Chapter – V

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

In the preceding 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 of criterion scores
5.2 Analysis of formative test scores
5.3 Analysis of achievement scores
5.4 Analysis of retention scores.
5.5 Analysis of scores on attitude towards peer tutoring
5.6 Analysis of learning environment inventory scores
5.7 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 organised. 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.

Performance Criterion

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

Each graph was plotted for the exact lower limits of class intervals on the axis of "X" and the corresponding percentage of their cumulative frequencies were computed from the highest class to the lowest class on the axis of "Y". The scores obtained by each of the above mentioned groups have been placed in Table 5.1 and curves have been presented in Figs.5.1 and 5.2.
Table 5.1

Frequency Distribution of Post-test Criterion Scores of the Treatment and Control Groups

<table>
<thead>
<tr>
<th>Class intervals</th>
<th>Lower limits</th>
<th>Total</th>
<th>High Intelligence</th>
<th>Low Intelligence</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>I₁T₁</td>
<td>T₂I₁</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>T₁I₂</td>
<td>T₂I₂</td>
</tr>
<tr>
<td>f</td>
<td>Cumf.</td>
<td>Cum % f</td>
<td>f</td>
<td>Cumf.</td>
</tr>
<tr>
<td>111-120</td>
<td>110.5</td>
<td>7</td>
<td>6.51</td>
<td>7</td>
</tr>
<tr>
<td>101-110</td>
<td>100.5</td>
<td>10</td>
<td>15.81</td>
<td>8</td>
</tr>
<tr>
<td>91-100</td>
<td>90.5</td>
<td>17</td>
<td>31.62</td>
<td>11</td>
</tr>
<tr>
<td>81-90</td>
<td>80.5</td>
<td>51</td>
<td>47.43</td>
<td>1</td>
</tr>
<tr>
<td>71-80</td>
<td>70.5</td>
<td>30</td>
<td>75.33</td>
<td>12</td>
</tr>
<tr>
<td>61-70</td>
<td>60.5</td>
<td>22</td>
<td>95.79</td>
<td>2</td>
</tr>
<tr>
<td>51-60</td>
<td>50.5</td>
<td>5</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>N=108</td>
<td>N=27</td>
<td>N=27</td>
<td>N=27</td>
<td>N=27</td>
</tr>
</tbody>
</table>
Fig. 5.1: Cumulative frequency curve for the high intelligence treatment groups.
Fig. 5.2: Cumulative frequency curve for the low intelligence treatment groups.
It may be observed from figures 5.1 and 5.2 that about 90 percent of the high intelligence group obtained 94 percent or more marks when taught through the teacher directed instruction followed by peer tutoring, 71.5 percent or more marks when taught by traditional instruction as against 62 percent marks obtained by the total group.

About 90 percent of the low intelligence group obtained 71.5 percent or more marks when taught through the teacher directed instruction followed by peer tutoring, 57 percent or more marks when taught by traditional instruction as against 62 percent marks obtained by the total group.

About 80 percent of the high intelligence group obtained 97 percent or more marks when taught through the teacher directed instruction followed by peer tutoring, 75.5 percent or more marks when taught by traditional instruction as against 69 percent marks obtained by the total group.

About 80 percent of the low intelligence group obtained 72.5 percent or more marks when taught through the teacher directed instruction followed by peer tutoring, 60 percent or more marks when taught by traditional instruction as against 69 percent marks obtained by the total group.

About 70 percent of the high intelligence group obtained 99 percent or more marks when taught through teacher directed instruction followed by peer tutoring, 78.5 percent or more marks when taught by traditional instruction as against 71.5 percent marks obtained by the total group.

About 70 percent of the low intelligence group obtained 75.5 percent or more marks when taught through teacher directed instruction followed by peer tutoring, 61 percent or more marks when taught by traditional instruction as against 71.5 percent marks obtained by the total group.

5.2. ANALYSIS OF FORMATIVE TESTS SCORES

Further, the means of formative test scores of each unit test of the high and low intelligence students of the experimental group were converted into percentages. The Table 5.2 reveals that the low intelligence group showed an improvement in performance at the second administration of the unit tests after being exposed to peer tutoring sessions after first administration of the unit tests.
Also, the high intelligence group’s performance improved after each peer tutoring session at the second administration of the unit tests. So, both the high and low intelligence groups benefited from peer tutoring as can be seen from the table 5.2. The bar diagrams in Figs. 5.3 and 5.4 also represent these findings.

### Table 5.2
**Means of Formative Test Scores of the High and Low Intelligence Groups of the Experimental Group**

<table>
<thead>
<tr>
<th></th>
<th>High Intelligence Group</th>
<th>Low Intelligence Group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Unit-1 MM=25</td>
<td>Unit-2 MM=19</td>
</tr>
<tr>
<td>Means of 1st administration of Unit Test</td>
<td>23.37 (93.48%)</td>
<td>17.81 (93.74%)</td>
</tr>
<tr>
<td>Means of 2nd administration of Unit Test</td>
<td>24.52 (98.08%)</td>
<td>18.67 (98.26%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Means of 1st administration of Unit Test</td>
<td>18.30 (73.20%)</td>
<td>14.56 (76.63%)</td>
</tr>
<tr>
<td>Means of 2nd administration of Unit Test</td>
<td>23.44 (93.76%)</td>
<td>16.41 (86.37%)</td>
</tr>
</tbody>
</table>
Fig. 5.3: Percentage of means of formative test scores of the high intelligence students of the experimental group
Fig. 5.4: Percentage of means of formative test scores of the low intelligence students of the experimental group.
5.3 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. Kempthorne 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 straightforward analysis.

Selection of the Statistical Technique - its justification

The present study employed a 2x2x2 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 sense 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 these 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 experimental unit (usually a subject) are 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 terms 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 gains were subjected to the analysis of variance. The present factorial design deviated from simple experimental designs in its special provision for the variables of categories of objectives viz., knowledge and comprehension categories. The variables of categories of objectives was a repeated variable. The deviation in the design was reflected in its special calculation for the error variance component.

F-ratio was computed for the pre-test scores of the treatment groups on achievement test and was found to be 2.4199, i.e. not significant at even 0.05 level of confidence. Summary of one-way ANOVA on pre-test scores on achievement test has been presented in Table 5.3.

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>SS</th>
<th>df</th>
<th>MSS</th>
<th>F-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>212.1010</td>
<td>2</td>
<td>29.2158</td>
<td>2.4199</td>
</tr>
<tr>
<td>Within Groups (Error)</td>
<td>3038.4450</td>
<td>105</td>
<td>70.7003</td>
<td>(N.S.)</td>
</tr>
<tr>
<td>Total</td>
<td>3250.5460</td>
<td>107</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

N.S. – Not significant

Thus, it may be inferred that the two treatment groups were comparable with regard to their previous knowledge.

3-way Analysis of Variance on Gain Scores of Achievement in Science

Following set of null hypotheses were tested through this analysis:

H$_1$ The two instructional treatments yield comparable mean gain on achievement scores in science.

H$_2$ The high and low intelligence groups yield equal mean gain on achievement scores.
H₃ Comparable mean gain on achievement scores are yielded by the students at knowledge and comprehension categories of objectives.

H₄ There is no significant interaction between instructional treatment and levels of intelligence.

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

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

H₇ The two instructional groups attain comparable mean gain on achievement scores with both the levels of intelligence at knowledge and comprehension categories of objectives.

The means and SD’s of different sub-samples were calculated and have been presented in Table 5.4 and the summary of ANOVA for 2x2x2 design for gain scores in achievement in Table 5.5.

The data was treated according to the specification of Winer (1971).

Table 5.4

Means and S.D.’s of Sub-samples of 2x2x2 Design for Gain Scores in Achievement

<table>
<thead>
<tr>
<th>Intelligence</th>
<th>Objectives</th>
<th>T₁</th>
<th>T₂</th>
</tr>
</thead>
<tbody>
<tr>
<td>I₁</td>
<td>O₁</td>
<td>M=37.926, n= 27, SD= 2.433</td>
<td>M=30.185, n= 27, SD= 2.569</td>
</tr>
<tr>
<td></td>
<td>O₂</td>
<td>M=34.962, n= 27, SD= 3.423</td>
<td>M=23.592, n= 27, SD= 3.509</td>
</tr>
<tr>
<td>I₂</td>
<td>O₁</td>
<td>M=26.407, n= 27, SD= 2.361</td>
<td>M=19.962, n= 27, SD= 1.753</td>
</tr>
<tr>
<td></td>
<td>O₂</td>
<td>M=25.704, n= 27, SD= 2.301</td>
<td>M=18.074, n= 27, SD= 2.159</td>
</tr>
</tbody>
</table>
Table 5.5
Summary of 2x2x2 ANOVA for Gain Scores on Achievement in Science

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>SS</th>
<th>df</th>
<th>MSS</th>
<th>F</th>
<th>Level of Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Subjects</td>
<td>9140.76</td>
<td>107</td>
<td>85.427</td>
<td>10.612</td>
<td>S (.01)</td>
</tr>
<tr>
<td>T</td>
<td>3716.74</td>
<td>1</td>
<td>3716.74</td>
<td>461.707</td>
<td>S (.01)</td>
</tr>
<tr>
<td>I</td>
<td>4500.9</td>
<td>1</td>
<td>4500.9</td>
<td>616.472</td>
<td>S (.01)</td>
</tr>
<tr>
<td>T x I</td>
<td>85.62</td>
<td>1</td>
<td>85.62</td>
<td>10.636</td>
<td>S (.01)</td>
</tr>
<tr>
<td>Error Between</td>
<td>837.5</td>
<td>104</td>
<td>8.05</td>
<td></td>
<td>-</td>
</tr>
<tr>
<td>Within Subjects</td>
<td>1447</td>
<td>108</td>
<td>13.398</td>
<td>2.028</td>
<td>S (.01)</td>
</tr>
<tr>
<td>O</td>
<td>498.07</td>
<td>1</td>
<td>498.07</td>
<td>75.408</td>
<td>S (.01)</td>
</tr>
<tr>
<td>T x O</td>
<td>77.95</td>
<td>1</td>
<td>77.95</td>
<td>11.802</td>
<td>S (.01)</td>
</tr>
<tr>
<td>I x O</td>
<td>163.63</td>
<td>1</td>
<td>163.63</td>
<td>24.774</td>
<td>S (.01)</td>
</tr>
<tr>
<td>T x I x O</td>
<td>20.17</td>
<td>1</td>
<td>20.17</td>
<td>3.053</td>
<td>NS</td>
</tr>
<tr>
<td>Error Within</td>
<td>686.89</td>
<td>104</td>
<td>6.605</td>
<td></td>
<td>-</td>
</tr>
</tbody>
</table>

S – Significant
N.S. – Not significant

Main Effects
Treatment (T)

F-ratio for the difference in the mean scores of the two treatment groups was found to be significant at 0.01 level of confidence leading to the inference that the two instructional treatments yield different means gains on achievement scores in science.

An examination of means indicates that there is a difference in the mean gain scores of the two groups. Thus, $H_1$ was rejected, as student taught by teacher directed instruction followed by peer tutoring exhibited better gain in achievement scores as compared to those taught by traditional instruction.

Intelligence (I)

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

F-ratio for the difference in means of the two categories of objectives was found to be significant at 0.01 level of confidence. An examination of the means for learning at knowledge and comprehension categories leads to the inference that performance at knowledge category was superior to that at comprehension category. Thus, \( H_3 \) was rejected. The gain means of the three main effects have been shown through bar diagrams in Fig. 5.5.

Interaction Effects
Treatment and Intelligence (T x I)

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:

- \( H_{4.01} \) For high intelligence group students taught by teacher directed instruction followed by peer tutoring and traditional instruction yield equal mean gain scores on achievement.
- \( H_{4.02} \) For low intelligence group students taught by teacher directed instruction followed by peer tutoring and traditional instruction yield equal mean gain scores on achievement.
- \( H_{4.03} \) Through teacher directed instruction followed by peer tutoring the high and low intelligence students attain comparable mean gain scores on achievement.
- \( H_{4.04} \) Through traditional instruction the high and low intelligence students attain comparable mean gain scores on achievement.
- \( H_{4.05} \) The high intelligence group taught by teacher directed instruction followed by peer tutoring perform comparably with the low intelligence group taught by traditional instruction.
- \( H_{4.06} \) The low intelligence group taught by teacher directed instruction followed by peer tutoring perform comparably with the high intelligence group taught by traditional instruction.
5.5: Bar diagram showing gain means corresponding to the three main effects of achievement scores

- Treatment
- Intelligence
- Categories of objectives

Gain mean scores

T1
T2
I1
I2
O1
O2
The t-ratios have been placed in Table 5.6

### Table 5.6
**t-ratios for Different Combination of T x I for Mean Gain Achievement Scores**

<table>
<thead>
<tr>
<th>Group</th>
<th>T₁₁₁</th>
<th>T₁₁₂</th>
<th>T₂₁₁</th>
<th>T₂₁₂</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( M=36.44 )</td>
<td>( M=26.056 )</td>
<td>( M=26.889 )</td>
<td>( M=19.019 )</td>
</tr>
<tr>
<td></td>
<td>( n=54 )</td>
<td>( n=54 )</td>
<td>( n=54 )</td>
<td>( n=54 )</td>
</tr>
<tr>
<td>T₁₁₁</td>
<td>-</td>
<td>2.56*</td>
<td>17.50**</td>
<td>31.92**</td>
</tr>
<tr>
<td>T₁₁₂</td>
<td>-</td>
<td>-</td>
<td>1.53</td>
<td>12.90**</td>
</tr>
<tr>
<td>T₂₁₁</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>14.42**</td>
</tr>
<tr>
<td>T₂₁₂</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

* Significant at 0.05 level.
** Significant at 0.01 level.

The interaction between Treatment and Intelligence for mean gain scores on achievement has been presented in Fig. 5.6.

The table 5.6 reveals that:

- For high intelligence group, students taught by teacher directed instruction followed by peer tutoring yielded better mean gain scores on achievement than those taught by traditional instruction \((t=17.50)\). Thus, \( H_{4.01} \) was rejected as t-value was found to be significant at 0.01 level of confidence.

- For low intelligence group, students taught by teacher directed instruction followed by peer tutoring attained better mean gain scores on achievement than those taught by the traditional instruction \((t=12.90)\). Thus, \( H_{4.02} \) was rejected as t-value was found to be significant at 0.01 level of confidence.

- When taught by teacher directed instruction followed by peer tutoring, the high intelligence students performed better than the low intelligence students \((t=2.56)\). Thus, \( H_{4.03} \) was rejected as t-value was found to be significant at 0.05 level.
Fig. 5.6: Interaction between treatment and intelligence for mean gain achievement scores.
When taught by traditional instruction, the high intelligence students performed better than the low intelligence students. Thus, $H_{4.04}$ was rejected as t-value (14.42) was found to be significant at 0.01 level.

The high intelligence group taught by teacher directed instruction followed by peer tutoring performed better than the low intelligence group taught by traditional instruction. Thus, $H_{4.05}$ was rejected as $t=31.92$ was found to be highly significant at 0.01 level of confidence.

The low intelligence group taught by teacher directed instruction followed by peer tutoring performed comparably with the high intelligence group taught by traditional instruction ($t=1.53$). Thus, $H_{4.06}$ was retained as the t-value was insignificant even at 0.05 level of confidence.

**Treatment and Categories of Objectives (T x O)**

The 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 inference that the two variables interact with each other.

Thus, $H_5$ was rejected.

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

- $H_{5.01}$ At knowledge category of objectives, the students taught by teacher directed instruction followed by peer tutoring yield mean gain scores comparable to their counterparts taught by traditional instruction.

- $H_{5.02}$ At comprehension category of objectives, the students taught by teacher directed instruction followed by peer tutoring and traditional instruction yield equal mean gain scores.

- $H_{5.03}$ Students taught by teacher directed instruction followed by peer tutoring yield comparable mean gain scores at knowledge and comprehension category of objectives.

- $H_{5.04}$ Students taught by traditional instruction yield comparable mean gain scores at knowledge and comprehension category of objectives.
H5.05  Students taught by teacher directed instruction followed by peer tutoring at knowledge category of objectives perform comparably with students taught by traditional instruction at comprehension category of objectives.

H5.06  Students taught by teacher directed instruction followed by peer tutoring at comprehension category yield equal mean gain scores to their counterparts taught by traditional instruction at knowledge category of objectives.

The t-ratios have been placed in Table 5.7 and the interaction has been presented through Fig. 5.7.

**Table 5.7**

<table>
<thead>
<tr>
<th>Group</th>
<th>$T_1 O_1$ M=32.167 n=54</th>
<th>$T_1 O_2$ M=30.333 n=54</th>
<th>$T_2 O_1$ M=25.074 n=54</th>
<th>$T_2 O_2$ M=20.833 n=54</th>
</tr>
</thead>
<tbody>
<tr>
<td>$T_1 O_1$ M=32.167 n=54</td>
<td>-</td>
<td>3.72**</td>
<td>14.36**</td>
<td>22.94**</td>
</tr>
<tr>
<td>$T_1 O_2$ M=30.333 n=54</td>
<td>-</td>
<td>-</td>
<td>10.65**</td>
<td>19.23**</td>
</tr>
<tr>
<td>$T_2 O_1$ M=25.074 n=54</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>8.59**</td>
</tr>
<tr>
<td>$T_2 O_2$ M=20.833 n=54</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

* Significant at 0.05 level.
** Significant at 0.01 level.

The table 5.7 reveals that:

- At knowledge category of objectives, the students taught by teacher directed instruction followed by peer tutoring attain better mean gain scores than their counterparts taught by traditional instruction (t=14.36). Thus, H5.01 was rejected as the t-value was found to be significant at 0.01 level of confidence.
Fig. 5.7: Interaction between treatment and categories of objectives for mean gain in achievement scores
At comprehension category of objectives, the students taught by teacher directed instruction followed by peer tutoring performed better than those taught by traditional instruction (t=19.23). Thus, H5.02 was rejected as the t-value was found to be significant at 0.01 level of confidence.

Students taught by teacher directed instruction followed by peer tutoring yielded more mean gain scores at knowledge than at comprehension category of objectives (t=3.72). Thus, H5.03 was rejected as the t-value was found to be significant at 0.01 level of confidence.

Students taught by traditional instruction yielded better gain scores at knowledge than at comprehension category of objectives. (t=8.59). Thus, H5.04 was rejected as t-value was found to be significant at 0.01 level of confidence.

Students taught by teacher directed instruction followed by peer tutoring at knowledge category of objectives performed better than those taught by traditional instruction at comprehension category of objectives (t=22.94). Thus, H5.05 was rejected.

Students taught by teacher directed instruction followed by peer tutoring yielded better mean gain scores at comprehension category than their counterparts taught by traditional instruction at knowledge category of objectives (t=10.65). Thus, H5.06 was also rejected.

Intelligence and Categories of Objectives (I x O)

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, H6 was rejected.

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

H6.01 At knowledge category of objectives, the high and low intelligence groups attain comparable mean gain scores on achievement.

H6.02 At comprehension category of objectives, the high and low intelligence groups perform comparably.
H₆.₀₃ High intelligence group perform comparably at knowledge category and comprehension category of objectives.

H₆.₀₄ Low intelligence group perform comparably at knowledge and comprehension category of objectives.

The t-ratio have been placed in Table 5.8 and the interaction between intelligence and categories of objectives has been presented in Fig. 5.8.

### Table 5.8

<table>
<thead>
<tr>
<th>Group</th>
<th>I₁O₁ M=34.056 n=54</th>
<th>I₁O₂ M=29.278 n=54</th>
<th>I₂O₁ M=23.185 n=54</th>
<th>I₂O₂ M=21.888 n=54</th>
</tr>
</thead>
<tbody>
<tr>
<td>I₁O₁ M=34.056 n=54</td>
<td>-</td>
<td>9.67**</td>
<td>22**</td>
<td>24.63**</td>
</tr>
<tr>
<td>I₁O₂ M=29.278 n=54</td>
<td>-</td>
<td>-</td>
<td>12.33**</td>
<td>14.96**</td>
</tr>
<tr>
<td>I₂O₁ M=23.185 n=54</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2.63**</td>
</tr>
<tr>
<td>I₂O₂ M=21.888 n=54</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

* Significant at 0.05 level.
** Significant at 0.01 level.

The Table 5.8 reveals that:

- At knowledge category of objectives, the high intelligence group attained better mean gain scores than low intelligence group. Thus, H₆.₀₁ was rejected as t=22 was found to be significant at 0.01 level of confidence.
- At comprehension category of objectives, the high intelligence group attained better mean gain scores than low intelligence group. Thus, H₆.₀₂ was rejected as t=14.96 was found to be significant at 0.01 level of confidence.
Fig. 5.8: Interaction between intelligence and categories of objectives for mean gain in achievement scores.
- High intelligence group performed better at knowledge than at comprehension category of objectives. Thus, $H_{6.03}$ was rejected as $t=9.67$ was found to be significant at 0.01 level of confidence.
- Low intelligence group performed better at knowledge than at comprehension category of objectives. Thus, $H_{6.04}$ was rejected as $t=2.63$ was found to be significant at 0.01 level of confidence.

**Treatment, Intelligence and Categories of Objectives ( T x I x O)**

The F-ratios 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 ad categories of objectives do not interact with each other. Thus, $H_{7}$ was retained.

**5.4 ANALYSIS OF RETENTION SCORES**

Retention scores are the scores obtained by the students fifteen 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 score. The obtained scores were subjected to 2x2x2 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 taught through different instructional treatments attain comparable retention scores at knowledge and comprehension categories of objectives.
- $H_{12}$ Students of high and low intelligence retain comparably when taught science through different instructional treatments.
- $H_{13}$ Students of high and low intelligence retain comparably at knowledge and comprehension categories of objectives.
- $H_{14}$ Students of high and low intelligence retain comparably at knowledge and comprehension 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 the summary of ANOVA for 2x2x2 design for retention scores in science in the table 5.10.

The data was tested according to the specification of Winer (1971).

Table 5.9
Means and S.D.'s of Sub-Samples of 2x2x2 Design for Retention Scores

<table>
<thead>
<tr>
<th>Intelligence</th>
<th>Objectives</th>
<th>T₁</th>
<th>T₂</th>
</tr>
</thead>
<tbody>
<tr>
<td>I₁</td>
<td>O₁</td>
<td>M=30.407</td>
<td>M=24.111</td>
</tr>
<tr>
<td></td>
<td>n=27</td>
<td>n=27</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SD=4.208</td>
<td>SD=1.45</td>
<td></td>
</tr>
<tr>
<td>I₂</td>
<td>O₂</td>
<td>M=32.333</td>
<td>M=17.777</td>
</tr>
<tr>
<td></td>
<td>n=27</td>
<td>n=27</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SD=3.713</td>
<td>SD=1.613</td>
<td></td>
</tr>
<tr>
<td>I₂</td>
<td>O₁</td>
<td>M=17.925</td>
<td>M=12.925</td>
</tr>
<tr>
<td></td>
<td>n=27</td>
<td>n=27</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SD=3.019</td>
<td>SD=2.385</td>
<td></td>
</tr>
<tr>
<td>I₂</td>
<td>O₂</td>
<td>M=20.185</td>
<td>M=15.185</td>
</tr>
<tr>
<td></td>
<td>n=27</td>
<td>n=27</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SD=3.648</td>
<td>SD=2.419</td>
<td></td>
</tr>
</tbody>
</table>

Table 5.10
Summary of 2x2x2 ANOVA for Retention Scores in Science

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>SS</th>
<th>Df</th>
<th>MSS</th>
<th>F</th>
<th>Level of Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Subjects</td>
<td>10046.06</td>
<td>107</td>
<td>93.888</td>
<td>6.699</td>
<td>S</td>
</tr>
<tr>
<td>T</td>
<td>3212.45</td>
<td>1</td>
<td>3212.45</td>
<td>229.215</td>
<td>S (.01)</td>
</tr>
<tr>
<td>I</td>
<td>4978.56</td>
<td>1</td>
<td>4978.56</td>
<td>355.231</td>
<td>S (.01)</td>
</tr>
<tr>
<td>T×I</td>
<td>397.459</td>
<td>1</td>
<td>397.459</td>
<td>28.359</td>
<td>S (.01)</td>
</tr>
<tr>
<td>Error Between</td>
<td>1457.6</td>
<td>104</td>
<td>14.015</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Within Subjects</td>
<td>1335.5</td>
<td>108</td>
<td>12.366</td>
<td>2.20</td>
<td>S (.01)</td>
</tr>
<tr>
<td>O</td>
<td>0.04</td>
<td>1</td>
<td>0.04</td>
<td>0.007</td>
<td>N.S.</td>
</tr>
<tr>
<td>T×O</td>
<td>230.23</td>
<td>1</td>
<td>230.23</td>
<td>41.003</td>
<td>S (.01)</td>
</tr>
<tr>
<td>I×O</td>
<td>268.9</td>
<td>1</td>
<td>268.9</td>
<td>47.899</td>
<td>S (.01)</td>
</tr>
<tr>
<td>T×I×O</td>
<td>230.21</td>
<td>1</td>
<td>230.21</td>
<td>40.999</td>
<td>S (.01)</td>
</tr>
<tr>
<td>Error Within</td>
<td>606.40</td>
<td>104</td>
<td>5.615</td>
<td>-</td>
<td></td>
</tr>
</tbody>
</table>

S – Significant
N.S. – Not significant
Main Effects

Treatment (T)

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

An examination of means indicates that there is a difference in the retention scores of the two groups. Thus, $H_8$ was rejected, as students taught by teacher directed instruction followed by peer tutoring exhibited better retention as compared to those taught by traditional instruction.

Intelligence (I)

F-ratio for the difference in the mean gains of the two intelligence groups was found to be highly significant at 0.01 level of confidence. An examination of means of the two groups reveals that the means of high intelligence group were superior to that of low intelligence group. Thus, $H_9$ was also rejected.

Categories of Objectives (O)

F-ratio for the difference in the mean retention scores at the two categories of objectives was not found to be significant even at 0.05 level of confidence. Thus, $H_{10}$ was retained, as the students retained comparably at knowledge and comprehension category of objectives.

The mean retention scores of three main effects have been shown through bar diagrams in Fig. 5.9.
5.9: Bar diagram showing means of retention scores corresponding to the three main effects.
Interaction Effects
Treatment and Intelligence (T XI)

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, $H_{11}$ was rejected.

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

$H_{11.01}$ For high intelligence group students taught by teacher directed instruction followed by peer tutoring and traditional instruction yield comparable scores on retention.

$H_{11.02}$ For low intelligence group students taught by teacher directed instruction followed by peer tutoring and traditional instruction yield equal scores on retention.

$H_{11.03}$ Through teacher directed instruction followed by peer tutoring the high and low intelligence students exhibit comparable retention scores.

$H_{11.04}$ Through traditional instruction the high and low intelligence students retain comparably.

$H_{11.05}$ The high intelligence group taught by teacher directed instruction followed by peer tutoring and the low intelligence group taught by traditional instruction retain comparably.

$H_{11.06}$ The low intelligence group taught by teacher directed instruction followed by peer tutoring and the high intelligence group taught by traditional instruction retain comparably.
The t-ratios have been placed in table 5.11:

Table 5.11
t-ratios for Different Combination of T X 1 for Retention Score

<table>
<thead>
<tr>
<th>Group Mean</th>
<th>T₁₁₂ ( M=31.37 ) ( n=54 )</th>
<th>T₁₁₂ ( M=19.055 ) ( n=54 )</th>
<th>T₂₁₂ ( M=20.944 ) ( n=54 )</th>
<th>T₂₂₂ ( M=14.055 ) ( n=54 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>T₁₁₂</td>
<td>- 17.10**</td>
<td>14.48**</td>
<td>24.05**</td>
<td></td>
</tr>
<tr>
<td>T₂₁₂</td>
<td>- 2.63**</td>
<td>- 6.94**</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>T₂₁₂</td>
<td>- 9.57**</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>T₂₂₂</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
</tbody>
</table>

* - Significant at 0.05 level
** - Significant at 0.01 level.

The interaction between treatment and intelligence for retention scores has been presented in Fig. 5.10.

The table 5.11 reveals that:

- For high intelligence group, students taught by teacher directed instruction followed by peer tutoring yielded better scores on retention than those taught by traditional instruction \( t=14.48 \). Thus, \( H_{1.01} \) was rejected as t-value was found to be significant at 0.01 level of confidence.

- For low intelligence group, students taught by teacher directed instruction followed by peer tutoring retained better than those taught by traditional instruction \( t=6.94 \). Thus, \( H_{1.02} \) was rejected as t-value was found to be significant at 0.01 level of confidence.

- When taught by teacher directed instruction followed by peer tutoring, the high intelligence students retained better than the low intelligence students \( t=17.10 \). Thus \( H_{1.03} \) was rejected as t-value was found to be significant at 0.01 level of confidence.
Fig. 5.10: Interaction between treatment and intelligence for retention scores.
When taught by traditional instruction the high intelligence students retained better than the low intelligence students. Thus, $H_{11.04}$ was rejected as t-value ($9.57$) was found to be significant at 0.01 level of confidence.

The high intelligence group taught by teacher directed instruction followed by peer tutoring retained better than the low intelligence group taught by traditional instruction. Thus, $H_{11.05}$ was rejected as t-value ($24.05$) was found to be highly significant at 0.01 level of confidence.

The low intelligence group taught by teacher directed instruction followed by peer tutoring retained better than the high intelligence group taught by traditional instruction ($t=2.63$). Thus, $H_{11.06}$ was rejected as the t-value was found to be 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 significant at 0.01 level of confidence, leading to the inference that the two variables interact with each other.

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

- **$H_{12.01}$** At knowledge category of objectives the students taught by teacher directed instruction followed by peer tutoring yield retention scores comparable to their counterparts taught by traditional instruction.

- **$H_{12.02}$** At comprehension category of objectives the students taught by teacher directed instruction followed by peer tutoring and traditional instruction yield equal retention scores.

- **$H_{12.03}$** Students taught by teacher directed instruction followed by peer tutoring yield comparable retention scores at knowledge and comprehension category of objectives.

- **$H_{12.04}$** Students taught by traditional instruction yield comparable retention scores at knowledge and comprehension category of objectives.
H12.05 Students taught by teacher directed instruction followed by peer tutoring at knowledge category of objectives retain comparably with students taught by traditional instruction at comprehension category of objectives.

H12.06 Students taught by teacher directed instruction followed by peer tutoring at comprehension category yield retention scores comparable to their counterparts taught by traditional instruction at knowledge category of objectives.

The t-ratios have been placed in Table 5.12.

Table 5.12

<table>
<thead>
<tr>
<th>Group</th>
<th>Mean</th>
<th>T1O1</th>
<th>T1O2</th>
<th>T2O1</th>
<th>T2O2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>M=24.166 n=54</td>
<td>M=26.259 n=54</td>
<td>M=18.518 n=54</td>
<td>M=16.481 n=54</td>
</tr>
<tr>
<td>T1O1</td>
<td></td>
<td>-</td>
<td>4.59**</td>
<td>12.39**</td>
<td>16.86**</td>
</tr>
<tr>
<td>T1O2</td>
<td></td>
<td>-</td>
<td>-</td>
<td>16.98**</td>
<td>21.45**</td>
</tr>
<tr>
<td>T2O1</td>
<td></td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>4.47**</td>
</tr>
<tr>
<td>T2O2</td>
<td></td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

* - significant at 0.05 level  
** - significant at 0.01 level

Mean gain scores on retention have been presented in Fig.5.11.

The table 5.12 reveals that:
- At knowledge category of objectives, the students taught by teacher directed instruction followed by peer tutoring retained better than their counterparts taught by traditional instruction (t=12.39). Thus, H12.01 was rejected as the t-value was found to be significant at 0.01 level of confidence.
Fig. 5.11: Interaction between treatment and categories of objectives for retention scores

- T1
- T2

Categories of objectives

Mean Retention Scores

O1  O2
At comprehension category of objectives, the students taught by teacher directed instruction followed by peer tutoring retained better than those taught by traditional instruction ($t=21.45$). Thus, $H_{12.02}$ was rejected as the t-value was found to be significant at 0.01 level of confidence.

Students taught by teacher directed instruction followed by peer tutoring retained more at comprehension than at knowledge category of objectives ($t=4.59$). Thus, $H_{12.03}$ was rejected as the t-value was found to be significant at 0.01 level of confidence.

Students taught by traditional instruction yielded better retention scores at knowledge than at comprehension category of objectives ($t=4.47$). Thus, $H_{12.04}$ was rejected as t-value was found to be significant at 0.01 level of confidence.

Students taught by teacher directed instruction followed by peer tutoring at knowledge category of objectives retained better than those taught by traditional instruction at comprehension category of objectives ($t=16.86$). Thus, $H_{12.05}$ was rejected.

Students taught by teacher directed instruction followed by peer tutoring retained better at comprehension category than their counterparts taught by traditional instruction at knowledge category of objectives ($t=16.98$). Thus, $H_{12.06}$ was also rejected.

**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, $H_{13}$ was rejected.

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

$H_{13.01}$ At knowledge category of objectives, the high and low intelligence groups retain comparably.

$H_{13.02}$ At comprehension category of objectives, the high and low intelligence groups retain comparably.
H13.03 High intelligence group retain comparably at knowledge and comprehension category of objectives.

H13.04 Low intelligence group retain comparably at knowledge and comprehension category of objectives.

The t-values have been placed in Table 5.13.

Table 5.13

<table>
<thead>
<tr>
<th>Group Mean</th>
<th>I₁O₁ M=27.259 n=54</th>
<th>I₁O₂ M=25.055 n=54</th>
<th>I₂O₁ M=15.426 n=54</th>
<th>I₂O₂ M=17.685 n=54</th>
</tr>
</thead>
<tbody>
<tr>
<td>I₁O₁ M=27.259 n=54</td>
<td>-</td>
<td>4.84**</td>
<td>25.96**</td>
<td>21**</td>
</tr>
<tr>
<td>I₁O₂ M=25.055 n=54</td>
<td>-</td>
<td>-</td>
<td>21.13**</td>
<td>16.17**</td>
</tr>
<tr>
<td>I₂O₁ M=15.426 n=54</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>4.96**</td>
</tr>
<tr>
<td>I₂O₂ M=17.685 n=54</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

* - significant at 0.05 level  
** - significant at 0.01 level

The interaction effect between Intelligence and categories of objectives has been presented in Fig.5.12.

The table 5.13 reveals that:
- At knowledge category of objectives, the high intelligence group attained better retention scores than low intelligence group. Thus, H13.01 was rejected as (t=25.96) was found to be significant at 0.01 level of confidence.
- At comprehension category of objectives, the high intelligence group attained better retention scores than low intelligence group. Thus, H13.02 was rejected as (t=16.17) was found to be significant at 0.01 level of confidence.
Fig. 5.12: Interaction between intelligence and categories of objectives for retention scores.
High intelligence group retained better at knowledge category than at comprehension category of objectives. Thus, \( H_{13.03} \) was rejected as \((t=4.84)\) was found to be significant at 0.01 level of confidence.

Low intelligence group retained better at comprehension category than at knowledge category of objectives. Thus, \( H_{13.04} \) was rejected as \((t=4.96)\) was found to be significant at 0.01 level of confidence.

**Treatment, Intelligence and Categories of Objectives (TxTxO)**

The F-ratio for the interaction among the three variables was found to be significant at 0.01 level of confidence. Thus, \( H_{14} \) was rejected as treatment, intelligence and categories of objectives were found to interact with one another.

In order to investigate this interaction further, t-ratios were computed to test the following hypotheses:

- **H_{14.1}** Through teacher directed instruction followed by peer tutoring the high intelligence group retain comparably at knowledge and comprehension categories objectives.
- **H_{14.2}** Through teacher directed instruction followed by peer tutoring the low intelligence group retain comparably at knowledge and comprehension categories of objectives.
- **H_{14.3}** Through teacher directed instruction followed by peer tutoring the high and low intelligence groups of students retain comparably at knowledge category of objectives.
- **H_{14.4}** Through teacher directed instruction followed by peer tutoring the high and low intelligence groups of students retain comparably at comprehension category of objectives.
- **H_{14.5}** Through traditional instruction the high intelligence group retain comparably at knowledge and comprehension category of objectives.
- **H_{14.6}** Through traditional instruction the low intelligence group retain comparably at knowledge and comprehension categories of objectives.
- **H_{14.7}** Through traditional instruction the high and low intelligence group of students retain comparably at knowledge category of objectives.
$H_{14.08}$ Through traditional instruction the high and low intelligence groups retain comparably at comprehension category of objectives.

$H_{14.09}$ At knowledge category of objectives high and low intelligence groups retain comparably when taught by teacher directed instruction followed by peer tutoring.

$H_{14.10}$ At comprehension category of objectives high and low intelligence groups retain comparably when taught by teacher directed instruction followed by peer tutoring.

$H_{14.11}$ At knowledge category of objectives low intelligence group taught by teacher directed instruction followed by peer tutoring retain comparably with the high intelligence group taught by traditional instruction at comprehension category of objectives.

$H_{14.12}$ At comprehension category of objectives low intelligence group taught by teacher directed instruction followed by peer tutoring retain comparably with the high intelligence group taught by traditional instruction.

The t-ratios have been placed in Table 5.14 and the interaction effect has been depicted by Fig.5.13(a) and Fig.5.13(b).
### Table 5.14

t-ratios for Different Combinations of TxIxO Treatment, Intelligence and Categories of Objectives for Retention Scores

<table>
<thead>
<tr>
<th>Group Means</th>
<th>T₁x₁O₁ M=30.407 n=27</th>
<th>T₁x₁O₂ M=32.333 n=27</th>
<th>T₁x₂O₁ M=17.925 n=27</th>
<th>T₁x₂O₂ M=20.185 n=27</th>
<th>T₂x₁O₁ M=24.111 n=27</th>
<th>T₂x₁O₂ M=17.777 n=27</th>
<th>T₂x₂O₁ M=12.925 n=27</th>
<th>T₂x₂O₂ M=15.185 n=27</th>
</tr>
</thead>
<tbody>
<tr>
<td>T₁x₁O₁ M=30.407 n=27</td>
<td>-</td>
<td>2.99**</td>
<td>19.36**</td>
<td>15.66**</td>
<td>9.77**</td>
<td>19.39**</td>
<td>27.12**</td>
<td>23.61**</td>
</tr>
<tr>
<td>T₁x₂O₂ M=32.333 n=27</td>
<td>-</td>
<td>-</td>
<td>22.35**</td>
<td>18.85**</td>
<td>12.76**</td>
<td>22.58**</td>
<td>30.11**</td>
<td>26.60**</td>
</tr>
<tr>
<td>T₂x₁O₁ M=17.925 n=27</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>3.51**</td>
<td>9.6**</td>
<td>.23</td>
<td>7.76**</td>
<td>4.25**</td>
</tr>
<tr>
<td>T₂x₂O₂ M=20.185 n=27</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>6.09**</td>
<td>3.74*</td>
<td>11.26**</td>
<td>7.78**</td>
</tr>
<tr>
<td>T₂x₁O₁ M=24.111 n=27</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>9.83**</td>
<td>17.35**</td>
<td>13.85**</td>
</tr>
<tr>
<td>T₂x₂O₂ M=17.777 n=27</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>7.53**</td>
<td>4.02**</td>
</tr>
<tr>
<td>T₂x₁O₁ M=12.925 n=27</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>3.51**</td>
</tr>
<tr>
<td>T₂x₂O₂ M=15.185 n=27</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
** - significant at 0.01 level

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Fig. 5.13(a): Interaction between treatment, intelligence and categories of objectives (2x2x2 factorial design) for retention scores of High intelligence group.
Fig. 5.13(b): Interaction between treatment, intelligence and categories of objectives (2x2x2 factorial design) for retention scores of Low intelligence group.
The table 5.14 reveals that:

Through teacher directed instruction followed by peer tutoring:

- the high intelligence group retained more at comprehension category of objectives than at knowledge category. Thus, $H_{14.01}$ was rejected as t-ratio (2.99) was found to be significant at 0.01 level of confidence.
- the low intelligence group retained more at comprehension category of objectives than at knowledge category. Thus, $H_{14.02}$ was rejected as t-ratio (3.51) was found to be significant at 0.01 level of confidence.
- the high intelligence group of students retained more than their low intelligence counterparts at knowledge category of objectives as t-ratio (19.36) was found to be significant at 0.01 level of confidence. Thus, $H_{14.03}$ was rejected.
- the high intelligence group of students retained more than their low intelligence counterparts at comprehension category of objectives. The t-ratio (18.85) was found to be highly significant at 0.01 level of confidence. Thus, $H_{14.04}$ was rejected.

Through traditional instruction:

- the high intelligence group retained more at knowledge category than at comprehension category of objectives. Thus, $H_{14.05}$ was rejected as t-value (9.83) was found to be significant at 0.01 level of confidence.
- the low intelligence group retained more at comprehension than at knowledge category of objectives. Thus, $H_{14.06}$ was rejected as t-value (3.51) was found to be significant at 0.01 level of confidence.
- the high intelligence group retained more than their low intelligence counterparts at knowledge category of objectives. So, $H_{14.07}$ was rejected as t-value (17.35) was found to be significant at 0.01 level of confidence.
- the high intelligence group retained more than their low intelligence counterparts at comprehension category of objectives. Thus, $H_{14.08}$ was rejected as t-value (4.02) was found to be significant at 0.01 level of confidence.

At knowledge category of objectives, high intelligence group retained more than the low intelligence group when taught by teacher directed instruction.
followed by peer tutoring. Thus, $H_{14.09}$ was rejected as t-value (19.36) was found to be significant at 0.01 level of confidence.

At comprehension category of objectives, the high intelligence group retained more than the low intelligence group when taught by teacher directed instruction followed by peer tutoring. Thus, $H_{14.10}$ was rejected as t-value (18.85) was found to be significant at 0.01 level of confidence.

At knowledge category of objectives, low intelligence group taught by teacher directed instruction followed by peer tutoring retained comparably with the high intelligence group taught by traditional instruction at comprehension category of objectives. Thus, $H_{14.11}$ was retained as t-value (0.23) was found to be not significant even at 0.05 level of confidence.

At comprehension category of objectives, the low intelligence group taught by teacher directed instruction followed by peer tutoring retained more than the high intelligence group taught by traditional instruction. Thus, $H_{14.12}$ was rejected as the t-value (3.74) was found to be significant at 0.01 level of confidence.

5.5 ANALYSIS OF SCORES ON ATTITUDE TOWARDS PEER TUTORING

Here, scores of only experimental group students were processed. The data was used to test the following hypothesis:

$H_{15}$  High and low intelligence groups exhibit comparable attitude towards peer tutoring.

The mean, S.D.’s and t-ratio for scores on attitude towards peer tutoring scale of the high and low intelligence groups have been placed in Table 5.15.

Table 5.15  
Means, S.D.’s and t-ratio for Attitude Towards Peer Tutoring of Different Sub-Samples of the Experimental Group

<table>
<thead>
<tr>
<th></th>
<th>High Intelligence n=27</th>
<th>Low Intelligence n=27</th>
</tr>
</thead>
<tbody>
<tr>
<td>Means</td>
<td>117.77</td>
<td>93.15</td>
</tr>
<tr>
<td>S.D.’s</td>
<td>9.73</td>
<td>3.06</td>
</tr>
<tr>
<td>t-value</td>
<td>2.01*</td>
<td></td>
</tr>
</tbody>
</table>

* - Significant at 0.05 level of confidence.
The t-value was found to be significant at 0.05 level of confidence. Hence, $H_{15}$ was rejected as the high intelligence group exhibited better attitudes towards peer tutoring than the low intelligence group.

5.6 ANALYSIS OF LEARNING ENVIRONMENT INVENTORY SCORES

After scoring, the gain scores as measured by the difference of post-test and pre-test scores on LEI were computed for each student. The obtained gains were subjected to the analysis of variance.

2x2 ANOVA on gain scores of LEI

Following set of null hypotheses were tested through this analysis.

$H_{16}$ The two instructional treatments yield comparable mean gain scores on learning environment inventory.

$H_{16.01}$ The two instructional treatments yield comparable mean gain scores for fifteen dimensions of learning environment namely cohesiveness diversity formality speed environment friction goal direction favouritism cliqueness satisfaction disorganization difficulty apathy democratic and competitiveness.

$H_{17}$ High and low intelligence groups exhibit comparable mean gain scores on the learning environment inventory.

$H_{17.01}$ High and low intelligence groups exhibit comparable mean gain scores on the fifteen dimensions of learning environment.

$H_{18}$ High and low intelligence groups for different instructional treatments yield comparable mean gain scores on learning environment inventory.

$H_{18.01}$ High and low intelligence groups for different instructional treatments yield comparable mean gain scores on the fifteen dimensions of learning environments.

The means and S.D.'s of different sub-samples were calculated and have been presented in Table 5.16 and the summary of ANOVA for main effects and interaction effects have been presented in Table 5.17 for total mean gain scores on LEI and the fifteen dimensions of learning environment.
Table 5.16
Means and S.D.'s for 15 Dimensions of Learning Environment

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Variables</th>
<th>$T_1$ (Experimental Group)</th>
<th>$T_2$ (Control Group)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>$I_1$ n=27</td>
<td>$I_2$ n=27</td>
</tr>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
<td>M</td>
</tr>
<tr>
<td>1.</td>
<td>Cohesiveness</td>
<td>1.59</td>
<td>1.95</td>
</tr>
<tr>
<td>2.</td>
<td>Diversity</td>
<td>1.85</td>
<td>2.07</td>
</tr>
<tr>
<td>3.</td>
<td>Formality</td>
<td>2.11</td>
<td>1.87</td>
</tr>
<tr>
<td>4.</td>
<td>Speed</td>
<td>1.15</td>
<td>1.10</td>
</tr>
<tr>
<td>5.</td>
<td>Environment</td>
<td>1.26</td>
<td>1.58</td>
</tr>
<tr>
<td>6.</td>
<td>Friction</td>
<td>1.67</td>
<td>2.13</td>
</tr>
<tr>
<td>7.</td>
<td>Goal Direction</td>
<td>1.41</td>
<td>1.80</td>
</tr>
<tr>
<td>8.</td>
<td>Favouritism</td>
<td>2.00</td>
<td>2.59</td>
</tr>
<tr>
<td>9.</td>
<td>Cliqueness</td>
<td>1.63</td>
<td>1.92</td>
</tr>
<tr>
<td>10.</td>
<td>Satisfaction</td>
<td>1.33</td>
<td>1.78</td>
</tr>
<tr>
<td>11.</td>
<td>Disorganisation</td>
<td>1.67</td>
<td>2.04</td>
</tr>
<tr>
<td>12.</td>
<td>Difficulty</td>
<td>1.96</td>
<td>1.85</td>
</tr>
<tr>
<td>13.</td>
<td>Apathy</td>
<td>1.63</td>
<td>1.74</td>
</tr>
<tr>
<td>14.</td>
<td>Democratic</td>
<td>2.89</td>
<td>1.97</td>
</tr>
<tr>
<td>15.</td>
<td>Competitiveness</td>
<td>1.37</td>
<td>1.39</td>
</tr>
<tr>
<td><strong>Total Mean Gain</strong></td>
<td><strong>Scores on LEI</strong></td>
<td><strong>25.52</strong></td>
<td><strong>7.19</strong></td>
</tr>
</tbody>
</table>

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### Table 5.17
Summary of ANOVA for Fifteen Dimensions of Learning Environment

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Variables</th>
<th>F-ratio Main Effect Treatment (T)</th>
<th>F-ratio Main Effect Intelligence (I)</th>
<th>F-ratio Interaction Effect (T x I)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Cohesiveness</td>
<td>2.10978</td>
<td>2.10978</td>
<td>.02920</td>
</tr>
<tr>
<td>2</td>
<td>Diversity</td>
<td>.14092</td>
<td>.14092</td>
<td>.62808</td>
</tr>
<tr>
<td>3</td>
<td>Formality</td>
<td>5.94924*</td>
<td>.13196</td>
<td>.13197</td>
</tr>
<tr>
<td>4</td>
<td>Speed</td>
<td>1.34958</td>
<td>10.65278**</td>
<td>.00306</td>
</tr>
<tr>
<td>5</td>
<td>Environment</td>
<td>.39336</td>
<td>.00000</td>
<td>.53541</td>
</tr>
<tr>
<td>6</td>
<td>Friction</td>
<td>.00000</td>
<td>.87292</td>
<td>.00873</td>
</tr>
<tr>
<td>7</td>
<td>Goal Direction</td>
<td>.01979</td>
<td>.00220</td>
<td>1.16323</td>
</tr>
<tr>
<td>8</td>
<td>Favouritism</td>
<td>1.42301</td>
<td>.05692</td>
<td>1.06884</td>
</tr>
<tr>
<td>9</td>
<td>Cliqueness</td>
<td>.33609</td>
<td>.14937</td>
<td>.08402</td>
</tr>
<tr>
<td>10</td>
<td>Satisfaction</td>
<td>.11782</td>
<td>.83786</td>
<td>.64149</td>
</tr>
<tr>
<td>11</td>
<td>Disorganisation</td>
<td>.82161</td>
<td>1.18313</td>
<td>.03286</td>
</tr>
<tr>
<td>12</td>
<td>Difficulty</td>
<td>1.54733</td>
<td>1.54733</td>
<td>.06189</td>
</tr>
<tr>
<td>13</td>
<td>Apathy</td>
<td>.80420</td>
<td>.39406</td>
<td>2.05877</td>
</tr>
<tr>
<td>14</td>
<td>Democratic</td>
<td>10.55257**</td>
<td>9.21400**</td>
<td>1.02378</td>
</tr>
<tr>
<td>15</td>
<td>Competitiveness</td>
<td>.39073</td>
<td>3.91818</td>
<td>.27134</td>
</tr>
<tr>
<td><strong>Total Mean Gain Scores on LEI</strong></td>
<td><strong>6.655</strong></td>
<td><strong>1.06052</strong></td>
<td><strong>1.06050</strong></td>
<td></td>
</tr>
</tbody>
</table>

* - Significant at 0.05 level  
** - Significant at 0.01 level

The results recorded in Tables 5.16 and 5.17 reveal the following:
Main effects

Treatment (T)

The students taught by teacher directed instruction followed by peer tutoring exhibited better mean gains on learning environment on the whole than their counterparts who were taught by traditional instruction. Thus, \( H_{16} \) was rejected as the F-ratio was found to be significant at 0.05 level.

With respect to the fifteen dimensions of learning environment, students of experimental group exhibited more formality (F-ratio was found to be significant at 0.05 level) and more democratic (F-ratio was found to be significant at 0.01 level) than their counterparts taught by traditional instruction.

The two treatment groups exhibited comparable mean gains for the remaining thirteen dimensions of learning environment, viz, cohesiveness, diversity, speed, environment, friction, goal direction, favouritism, cliqueness, satisfaction, disorganization, difficulty, apathy and competitiveness. So, \( H_{16.01} \) was also rejected.

Intelligence (I)

The high and low intelligence groups exhibited comparable mean gain scores on the learning environment inventory. Thus, \( H_{17} \) was retained as the F-ratio was found to be not significant even at 0.05 level of confidence.

For the fifteen dimensions of learning environment, high intelligence group exhibited better speed and democracy than the low intelligence group, as F-ratios for these two dimensions only were found to be significant at 0.01 level of confidence. However, for the remaining thirteen dimensions, viz., cohesiveness, diversity, formality, environment, friction, goal direction, favouritism, cliqueness, satisfaction, disorganization, difficulty, apathy and competitiveness, the high and low intelligence groups yielded mean gain scores. Hence, \( H_{17.01} \) was rejected, as the F-ratio for these thirteen dimensions were found to be not significant even at 0.05 level of confidence.
Interaction Effects

Treatment x Intelligence (T x I)

High and low intelligence groups for different instructional treatments yielded comparable mean gain scores on learning environment inventory. Thus, $H_{18}$ was retained as the F-ratio for the interaction effect was found to be not significant even at 0.05 level of confidence.

With respect to the fifteen dimensions of learning environment, high and low intelligence groups of students yielded comparable mean gain scores on all the fifteen dimensions of learning environment. Thus, $H_{18,01}$ was retained as F-ratios for all the interaction effects were found to be not significant even at 0.05 level of confidence.

Treatment did not interact with intelligence with respect to the fifteen dimensions of learning environment, viz., cohesiveness, diversity, formality, speed, environment, friction, goal direction, favouritism, cliqueness, satisfaction, disorganisation, difficulty, apathy, democratic and competitiveness.

5.7 DISCUSSION OF RESULTS

This section has been presented in separate sub-sections for results related to achievements scores, retention scores, attitude towards peer tutoring and learning environment inventory scores.

Achievement Scores

The present study revealed that there is a difference in the mean gain scores of the two treatment groups. Students taught science by teacher directed instruction followed by peer tutoring exhibited better gain in achievement scores as compared to those taught by traditional instruction. Thus, $H_1$ was rejected.

This finding was supported by: Cloward (1967) who found that peer tutoring improved reading skills of 16 year old New York-school children; Klosterman (1970) who reported that elementary school students made significant gains when tutored individually or in groups; Delquadri et al. (1986) and Greenwood, Carta and Hall (1988) who found this strategy effective for low achievers. Peers were often able to provide explanations in words that were more easily understood was Webb's (1991) finding. Peer tutoring improved
achievement of class IX and X Geography students was reported by Pahuja (1992). Further peer tutoring facilitated: learning of fifth graders in a basal reading program (McMohan and Goatley, 1995); spelling performance of class IX students (Gyanani, 1996); learning of basic multiplication facts of 3rd graders (Slaughter, 1997); mastery gains in mathematics of ninth graders (Carroll, 1998) and elementary school mathematics urban students (Ginsburg-Block, 1998). Peer tutoring was found to be an effective instructional strategy by: Bevington and Wishart (1999) for improving academic achievement of 9-14 years students; Bergeron (1999) and Menkioff (1999) for improving reading achievement of 2nd grade students. Mumford (2000) reported that peer tutoring was effective for college students' success in an anatomy and physiology class.

This strategy was found to be effective for: promoting mathematics achievement at the eighth grade level (White, 2000); improvement in writing skills of 4th graders (Gray, 2000); learning multiplication facts by special education students (Drew, 2000); improving elementary students reading achievement (Kang, 2000) spelling performance (Li, 2000).

Peer tutoring was reported to improve technological competence and skills of elementary school girls (Jenson, 2001) and English language skills of 6th grade students (Arquette, 2001).

However, Swenson (1975) and Gray (2000) found no evidence of effectiveness of peer tutoring for elementary arithmetic students and reading and writing students of 3rd and 4th graders, respectively.

The means of high intelligence group were superior to that of low intelligence group. Thus, H2 was also rejected. The findings were supported by Khare (2000).

The means for learning at knowledge and comprehension categories lead to the inference that performance at knowledge category was superior to that at comprehension category. Thus, H3 was rejected. The finding was in contrast to Khare’s (2000) finding, where students attained more at comprehension category of objectives than at knowledge category, but was supported by Mehra (1992) in Biology and Neeru (2001) in Maths.
Treatment and intelligence were found to interact with one another which lead to the rejection of $H_4$. Further analysis revealed that, for high intelligence group, students taught by teacher directed instruction followed by peer tutoring yielded better mean gain scores in achievement than those taught by traditional instruction. Thus, $H_{401}$ was rejected. For low intelligence group, students taught by teacher directed instruction followed by peer tutoring attained better mean gain scores on achievement than those taught by traditional instruction. Thus, $H_{402}$ was rejected. When taught by teacher directed instruction followed by peer tutoring, the high intelligence students performed better than the low intelligence students. Thus, $H_{403}$ was rejected.

When taught by traditional instruction, the high intelligence students performed better than their low intelligence counterparts. Thus, $H_{404}$ was rejected.

The high intelligence group taught by teacher directed instruction followed by peer tutoring performed better than the low intelligence group taught by traditional instruction. Thus, $H_{405}$ was rejected.

The low intelligence group taught by teacher directed instruction followed by peer tutoring performed comparably with the high intelligence group taught by traditional instruction. Thus, $H_{406}$ was rejected. This was an important finding, as it revealed the importance of instructional strategy in improving the performance of the low intelligence group, who needed more help than their high intelligence counterparts.

The interaction between treatment and categories of objectives was found to be significant which led to rejection of $H_5$. Further investigations revealed that at knowledge category of objectives, the students taught by teacher directed instruction followed by peer tutoring attained better mean gain scores than their counterparts taught by traditional instruction. Thus, $H_{501}$ was rejected.

At comprehension category of objectives, the students taught by teacher directed instruction followed by peer tutoring performed better than those taught by traditional instruction. Thus, $H_{502}$ was rejected.
Students taught by teacher directed instruction followed by peer tutoring yielded better mean gain scores at knowledge than at comprehension category of objectives. Thus, H5.03 was rejected.

Students taught by traditional instruction yielded better mean gain scores at knowledge than at comprehension category of objectives. Thus, H5.04 was rejected.

Students taught by teacher directed instruction followed by peer tutoring at knowledge category of objectives performed better than those taught by traditional instruction at comprehension category of objectives. Thus H5.05 was rejected.

Students taught by teacher directed instruction followed by peer tutoring yielded better mean gain scores at comprehension category than their counterparts taught by traditional instruction at knowledge category of objectives. Thus H5.06 was rejected.

The variables intelligence and categories of objectives interacted with one another. Thus, H6 was rejected. Further analysis lead to the results that at knowledge category of objectives the high intelligence group attained better mean gain scores than low intelligence group. Thus, H6.01 was rejected. At comprehension category of objectives, the high intelligence group attained better mean gain scores than low intelligence group. Thus, H6.02 was rejected. High intelligence group performed better at knowledge than at comprehension category of objectives. Thus, H6.03 was rejected.

Low intelligence group performed better at knowledge than at comprehension category of objectives. Thus, H6.04 was rejected.

The present study revealed that treatment, intelligence, and categories of objectives do not interact with one another for achievement scores. Thus, H7 was retained.

Retention Scores

The means indicate that there is a difference in the gain in retention scores of the two groups, as students taught by teacher directed instruction
followed by peer tutoring exhibited better retention as compared to those taught by traditional instruction. Thus, $H_6$ was rejected.

High intelligence group retained better than low intelligence group. Thus, $H_9$ was rejected. The finding was supported by Berlyne (1966), Sood (1988) and Khare (2000).

The students retained comparably at knowledge and comprehension category of objectives. Thus, $H_{10}$ was retained. The finding was in contrast to Neeru's (2001) result where class V students were found to retain better at knowledge category than at comprehension category.

Treatment and intelligence were found to interact with each other with respect to retention scores. Thus, $H_{11}$ was rejected. Further analysis revealed that, for high intelligence group, students taught by teacher directed instruction followed by peer tutoring yielded better scores on retention than those taught by traditional instruction. Thus, $H_{11.01}$ was rejected.

For low intelligence group, students taught by teacher directed instruction followed by peer tutoring retained better than those taught by traditional instruction. Thus, $H_{11.02}$ was rejected.

When taught by teacher directed instruction followed by peer tutoring, the high intelligence students retained better than the low intelligence students. Thus, $H_{11.03}$ was rejected.

When taught by traditional instruction the high intelligence students retained better than the low intelligence students. Thus, $H_{11.04}$ was rejected.

The high intelligence group taught by teacher directed instruction followed by peer tutoring retained better than the low intelligence group taught by traditional instruction. Thus, $H_{11.05}$ was rejected.

The low intelligence group taught by teacher directed instruction followed by peer tutoring retained better than the high intelligence group taught by traditional instruction. Thus, $H_{11.06}$ was rejected.

The variables treatment and categories of objectives were found to interact with each other leading to rejection of $H_{12}$. Further investigation revealed that, at knowledge category of objectives, the students taught by teacher
directed instruction followed by peer tutoring retained better than their counterparts taught by traditional instruction. Thus, H12.01 was rejected.

At comprehension category of objectives, the students taught by teacher directed instruction followed by peer tutoring retained better than those taught by traditional instruction. Thus, H12.02 was rejected.

Students taught by teacher directed instruction followed by peer tutoring retained more at comprehension than at knowledge category of objectives. Thus, H12.03 was rejected.

Students taught by traditional instruction yielded better retention scores at knowledge than at comprehension category of objectives. Thus, H12.04 was rejected.

Students taught by teacher directed instruction followed by peer tutoring at knowledge category of objectives retained better than those taught by traditional instruction at comprehension category of objectives. Thus, H12.05 was rejected.

Students taught by teacher directed instruction followed by peer tutoring retained better at comprehension category than their counterparts taught by traditional instruction at knowledge category of objectives. Thus, H12.06 was rejected.

The variables intelligence and categories of objectives were found to interact significantly for retention scores. Thus, H13 was rejected. Further analysis revealed that at knowledge category of objectives, the high intelligence group retained better than low intelligence group. Thus, H13.01 was rejected.

At comprehension category of objectives, the high intelligence group retained better than low intelligence group. Thus, H13.02 was rejected.

High intelligence group retained better at knowledge category than at comprehension category of objectives. Thus, H13.03 was rejected.

Low intelligence group retained better at comprehension category than at knowledge category of objectives. Thus, H13.04 was rejected.

The present study revealed that the variables treatment, intelligence and category of objectives interacted with one another. Thus, H14 was rejected. Further investigation revealed that:
Through teacher directed instruction followed by peer tutoring:

(a) The high intelligence group retained more at comprehension category of objectives than at knowledge category. Thus, $H_{14.01}$ was rejected.

(b) The low intelligence group retained more at comprehension category of objectives than at knowledge category. Thus, $H_{14.02}$ was rejected.

(c) The high intelligence group of students retained more than their low intelligence counterparts at knowledge category of objectives. Thus, $H_{14.03}$ was rejected.

(d) The high intelligence group of students retained more than their low intelligence counterparts at comprehension category of objectives. Thus, $H_{14.04}$ was rejected.

Through traditional instruction:

(a) The high intelligence group retained more at knowledge category than at comprehension category of objectives. Thus, $H_{14.05}$ was rejected.

(b) The low intelligence group retained more at comprehension than at knowledge category of objectives. Thus, $H_{14.06}$ was rejected.

(c) The high intelligence group retained more than their low intelligence counterparts at knowledge category of objectives. Thus, $H_{14.07}$ was rejected.

(d) The high intelligence group retained more than their low intelligence counterparts at comprehension category of objectives. Thus, $H_{14.08}$ was rejected.

At knowledge category of objectives, high intelligence group retained more than the low intelligence group when taught by teacher directed instruction followed by peer tutoring. Thus, $H_{14.09}$ was rejected.

At comprehension category of objectives, the high intelligence group retained more than the low intelligence group when taught by teacher directed instruction followed by peer tutoring. Thus, $H_{14.10}$ was rejected.

At knowledge category of objectives, low intelligence group taught by teacher directed instruction followed by peer tutoring retained comparably with the high intelligence group taught by traditional instruction at comprehension category of objectives. Thus, $H_{14.11}$ was retained.
At comprehension category of objectives, the low intelligence group taught by teacher directed instruction followed by peer tutoring retained more than the high intelligence group taught by traditional instruction. Thus, $H_{14.12}$ was rejected.

**Attitudes Towards Peer Tutoring**

The high intelligence group exhibited better attitudes towards peer tutoring than the low intelligence group. Thus, $H_{15}$ was rejected.

This finding was supported by Cloward (1967) who reported gain in attitudes of 16 year old students who received peer tutoring for improving their reading skills. Eiserman (1988) and Nath (1997) also reported an increase in positive attitudes towards peer tutoring. Both tutors and tutees felt positively about their participation in the project was Wilson's (1999) finding. Bergeron's study in 1999 indicates that students reported that peer tutor helped them learn, they enjoyed learning from peer tutor and they would like to continue with peer tutoring for improving reading achievement.

Menikoff (1999) reported that tutors (6th grade) and tutees (2nd grade) of cross-age peer tutoring program exhibited very positive perceptions of their involvement as helpers and learners.

**Learning Environment Scores**

The students taught by teacher directed instruction followed by peer tutoring exhibited better mean gains on learning environment on the whole than their counterparts who were taught by traditional instruction. Thus, $H_{16}$ was rejected. The finding was supported by Pahuja (1992), who reported that peer tutoring helped to improve the classroom climate of classes IX and X geography students. With respect to the fifteen dimensions of learning environment, students of experimental group exhibited more formality and democracy than their counterparts taught by traditional instruction. For the remaining thirteen dimensions, viz., cohesiveness, diversity, speed, environment, friction, goal direction, favouritism, cliqueness, satisfaction, disorganization, difficulty, apathy and competitiveness, the two treatment groups exhibited comparable mean gains. Thus, $H_{16.01}$ was rejected.
The high and low intelligence groups exhibited comparable mean gain scores on the learning environment inventory. Thus, H17 was retained.

For the fifteen dimensions of learning environment high intelligence group exhibited better speed and democracy than the low intelligence group. However, for the remaining thirteen dimensions viz., cohesiveness, diversity, formality, environment, friction, goal-direction, favouritism, cliqueness, satisfaction, disorganization, difficulty, apathy and competitiveness, the high and low intelligence groups yielded comparable mean gain scores. Thus, H17.01 was rejected.

This finding is partially supported by Mistry (1986) who reported that high intelligence students scored higher than the low intelligence group on dimensions of formality, speed, environment, goal direction, satisfaction, difficulty, democracy and competitiveness. On the other hand, low intelligence students scored higher than the high intelligence students on cohesiveness, diversity, friction, favouritism, cliqueness, organization and apathy.

High and low intelligence groups for different instructional treatments yielded comparable mean gain scores on learning environment inventory. Thus, H18 was retained.

With respect to the fifteen dimensions of learning environment, high and low intelligence groups of students yielded comparable mean gain scores on all the fifteen dimensions of learning environment. Thus, H18.01 was retained.