>n=60</td>
<td>n=60</td>
<td>n=60</td>
<td></td>
<td></td>
</tr>
<tr>
<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>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.78</td>
<td>-</td>
<td>15.62**</td>
<td>2.32*</td>
<td>-</td>
<td>13.33**</td>
<td>3.35**</td>
<td>9.7**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>17.41**</td>
<td>-</td>
<td>4.58**</td>
<td>11.33**</td>
<td>15.19**</td>
<td>6.12**</td>
<td>6.12**</td>
<td>9.64**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.37**</td>
<td>-</td>
<td>2.27*</td>
<td>0.298</td>
<td>15.19**</td>
<td>6.12**</td>
<td>6.12**</td>
<td>9.64**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.06**</td>
<td>-</td>
<td>17.70**</td>
<td>15.19**</td>
<td>6.12**</td>
<td>5.27**</td>
<td>5.27**</td>
<td>17.83**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>17.70**</td>
<td>-</td>
<td>17.70**</td>
<td>15.19**</td>
<td>6.12**</td>
<td>5.27**</td>
<td>5.27**</td>
<td>17.83**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.91**</td>
<td>-</td>
<td>7.91**</td>
<td>6.12**</td>
<td>6.12**</td>
<td>5.27**</td>
<td>5.27**</td>
<td>17.83**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8.06**</td>
<td>-</td>
<td>6.06**</td>
<td>7.91**</td>
<td>6.12**</td>
<td>5.27**</td>
<td>5.27**</td>
<td>17.83**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>19.62**</td>
<td>-</td>
<td>19.62**</td>
<td>17.70**</td>
<td>17.70**</td>
<td>6.12**</td>
<td>5.27**</td>
<td>17.83**</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Significant at 0.05 level of confidence.
** Significant at 0.01 level of confidence.
Fig. 5.10 Interaction between intelligence and categories of objectives for retention scores
The t-value have been placed in Table 5.16.

The Table 5.16 reveals that:

- For high intelligence students, retention at:
  - knowledge category of objectives was better than that at comprehension category of objectives (t=1.78). Thus $H_{13.1a}$ was rejected, as t-value was significant at 0.05 level of confidence.
  - knowledge category of objectives was better than that at application category of objectives (t=17.41). Thus $H_{13.1b}$ was rejected, as t-value was significant at 0.01 level of confidence.
  - comprehension category of objectives was better than that at application category of objectives (t=15.62). Thus $H_{13.1c}$ was rejected, as t-value was significant at 0.01 level of confidence.

- For average intelligence students, retention at:
  - comprehension category of objectives was better than that at knowledge category of objectives (t=2.32). Thus $H_{13.2a}$ was rejected, as t-value was significant at 0.05 level of confidence.
  - knowledge category of objectives was better than that at application category of objectives (t=11.33). Thus $H_{13.2b}$ was rejected, as t-value was significant at 0.01 level of confidence.
  - comprehension category of objectives was better than that at application category of objectives (t=13.76). Thus $H_{13.2c}$ was rejected, as t-value was significant at 0.01 level of confidence.

- For low intelligence students, retention at:
  - comprehension level attained comparable category of objectives (t=0.149). Thus $H_{13.3a}$ was retained, as t-value was not significant even at 0.05 level of confidence.
- knowledge category of objectives was better than that at application category of objectives \((t=11.70)\). Thus, \(H_{13.3.b}\) was rejected, as \(t\) value was significant at 0.01 level of confidence.

- comprehension category of objectives was better than that at application category of objectives \((t=11.55)\). Thus, \(H_{13.3.c}\) was rejected, as \(t\)-value was significant at 0.01 level of confidence.

- At knowledge categories at objectives:
  - high intelligence students retained better than average intelligence students \((t=6.37)\). Thus, \(H_{13.4.a}\) was rejected, as \(t\)-value was significant at 0.01 level.
  - average intelligence students and low intelligence students retained comparably \((t=1.53)\). Thus \(H_{13.4.b}\) was retained, as \(t\)-value was significant at 0.01 level.

- At comprehension category of objectives:
  - high intelligence students retained better than average intelligence students \((t-2.27)\). Thus \(H_{13.5.a}\) was rejected, as \(t\)-value was significant at 0.05 level of confidence.
  - average intelligence students retained better than low intelligence students \((t=4.00)\). Thus \(H_{13.5.b}\) was rejected, as \(t\)-value was significant average at 0.01 level of confidence.

- At application categories of objectives:
  - high and average intelligence students retained comparable \((t-0.298)\). Thus, \(H_{13.6.a}\) was retained, as \(t\) value was not significant even at 0.05 level of confidence.
  - average intelligence students retained better than low intelligence students \((t=1.99)\). Thus, \(H_{13.6.b}\) was significant at 0.05 level of confidence.
**Treatment x Intelligence x Categories of objectives (TxIxO)**

The F-ratio for the interaction between treatment, intelligence and categories of objectives was found to be not significant even at 0.05 level of confidence. It indicates that there no interaction between treatment, intelligence and categories of objectives with respect to retention. Thus H14 was retained.

### 5.4 Analysis of 3x3 ANOVA of mean scores on study habits

The following hypotheses will be tested:

- **H15** The three instructional treatments yield comparable mean gain scores on study habits.
- **H16** The high, average and low intelligence groups attain comparable mean gain scores on study habits inventory.
- **H17** There is no significant interaction between instructional treatments and levels of intelligence with respect to study habits. The mean and S.D.’s of different sub samples were calculated and have been presented in Table 5.17.

#### TABLE 5.17
Mean and S.D.’s, of sub-samples of 3x3 design for mean gain scores in study habits

<table>
<thead>
<tr>
<th></th>
<th>T&lt;sub&gt;1&lt;/sub&gt;</th>
<th>T&lt;sub&gt;2&lt;/sub&gt;</th>
<th>T&lt;sub&gt;3&lt;/sub&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>I&lt;sub&gt;1&lt;/sub&gt;</td>
<td>M = 46.25, SD = 4.05, n = 20</td>
<td>M = 49, SD = 3.98, N = 20</td>
<td>M = 29.25, SD = 1.55, n = 20</td>
</tr>
<tr>
<td>I&lt;sub&gt;2&lt;/sub&gt;</td>
<td>M = 37, SD = 3.34, n = 20</td>
<td>M = 38, SD = 3.85, N = 20</td>
<td>M = 25.5, SD = 2.42, n = 20</td>
</tr>
<tr>
<td>I&lt;sub&gt;3&lt;/sub&gt;</td>
<td>M = 27, SD = 2.37, n = 20</td>
<td>M = 28.25, SD = 2.54, N = 20</td>
<td>M = 18.25, SD = 1.31, n = 20</td>
</tr>
</tbody>
</table>
**Summary of 3x3 ANOVA mean scores on study habits**

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>Sum of squares</th>
<th>MSs</th>
<th>F ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>T</td>
<td>2</td>
<td>SSc = 7105.83</td>
<td>3552.915</td>
<td>379.48</td>
</tr>
<tr>
<td>I</td>
<td>2</td>
<td>SSR=8680.00</td>
<td>4340</td>
<td>463.55</td>
</tr>
<tr>
<td>TXI</td>
<td>4</td>
<td>0589.17</td>
<td>147.2925</td>
<td>15.73</td>
</tr>
<tr>
<td>Error term</td>
<td>171</td>
<td>1601</td>
<td>9.3625</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>179</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* * Significant at 0.01 level of confidence

**Main Effects**

**Treatment (T)**

The F-ratio for the difference in the mean scores of three instructional treatment groups was found to be highly significant at 0.01 level of confidence leading to the inference that the three instructional treatments yielded different mean gains on study habits in social studies. Thus H₁₅ was rejected, as student taught by different instructional treatments, viz., pre graphic organizer instruction and traditional instruction exhibited different study habits. Further, t-ratios were computed.

H₁₅.₁ Pre graphic organizer instruction and post graphic organizer instruction yield comparable mean gain on study habits.

H₁₅.₂ Pre graphic organizer instruction and traditional instruction yield comparable mean gain scores on study habits.

H₁₅.₃ Post graphic organizer instruction and traditional instruction yield comparable mean gain scores on study habits.
The t-ratios for the difference in the means of gain scores on study habits of the three treatment groups have been placed in Table 5.19.

**TABLE 5.19**

*t*-ratio for study habits’ mean gain scores between different treatments

<table>
<thead>
<tr>
<th>Group means</th>
<th>$T_1$ $M=36.75$ $n=60$</th>
<th>$T_2$ $M=38.41$ $n=60$</th>
<th>$T_3$ $M=24.34$ $n=60$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$T_1$ $m=36.75$ $n=60$</td>
<td>-</td>
<td>2.42*</td>
<td>18.14**</td>
</tr>
<tr>
<td>$T_2$ $M=38.41$ $n=60$</td>
<td>-</td>
<td>-</td>
<td>20.57**</td>
</tr>
<tr>
<td>$T_3$ $M=24.34$ $n=60$</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

* Significant at 0.05 level of confidence
** Significant at 0.01 level of confidence

The above table 5.19 reveals that

- Students taught by post graphic organizer instruction exhibited better mean gains on study habits as compared to those taught through pre graphic organizer instruction as is evident from the value ‘$t$’ (2.42), which is significant at 0.05 level of confidence. Thus $H_{15.1}$ was rejected.

- Students taught through pre graphic organizer instruction exhibited better mean gains on study habits as compared to those taught through traditional instruction as is evident from the value ‘$t$’ (18.14) which is significant at 0.01 level of confidence. Thus $H_{15.2}$ was rejected.

- Students taught through post graphic organizer instruction exhibited better gain scores on study habits as compared to those taught through traditional instruction as is evident from the value ‘$t$’ (20.57) which is significant at 0.01 level of confidence. Thus $H_{15.3}$ was rejected.
Intelligence (I) F-ratio for the difference in mean gain on study habits of the three intelligence groups was found to be highly significant at 0.01 level of confidence. An examination of means of the three intelligence groups reveals that there is a difference between the development of study habits among the three groups. Thus H₁₆ was also rejected. Further t-ratios were computed.

H₁₆₁ High and average intelligence groups yield comparable gain scores on study habits.

H₁₆₂ High and low intelligence groups yield comparable gain scores on study habits.

H₁₆₃ Average and low intelligence groups yield comparable gain scores on study habits.

The t-ratios for the difference in the mean gain scores on study habits of the three intelligence groups have been placed in Table 5.20.

**TABLE 5.20**

| Group means | I₁ M=41.5  
| n = 60 | I₂ M = 33.5  
| n = 60 | I₃ M = 24.5  
| n = 60 |
| ------------ | -------- | ------------ | -------- |
| I₁ M=41.5  
| n = 60 | -        | 11.69**    | 24.85**  |
| I₂ M = 33.5  
| n = 60 | -        | -          | 13.15**  |
| I₃ M = 24.5  
| n = 60 | -        | -          | -        |

The table 5.15 reveals that

- High intelligence group exhibited better mean gain on study habits as compared to the average intelligence group as is evident from the value `t` (11.69) which is significant at 0.01 level of confidence. Thus, H₁₅₁ was rejected.

169
High intelligence group exhibited better mean gain scores on study habits as compared to the low intelligence group as is evident from 0.01 level of `t' (24.85) which is significant at 0.01 level of confidence. Thus H_{16.2} was rejected.

Average intelligence group exhibited better mean gain scores on study habits as compared to the low intelligence group as is evident from the value `t' (13.15) which is significant at 0.01 level of confidence. Thus, H_{16.3} was rejected.

**Interaction Effects**

**Treatment and Intelligence (TxI)**

The F-ratio for the interaction between treatment and intelligence was found to be significant at 0.01 level of confidence, leading to the inference that the two variables interact with each other. Thus H_{17} was rejected. The gain means of the two main effects have been shown through bar graphs in Fig. 5.11.
Fig. 5.11 Bar diagram showing means gain corresponding to the two main effects of achievement scores.
To investigate further, the t ratios were computed to test the following hypotheses:

**H\textsubscript{17.1}** For high intelligence students mean gains on study habits:

(a) Pre graphic organizer instruction and post graphic organizer instruction are not different.

(b) Pre graphic organizer instruction and traditional instruction are not different.

(c) Post graphic organizer instruction and traditional instruction are not different.

**H\textsubscript{17.2}** For average intelligence students mean gains on study habits:

(a) Pre graphic organizer instruction and post graphic organizer instruction are not different.

(b) Pre graphic organizer instruction and traditional instruction are not different.

(c) Post graphic organizer instruction and traditional instruction are not different.

**H\textsubscript{17.3}** For low intelligence students mean gains on study habits:

(a) Pre graphic organizer instruction and post graphic organizer instruction are not different.

(b) Pre graphic organizer instruction and traditional instruction are not different.

(c) Post graphic organizer instruction and traditional instruction are not different.

**H\textsubscript{17.4}** When taught by pre graphic organizer instruction mean gains on study habits for:

(a) High and average intelligence students are not different.
(b) High and low intelligence students are not different.

(b) Average and low intelligence students are not different.

H_{17,5} When taught by post graphic organizer instruction mean gains on study habits for:

(a) High and average intelligence students are not different.

(b) High and low intelligence students are not different.

(c) Average and low intelligence students are not different.

### TABLE 5.21

**t-ratio for different combination of T x I for study habits scores**

<table>
<thead>
<tr>
<th>Group means</th>
<th>T_\text{I}_1 M=15.41 n=60</th>
<th>T_\text{I}_2 M=12.34 n=60</th>
<th>T_\text{I}_3 M=9.0 n=60</th>
<th>T_\text{I}_4 M=16.34 n=60</th>
<th>T_\text{I}_5 M=12.67 n=60</th>
<th>T_\text{I}_6 M=9.42 n=60</th>
<th>T_\text{I}_7 M=9.75 n=60</th>
<th>T_\text{I}_8 M=8.5 n=60</th>
<th>T_\text{I}_9 M=6.08 n=60</th>
</tr>
</thead>
<tbody>
<tr>
<td>T_\text{I}_1 M=15.41 n=60</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>T_\text{I}_2 M=12.34 n=60</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>T_\text{I}_3 M=9.0 n=60</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>T_\text{I}_4 M=16.34 n=60</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>T_\text{I}_5 M=12.67 n=60</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>T_\text{I}_6 M=9.42 n=60</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>T_\text{I}_7 M=9.75 n=60</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>T_\text{I}_8 M=8.5 n=60</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>T_\text{I}_9 M=6.08 n=60</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

* Significant at 0.05 level of confidence

** Significant at 0.01 level of confidence

The interaction between treatment and intelligence for mean gain our study habits has been presented in Table 5.21. The mean gains on study habits have shown in Fig. 5.12.
The table 5.21 reveals that:

* $H_{17.1}$ High intelligence students:
  - taught by pre graphic organizer instruction and post graphic organizer instruction yielded comparable mean gain scars on study habits ($t=1.66$). Thus $H_{17.1a}$ was retained, as the t-value was not significant even at 0.05 level at confidence.
Fig. 5.12 Interaction between treatment and intelligence for study habits
taught by pre graphic organizer instruction attained better mean gain scores on study habits than those taught by traditional instruction \((t=10.16)\). Thus \(H_{17.1b}\) was rejected, as t value was significant at 0.01 level of confidence.

- taught by post graphic organizer instruction attained better mean scores on study habits than those taught by traditional instructions \((t=11.83)\). Thus, \(H_{17.1c}\) was rejected, as t value was significant at 0.01 level of confidence.

\(H_{17.2}\) Average intelligence students:

- taught by pre graphic organizer instruction and post graphic organizer instruction attained comparable scores on study habits \((t=0.59)\). Thus \(H_{17.2a}\) was retained, as the t-value was not significant even at 0.05 level at confidence.

- taught by pre graphic organizer instruction attained better mean scores on study habits taught by traditional instruction \((t=6.89)\). Thus \(H_{17.2b}\) was rejected, as t value was significant at 0.01 level of confidence.

- taught by post graphic organizer instruction attained better mean scores on study habits those taught by traditional instruction \((t=7.48)\). Thus, \(H_{17.2c}\) was rejected, as t value was significant at 0.01 level of confidence.

\(H_{17.3}\) Low average students:

- taught by pre graphic organizer instruction and post graphic organizer instruction yield comparable mean gain scores on study habits \((t=0.75)\). Thus \(H_{17.3a}\) was retained, as the t-value was not significant even at 0.05 level at confidence.

- taught by pre graphic organizer instruction attained better mean gain scores on study habits than those taught by traditional
taught by post graphic organizer instruction attained better mean scores on study habits than those taught by traditional instruction (t=5.99). Thus, H173c was rejected, as t value was significant at 0.01 level of confidence.

H174 When taught by pre graphic organizer instruction:

- high intelligence students attained better means gain on study habits than the average intelligence students (t=5.51). Thus H174a was rejected, as t value was significant at 0.01 level of confidence.

- high intelligence students attained better mean gains on study habits than the low intelligence students (t=11.50). Thus, H174b was rejected, as t value was significant at 0.01 level of confidence.

- average intelligence students attain better mean gains on study habits than the low intelligence students (t=5.99). Thus, H174c was rejected, as t value was significant at 0.01 level of confidence.

H175 When taught by post graphic organizer instruction:

- high intelligence students attained better mean gains on study habits than the average intelligence students (t=6.58). Thus H175a was rejected, as t value was significant at 0.01 level of confidence.

- high intelligence students attained better mean gains on study habits than the low intelligence students (t=12.42). Thus, H175b was rejected, as t value was significant at 0.01 level of confidence.

- average intelligence students attained better mean gains on study habits than the low intelligence students (t=5.83). Thus, H175c was rejected, as t value was significant at 0.01 level of confidence.
5.5 DISCUSSION OF RESULTS

This section has been presented in separate sub-section for results, related to achievement scores, retention scores and study habits scores.

Achievement scores

The present study revealed that there is a difference in the mean gain scores of the three treatment groups. Students taught social studies by graphic organizer instruction exhibited better gain in achievement scores as compared to those taught by traditional instruction. Thus, $H_1$ was rejected.

This finding was supported by Richard (1985) who suggested that the graphic organizers in verbal or graphic organizer can effect approach to learning and Ran / Court (1986) who reported that comparative graphic organizers group scored significantly higher than the expository organizer group on achievement on VIth Class mathematics students. Little (1986)’s study revealed that the use of summaries outlines, key terms questions were effective in improving the social studies achievement of IXth grade students.

Classidy (1989) reported that Venn diagrams, story maps and charts helped teachers to develop analysis, synthesis and evaluation as critical thinking of Xth class students. Classidy and Harsler (1992) reported that graphic organizers helped high school to get main idea successfully. Smith (1993) found that 12th grade biology students with formal reasoning skills use more likely to succeed in a hypermedia based instructional environmental graphic organizers students with non formal reasoning skills.

Backer (1993)’s study indicated that visual advance organizer offered more power for learning and retention, than verbal advance organizer. Clarke (1994) also reported that graphic organizers helped high school history students for historical inquiry and result in provided thinking skills, more sophisticated conclusions and better decision making. Griffin, Malone and Kameenui (1995) also supported the finding as in this study, fifth grade students who received the graphic organizer instruction and explicit instruction performed better on the
measure of transfer than those students who received traditional basal instruction. Griffin and Tulbert (1995) reported that the use of graphic organizers on sixth grade students assisted students in the complex act of making sense of content area.

Robinson and Kiewra (1995)'s study revealed that college students studying graphic organizers learned more hierarchical and coordinate relations, were more successful in applying that knowledge than students studying text alone. Munroe (1997) found that the effective use of graphic organizer can help to teach vocabulary and develop conceptual understanding to IXth class students. Ekhaul (1998) suggested that students performance was better with use of graphic organizers in the form of venn diagram, graphs, cyclical and fishbone etc.

Wells (1999) also found that the use of concept map as a advance organizer is an effective method for imparting student learning in general biology. Pepper (1999)'s study can graphic organizer instruction in teaching of IXth standard biology suggested that students gain from graphic organizers were positive Egan (1999) also supported significant effects of graphic organizer instruction. Doyle (1999) found that graphic organizer instruction improved the comprehension of disabled students than traditional method.

Millet (2003) reported that reading comprehension achievement of second grade students with graphic organizer instruction was better than traditional instructoin Guestello (2000) found that biology learning of low achieving VIIth grade students was facilitated with concept maps and led to greater comprehension. Dicecco and Gleason (2002), found that graphic organizers facilitated retention and recall of content knowledge, application of relational knowledge.

Further analysis revealed that, students taught by pre graphic organizer instruction yielded better mean gains than post graphic organizer instruction. Thus, supported by Anderson (1983) who found that the pre graphic organizer instruction group did significantly better, when each of these cognitive levels were considered separately for college students.
Students taught by pre graphic organizer instruction attained better than traditional instruction. Thus $H_{12}$ was rejected. Students taught by post graphic organizer instruction exhibited better mean gains on achievement as compared to those taught by traditional instruction. Thus, $H_{13}$ was rejected.

The three intelligence groups exhibited different main gains on achievement. Thus, $H_2$ was rejected the means of high intelligence group and average intelligence group yielded comparable. Thus, $H_{21}$ was retained. High intelligence group performed better than average intelligence group. Thus, $H_{22}$ was rejected. Average intelligence group exhibited better than low intelligence group. Thus $H_{23}$ was rejected.

Different mean gains were reported at the three categories of objectives. Thus, $H_3$ was rejected. At knowledge category of objectives, students attained better than at comprehension category of objectives. Thus, $H_{31}$ was rejected. At knowledge category of objective students attained better than at application category of objectives. Thus, $H_{32}$ was rejected. At comprehension category of objectives, students attained better than at application category of objectives. Thus, $H_{33}$ was rejected.

Treatment and intelligence were found to interact with each other, which lead to the rejection of $H_4$. Further analysis revealed that, high intelligence students taught by pre graphic organizer instruction and post graphic organizer instruction yielded comparable mean gains. Thus, $H_{41}$ was retained. This finding was supported by Graber and Johnsten (1972) is study on effect of expository pre and post graphic organizer and a historical passage of under graduates was found no significant difference among groups.

High intelligence students taught by pre graphic organizer instruction exhibited better mean gains than those taught by traditional instruction. Thus, $H_{11}$ was rejected.

High intelligence students taught by post graphic organizer instruction exhibited better mean gain than those taught by traditional intelligence Thus,
was rejected. Average intelligence students taught by pre graphic organizer instruction and post graphic organizer instruction yielded comparable mean gains. Thus H4c was retained.

Average intelligence students taught by pre graphic organizer instruction attained better than those taught by traditional instruction. Thus, H4a was rejected. Average intelligence students taught by post graphic organizer instruction attained better than those taught by traditional instruction. Thus, H4b was rejected.

Low intelligence students taught by pre graphic organizer instruction attained better than those taught by post graphic organizer instruction. Thus, H4c was rejected. Low intelligence students taught by pre graphic organizer instruction attained better than those taught by traditional instruction. Thus, H4d was rejected. Low intelligence students taught by post graphic organizer instruction attained better than those taught by traditional instruction. Thus, H4e was rejected.

When taught by pre graphic organizer instruction, high intelligence students attained better than average intelligence students. Thus, H4a was rejected. When taught by pre graphic organizer instruction, high intelligence students attained better than low intelligence students. Thus, H4b was rejected.

When taught by pre graphic organizer instruction, average intelligence students attained better than low intelligence students. Thus, H4c was rejected. When taught by post graphic organizer instruction, high intelligence students attained better than average intelligence students. Thus, H4d was rejected.

When taught by post graphic organizer instruction, average high intelligence students attained better than low intelligence students. Thus, H4e was rejected. Students attained better than low intelligence students. Thus, H4f was rejected.

Treatment and categories of objectives did not interacted to each other. So H5 was rejected.
The interaction between treatment and categories of objectives was found to be significant, which lead to rejection of \( H_6 \). Further investigation revealed that high intelligence students at knowledge and comprehension yielded comparable mean gains. Thus, \( H_{6,1a} \) was retained. High intelligence students attained better at knowledge than application category of objectives. Thus, \( H_{6,1b} \) was rejected.

High intelligence students exhibited better mean scores at comprehension than application category of objectives. Thus, \( H_{6,1c} \) was rejected. Average intelligence students exhibited better gain achievement at knowledge than comprehension. Thus \( H_{6,2a} \) was rejected. Average intelligence students attained better at knowledge than application category of objectives. Thus \( H_{6,2b} \) was rejected. Average intelligence students attained better at comprehension than application category of objectives. Thus \( H_{6,2c} \) was rejected.

Low intelligence students attained better knowledge then comprehension category of objectives. Thus, \( H_{6,3a} \) was rejected. Low intelligence students attained better at knowledge than application category of objectives. Thus, \( H_{6,3b} \) was rejected. Low intelligence students attained better at comprehension than application category of objectives. Thus, \( H_{6,3c} \) was rejected.

At comprehension category of objectives, high intelligence students attained better mean gains than average intelligence students. Thus, \( H_{6,4a} \) was rejected. At comprehension category of objectives average students attained better than low intelligence students. Thus, \( H_{6,4b} \) was rejected. At knowledge category of objectives, high intelligence students attained better than average intelligence students. Thus, \( H_{6,4c} \) was rejected. At knowledge category of objective, average intelligence students attained better than low intelligence students. Thus, \( H_{6,4d} \) was rejected.

At application category of objectives high intelligence students attained better than average students. Thus \( H_{6,6a} \) was rejected. At application category of objectives, average and low intelligence students yielded comparable mean gains. So, \( H_{6,6c} \) was retained.
The present study revealed that treatment, intelligence and category of objectives do not interact with one another for achievement scores. Thus, H7 was retained.

**Retention Scores**

The mean indicates that there is a difference in the gain in retention scores of the three treatment groups, as students taught by graphic organizer instruction exhibited better retention as compared to those taught by traditional instruction. Thus, H8 was rejected.

This finding was supported by Mazure (1996) who reported that graphic organizer instruction helped fifth grade social studies students significantly in chapter retention than students taught through traditional instruction. Richard (1985) found that graphic advance organizer was most effective in the retention of aeronatical concept.

Students taught by pre graphic organizer instruction retained better as compared to those taught by post graphic organizer instruction. Thus, H8.1a was rejected. Students taught by pre graphic organizer instruction retained better as compared to those taught by traditional instruction. Thus, H8.1b was rejected. Students taught by post graphic organizer instruction retained better as compared to those taught by traditional instruction. Thus, H8.1c was rejected.

Retention independent of intelligence. Thus, H9 was rejected. High intelligence group retained better than average intelligence group. Thus H9.1a was rejected. High intelligence group was retained better than low intelligence group. Thus, H9.1b was rejected. This finding was supported by Sood (1988) and Khare (2000). Average intelligence students retained better than low intelligence group. Thus H9.1c was rejected.

Students retained better at comprehension category of objectives than knowledge category of objectives. Thus, H10.1a was rejected. At knowledge category of objectives students retained better than at application category of objectives.
Thus, $H_{10.1b}$ was rejected. At comprehension category of objectives students retained better than at application category of objectives Thus, $H_{10.1e}$ was rejected.

Treatment and intelligence were found to interact with each other with respect to retention scores. Thus, $H_{11}$ was rejected. Further analysis revealed that, high intelligence students taught by pre graphic organizer instruction retained better than those taught by post graphic organizer instruction. Thus, $H_{11.1a}$ was rejected.

High intelligence students taught by pre graphic organizer instruction obtained better than those taught by traditional instruction. Thus $H_{11.1b}$ was rejected. High intelligence students taught by post graphic organizer instruction retained better than those taught by traditional instruction. Thus $H_{11.1c}$ was rejected.

Average intelligence students taught by pre graphic organizer instruction retained comprehension with those taught by post graphic organizer instruction. Thus $H_{11.2a}$ was rejected. Average intelligence students taught by pre graphic organizer instruction retained better than those taught by traditional instruction. Thus, $H_{11.2b}$ was rejected. Average intelligence students taught by post graphic organizer instruction obtained better than traditional instruction. Thus, $H_{11.2c}$ was rejected.

Low intelligence students taught by pre graphic organizer instruction retained better than those taught by post graphic organizer instruction. Thus, $H_{11.3a}$ was rejected. Low intelligence students taught by pre graphic organizer instruction retained better than those taught by traditional instruction Thus, $H_{11.3b}$ was rejected. Low intelligence students taught by post graphic organizer instruction and traditional instruction yielded comparable retention scores. Thus, $H_{11.3c}$ was rejected.

When taught by pre graphic organizer instruction high intelligence students retained better than average intelligence students Thus, $H_{11.4a}$ was rejected. When taught by pre graphic organizer instruction high intelligence students retained better than low intelligence students. Thus, $H_{11.4b}$ was rejected.
Average and low intelligence students retained comparably. Thus, H114c was retained. When taught by post graphic organizer instruction high intelligence students retained better than average intelligence students. Thus, H115a was rejected. When students were taught by post graphic organizer instruction, high intelligence students retained better than low intelligence student. Thus, H116b was rejected. When students were taught by post graphic organizer instruction, average intelligence students obtained better than low intelligence student. Thus H115c was rejected.

Treatment and categories were found to interact with each other, which lead to the rejection of H12. Further analysis revealed that. At knowledge category of objectives, students taught by pre graphic organizer instruction retained better than those taught by post graphic organizer instruction. Thus H121a was rejected. At knowledge category of objectives. Students taught by pre graphic organizer instruction retained better than those taught by traditional instruction. Thus H121b was rejected. At knowledge category of objectives students taught by post graphic organizer instruction retained better than traditional instruction. Thus, H121c was rejected.

At comprehension category of objectives students taught by pre graphic organizer instruction and post graphic organizer instruction retained comparable retention scores. Thus, H122a was retained. At comprehension category of objectives students taught by pre graphic organizer instruction and traditional instruction, retained comparable retention scores. Thus, H122b was retained. At comprehension category of objectives students taught by post graphic organizer instruction and traditional instruction retained comparable retention scores. Thus H122c was retained.

At application category of objectives students taught by pre and post graphic organizer instruction yielded comparable retention scores. Thus H123a was retained. At application category of objectives students taught by pre graphic organizer instruction retained better than those taught by traditional instruction Thus, H123b was rejected. At application category of objectives, students taught by
post graphic organizer instruction retained better than taught by traditional instruction. Thus, H\textsubscript{12.3} was rejected.

When taught by pre graphic organizer instruction students retained comparable at knowledge and comprehension category of objectives Thus H\textsubscript{12.4a} was retained. When taught by pre graphic organizer instruction students obtained better at knowledge than application category of objectives Thus H\textsubscript{12.4b} was rejected. Students taught by pre graphic organizer instruction retained better at comprehension than application category of objectives Thus, H\textsubscript{12.4c} was rejected.

Students taught by post graphic organizer instruction retained better at comprehension than knowledge category of objectives. Thus, H\textsubscript{12.5a} was retained. Better at knowledge than application category of objectives. Thus, H\textsubscript{12.5b} was rejected. Students taught by post graphic organizer instruction retained better at comprehension than application category of objectives. Thus H\textsubscript{12.5c} was rejected.

Intelligence and categories of objectives were found to interact with each other. Thus H\textsubscript{13} was rejected. For further analysis revealed that, high intelligence students at knowledge and comprehension category of objectives retained comparable. Thus H\textsubscript{13.1a} was retained. High intelligence students retained better at knowledge than application category of objectives. Thus H\textsubscript{13.1b} was rejected. High intelligence students retained better at comprehension than application category of objectives. Thus, H\textsubscript{13.1c} was rejected.

Average intelligence students retained better at comprehension than knowledge category of objectives Thus, H\textsubscript{13.2a} was rejected. Average intelligence students retained better at knowledge than application category of objectives. Thus, H\textsubscript{13.2b} was rejected.

Average intelligence students retained better at comprehension than application category of objectives. Thus, H\textsubscript{13.2c} was rejected. Low intelligence students retained better at knowledge than comprehension G.O.O. Thus, H\textsubscript{13.3a} was rejected. Low intelligence students retained better at knowledge than application category of objectives Thus H\textsubscript{13.3b} was rejected. Low intelligence students retained
better at comprehension than application category of objectives Thus $H_{13.3c}$ was rejected.

At knowledge category of objectives high intelligence students retained better than average intelligence students. Thus $H_{13.4a}$ was rejected. At knowledge category of objectives average and low intelligence students retained comparable scores. Thus, $H_{13.4b}$ was rejected. At comprehension category of objectives high intelligence students retained better than average intelligence students. Thus $H_{13.5a}$ was rejected. At comprehension category of objectives average intelligence student retained better than low intelligence students. Thus $H_{13.5b}$ was rejected. At application category of objectives high and average intelligence students retained comparable. Thus $H_{13.6a}$ was retained.

Student taught through post graphic organizer instruction exhibited better study habits than pre graphic organizer instruction. Thus $H_{15.1a}$ was rejected. This finding supported by Moore and Readence (1980-1984) who found that graphic organizer instruction was more facilitative as a post reading activity than when used as a pre-reading activity for VIIth class students, Horton and Lovitt (1989) found that post graphic organizer (GPO) enhanced ability of secondary students with disabilities to be successful in regular education.

Students taught by pre graphic organizer instruction exhibited better mean gains on study habits than those taught by traditional instruction. Thus, $H_{15.1b}$ was rejected. Students taught by post graphic organizer instruction exhibited better study habits than those taught by traditional instruction. Thus, $H_{15.1c}$ was rejected.

At application category of objectives, average intelligence students retained better than low intelligence students. Thus, $H_{13.6b}$ was rejected.

Treatment, intelligence and objectives of categories were not found to interact with one other. Thus, $H_{14}$ was retained.

**Study Habits:**
The mean indicate that there is a difference in the gain in study habits scores of three treatment groups, as students taught by graphic organizer instruction exhibited better study habits as compared to traditional instruction.

This finding was supported by Patil (1996) who found that those pupils who had good habits did get significantly achievement scores than those who had been poor study habits. Carry (1999) reported the students were able to change some of their study habits as awareness of their learning styles. Huard (1998) found that use of proper study habits positively reflected their academic achievement.

The high, average and low intelligence groups attained different mean gain scores on study habits. Thus H16 was rejected. Further analysis revealed that, high intelligence students exhibited better study habits better than average intelligence students. Thus H16.2a was rejected. High intelligence students exhibited better study habits than low intelligence students. Thus H16.2b was rejected. Average intelligence students exhibited better students habits than low intelligence students. Thus, H16.2c was rejected.

Treatment and intelligence interacted one another. Thus H17 was rejected. For further analysis. High intelligence students taught by pre and post graphic organizer instruction exhibited comparable. Thus H17.1a was retained. High intelligence students taught by pre graphic organizer instruction exhibited better study habits than those taught by traditional instruction. Thus H17.1b was rejected. High intelligence students taught by post graphic organizer instruction exhibited better study habits than those taught by traditional instruction. Thus H17.1c was rejected. Average intelligence students taught by pre graphic organizer instruction and post graphic organizer instruction exhibited comparable study habits. Thus H17.2a was retained. Average intelligence students taught by pre graphic organizer instruction exhibited better study habits than those taught by traditional instruction. Thus H17.2b was rejected.

Average intelligence students taught by post graphic organizer instruction exhibited better study habits than those taught by traditional instruction. Thus, H17.2c was rejected. Low intelligence students taught by pre graphic organizer


instruction and post graphic organizer instruction yielded comparable study habits. Thus $H_{17.3a}$ was retained. Low intelligence students taught by pre graphic organizer instruction exhibited better study habits than those taught by traditional instruction Thus $H_{17.3b}$ was rejected. Low intelligence students taught by post graphic organizer instruction exhibited better study habits than those taught by traditional instruction Thus $H_{17.3c}$ was rejected. When taught by pre graphic organizer instruction. High intelligence students exhibited better study habits than average intelligence students. Thus $H_{17.4a}$ was rejected when taught by pre graphic organizer instruction. High intelligence students exhibited better study habits than low intelligence students. Thus $H_{17.4b}$ was rejected. When taught by pre graphic organizer instruction average intelligence students exhibited better study habits than low intelligence students. Thus $H_{17.4c}$ was rejected.

When taught by post graphic organizer instruction high intelligence students exhibited better study habits than average intelligence students. Thus $H_{17.5a}$ was rejected. When taught by post graphic organizer instruction high intelligence students exhibited better study habits than low intelligence students. Thus $H_{17.5b}$ was rejected. When taught by post graphic organizer instruction average intelligence students exhibited better study habits than low intelligence students. Thus $H_{17.5c}$ was rejected.