Analysis and Interpretation of Data
CHAPTER IV

ANALYSIS AND INTERPRETATION OF DATA

In the preceding chapters, the theoretical framework of the problem, review of related literature, the description of the tools used and method of the study were discussed. The present chapter deals with the analysis and interpretation of data.

The analysis of data has been reported in four sections.

SECTION-A

ANALYSES RELATED WITH ENTRY BEHAVIOUR STATUS:

A1 Analysis on scores of Pre – requisite Skills Test
A2 Analysis on scores on Computer knowledge Test.
A3 Analysis to match the groups on the basis of scores on Standard Progressive Matrices (SPM),
A4 Analysis of scores on Perseverance
A5 Analysis of scores on Learning Approaches.

SECTION-B

ANALYSIS RELATED WITH POST CRITERION SCORES

B1 DESCRIPTIVE ANALYSIS OF GAIN SCORES

❖ Performance Criterion
  • Frequency Polygon
  • Inverted Ogive

SECTION-C

ANALYSIS RELATED WITH GIAN SCORES

C1 2 x 2 x 2 Analysis related with Gain Scores in relation to instructional strategies [MLS (pooled) vs. CGL], Perseverance & Learning Approaches.

C2 3 x 2 x 2 analysis of variance on gain scores in relation to instructional strategies ( MLS with computers, MLS without computers and CGL), Perseverance ( High & Low ) and Learning approaches ( Deep & Surface )

SECTION-D

DISCUSSION OF THE RESULTS

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SECTION-A

ANALYSES RELATED WITH ENTRY BEHAVIOUR STATUS OF THE STUDENTS

In chapter II, it was discussed that the Entry Behaviour is constituted of two dimensions:

i Assumptions about the learners and
ii Pre - requisite Skills.

The assumptions about the learner were clearly specified in the chapter II. The Pre - requisite component is comprised of status of knowledge and skills of the child with which he enters into the instructional program for which a Test of Entry Behaviour was developed and used. One-way ANOVA was applied on the scores of EB to compare the selected groups. The analysis has been reported in the following paragraphs. In the present investigation knowledge of computers was another important dimension on which entry status of students was required to be assessed because the instructional programme for the experimental treatment was implemented through computers. A test was developed for computer knowledge as well. Therefore students were assessed on both these dimensions and accordingly following analyses were done:

A1 One – way ANOVA on scores of Pre – requisite skills.
A2 One – way ANOVA on scores of computer knowledge test.

Assumptions underlying Analysis of Variance:

In the analysis of variance, the ratio between the groups (Treatment) to within groups (Error) mean squares is distributed as F; if the assumptions underlying the analysis of variance are satisfied. If the assumptions are violated, the sampling distribution of mean square ratios may differ from the distribution. If the assumptions are not sufficiently approximated, the conclusions based on the F – test may not be valid. These assumptions are:
Normality of the distribution of Criterion Measures: The assumptions of the normality states, that the distribution of scores within each treatment population is normal (Brooter, 1999). However, Norton (1952) found that F-distribution is practically unaffected by lack of symmetry in the distribution of criterion measures.

Homogeneity: One of the basic assumptions underlying F-test is that the variances of scores in each of the treatment groups are homogeneous, that is, the variances of the individual groups are equal.

Independence of the dependent scores: The assumption of independence states that the scores of any particular subject is independent of the score of all other subjects. If we take only one observation from each subject and subjects are assigned at random to the different treatment conditions, the assumption of independence of scores will generally be met.

Rationale of One – Way Analysis of Variance:

The total variability of a set of measures composed of several groups, can be partitioned into specific parts, each indefinable with a given source of variation (Winer, 1971; Brooter, 1999).

In a One – Way ANOVA or simple analysis of Variance, the total sum of squares is partitioned into two parts:

(i) A sum of squares (SS Between) based on variations between the group means and,

(ii) A sum of squares (SS Within) based on variations within the several groups.

One way analysis of variance was applied on the scores of EB.

Thus F-ratio may be defined as:
...Analysis and Interpretation of Data

\[ F = \frac{\text{BetweenGroupMeanSquares}}{\text{WithinGroupMeanSquare}} \]

One Way Analysis of Variance was applied separately on scores on all the dimensions of EB viz:

A1  Scores on Pre-requisite skills
A2  Scores on Computer Knowledge Test
A3  Scores on SPM
A4  Scores on Perseverance Scores
A5  Scores on Learning Approaches

A1:  ANALYSIS BASED ON SCORES OF PRE-REQUISITE SKILLS

The planning and implementation of an effective mastery Learning Strategy may be helped by ascertaining entry behaviour, although it is not an pre – requisite for it. Entry behaviour test (designed by the investigator) was administered and the scores of total sample i.e. N = 450 were listed. The means and S.D’s were calculated and have been reported in Table-4.1

<table>
<thead>
<tr>
<th></th>
<th>Group I</th>
<th>Group II</th>
<th>Group III</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>30.12</td>
<td>27.01</td>
<td>23.68</td>
<td>26.93</td>
</tr>
<tr>
<td>SD</td>
<td>1.97</td>
<td>1.11</td>
<td>0.78</td>
<td>1.28</td>
</tr>
<tr>
<td>N= 150</td>
<td></td>
<td>150</td>
<td>150</td>
<td>450</td>
</tr>
</tbody>
</table>

Table 4.1

Means and SD's of Sample on Pre – requisite skills
The Sample data as depicted in the Bar diagram, showed variation in means. To ascertain, whether this variation is significant in the data or not, One – Way analysis of Variance was applied on EB scores to test the following hypothesis:

**Ho 1 : There will be no significant difference in the means of three selected Groups on Entry Behaviour (EB) Scores**

Sum of squares, mean Sum of Squares & F – ratio were computed.

A summary of ANOVA on EB scores has been presented below in Table 4.2
Table 4.2

Summary of One - Way Analysis of Variance on Entry Behaviour (EB) Scores

<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>10983.777</td>
<td>2</td>
<td>5491.885</td>
<td>1.82</td>
</tr>
<tr>
<td>Within Groups (Error)</td>
<td>690274.979</td>
<td>448</td>
<td>1540.792</td>
<td>-</td>
</tr>
<tr>
<td>Total</td>
<td>7012258.756</td>
<td>450</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Table 4.2 shows that the F-ratio for the difference in mean scores of EB of the three groups (School I, School II and School III) was not found to be significant even at the 0.05 level of significance. This shows that the students were not different in respect of EB scores. The hypothesis *H0: There will be no significant difference in the means of three selected Groups on Entry Behaviour (EB) Scores* was not rejected at the specified level. The observed differences may be ascribed to chance only. The data could not provide sufficient evidence to believe that the three groups differ from each other on the basis of EB scores. It may be concluded that the students of selected three groups were not different on EB scores.

**A2: ONE WAY ANOVA ON SCORES OF COMPUTER KNOWLEDGE TEST**

A similar analysis was done on scores of Computer knowledge. The scores were obtained by administering test of computer knowledge test, developed by the investigator.

Since the students were to be assigned to a Mastery Learning Strategy through computer assisted instruction, in which the learners were supposed to learn the subject matter with the help of computers. So, learner’s knowledge in the
computers was checked through the Scores on test of computer knowledge, developed by the investigator. The sample was distributed accordingly, presuming that adequate number is represented in the total sample as shown in the following table:

**Table 4.3**

**Classification of Sample in Three Groups on Computer Knowledge Scores**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Group I</th>
<th>Group II</th>
<th>Group III</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Achievement Scores In</td>
<td>Mean = 42.53</td>
<td>Mean = 41.92</td>
<td>Mean = 41.90</td>
<td>Mean = 42.12</td>
</tr>
<tr>
<td>Computer Knowledge</td>
<td>SD = 9.099</td>
<td>SD = 2.163</td>
<td>SD = 1.099</td>
<td>SD = 4.120</td>
</tr>
<tr>
<td>N=150</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Fig 4.2f: Distribution of Scores on Computer Knowledge Test**
Analysis and Interpretation of Data

The sample data as depicted in the table 4.3 and Bar diagram, showed variation in means on scores for computer knowledge. To study whether the difference in means was significant or not, One – Way analysis of Variance was applied on Computer Knowledge scores. This analysis was done to test following hypothesis:

**Ho 2 : There is no significant difference in means of three selected groups on scores of Computer Knowledge Test.**

The scores of Computer Knowledge Test of students of three selected groups were tabulated and means, Sum of squares, Mean Sum of Squares and F – ratio were computed. A summary of ANOVA on computer knowledge scores has been presented below in table 4.4.

**Table 4.4**

A summary of One – Way analysis of variance on Scores of Computer Knowledge

<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>983.777</td>
<td>2</td>
<td>491.88</td>
<td>2.01</td>
</tr>
<tr>
<td>Within Groups (Error)</td>
<td>67237.79</td>
<td>447</td>
<td>150.42</td>
<td>-</td>
</tr>
<tr>
<td>Total</td>
<td>69221.575</td>
<td>449</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

The Table 4.4 shows that F – value for the difference in means of scores of Computer Knowledge Test among three selected groups was not found to be significant, even at 0.05 level of significance. This indicates that the three groups of students selected for experiment were not different on computer knowledge.
scores. The data could not provide sufficient evidence to reject the hypothesis $H_0$

2 There is no significant difference in means of three selected groups on scores of Computer Knowledge Test It was confirmed that the three selected groups were similar with regard to computer knowledge scores of students and for one of the three proposed treatments, any group can be assigned randomly to any treatment.

A3: ANALYSIS ON SCORES OF STANDARD PROGRESSIVE MATRICES (SPM)

The Standard Progressive Matrices (SPM) comprises of five sets A,B,C,D and E which assess the method of reasoning. A cumulative score on these five sets was computed for each individual student and their Means & SD’s were calculated. These have been tabulated in Table 4.5.

<table>
<thead>
<tr>
<th>Table 4.5</th>
<th>Means and SD’s of Three Groups on SPM Scores</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Group 1</td>
</tr>
<tr>
<td>SPM Scores</td>
<td>Mean = 48.02</td>
</tr>
<tr>
<td></td>
<td>SD = 12.8</td>
</tr>
<tr>
<td></td>
<td>N = 150</td>
</tr>
</tbody>
</table>
The Table 4.5 and Fig 4.3f reveal that there was a difference in means of three selected groups in Standard Progressive Matrices. It was essential to ensure whether this variation was significant or not, One – Way ANOVA applied on Standard Progressive Matrices (SPM) scores to test the following Hypothesis:

**Ho 3: There will be no significant difference in the means of Standard Progressive Matrices scores.**

A summary of ANOVA on the Intelligence scores is presented in the following Table:
Table 4.6
A summary of One – Way analysis of variance on Scores of SPM

<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>132.56</td>
<td>2</td>
<td>66.28</td>
<td>1.301</td>
</tr>
<tr>
<td>Within Groups (Error)</td>
<td>22829.849</td>
<td>448</td>
<td>50.95</td>
<td>-</td>
</tr>
<tr>
<td>Total</td>
<td>574258.756</td>
<td>450</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

The Table 4.6 shows that F – value was not found to be significant even at the 0.05 level of significance. This means that the three groups of students selected for experiment were not different on intelligence scores. The observed difference may be because of some chance factors only. The data could not provide sufficient evidence to reject the hypothesis stating that **Ho 3 There will be no significant difference in the means of Standard Progressive Matrices scores.** It was confirmed that the three selected groups were similar with regard to intelligence scores of students and any one of group can be assigned randomly to any treatment.

Hence Group I, II and III were divided into three sub – groups. One sub – group from each Group was chosen for Mastery Learning with Computers while Second sub – group from each Group was chosen for Mastery Learning without Computers and third sub – group was from each Group was treated as Control Group.

A4: ANALYSIS BASED ON PERSEVERANCE SCORES

*Bloom (1981)* assumed that in the Mastery Learning strategy, majority of the students (95%) achieve mastery. One of the major component of this strategy is said to be Perseverance. It is the ability of an individual to accomplish the task
given inspite of difficulties. In the present study, it was hypothesized that the final performance level of each individual should not vary even if they have different scores on Perseverance Scale.

The scores on the Perseverance for all the students of selected three schools/groups were tabulated and One – Way ANOVA was employed to assess that all the three groups of students have almost same level of Perseverance for the task. The Sum of Squares, Mean Sum of Squares and F – ratio was computed and have been recorded in table 4.7 as summary of ANOVA. Following hypothesis was tested through this analysis.

**Ho 4: There is no difference in Perseverance scores of Mastery Learning Groups and Control Group.**

A summary of ANOVA is depicted in the following Table:

**Table 4.7**

<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>1130.16</td>
<td>2</td>
<td>565.08</td>
<td>2.74</td>
</tr>
<tr>
<td>Within Groups (Error)</td>
<td>92041.77</td>
<td>447</td>
<td>205.91</td>
<td>-</td>
</tr>
<tr>
<td>Total</td>
<td>93171.93</td>
<td>449</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

The table 4.7 reveals that the difference in means of Perseverance for the three selected groups, were not significant even at the 0.05 level of confidence. This means that the hypothesis **Ho 4 There is no difference in Perseverance scores of Mastery Learning Groups and Control Group** was not rejected at the specified level. The three groups were not statistically different in respect of their
Scores on Perseverance. The observed difference may be ascribed to chance only. It may therefore be concluded that level of Perseverance of students in all the three groups were almost equal. However another important measure was taken here to ensure that the three selected groups had almost similar number of High and Low Perseverant students, so that there is no variance due to this factor. For this, Chi square test was employed through following contingency table 4.8.

**Table 4.8**

Contingency Table for \(X^2\) – Test in respect of Frequencies of High Perseverance and Low Perseverance in each Group

<table>
<thead>
<tr>
<th></th>
<th>High Perseverance</th>
<th>Low Perseverance</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Group I (MLS 1)</strong></td>
<td>75</td>
<td>77</td>
</tr>
<tr>
<td><strong>Group II (MLS 2)</strong></td>
<td>75</td>
<td>73</td>
</tr>
<tr>
<td><strong>Control Group Learning</strong></td>
<td>75</td>
<td>75</td>
</tr>
</tbody>
</table>

\[X^2\text{ Value } = 0.054\]

The table 4.8 reveals that the Chi – Square value for the groups was 0.054 which is lower than the table value 0.95 for 2 degree of freedom. It suggests that the number of students in each of the groups was not different and High and Low Perseverant students had an adequate representation in each of the three selected groups.

**A5: ANALYSIS BASED ON SCORES FOR LEARNING APPROACHES SCORES**

Approaches to Learning (ATL) refer to those characteristics students bring to the learning process. *The process adopted prior to the outcome of learning or, it can refer to pre-dispositions to adopt particular processes, which is what is meant when students are asked by questionnaire how they usually go about learning*
So the way of learning may affect the performance of the students. The three groups of students were divided into two categories i.e. Deep Approach and Surface Approach. It was made sure that adequate number represent in both categories.

It was assumed that the learners with these two categories should have almost equal types of learning approaches and also that they are present in adequate number in each of the groups. Hence, ANOVA was employed to assess the types of Learning Approaches in the three selected groups to analyse the following hypothesis.

**Ho 5: There is no difference in Learning Approaches of students of Mastery Learning Groups and Control Group.**

Summary of ANOVA has been shown in the following table.

**Table 4.9**

A summary of One-Way analysis of variance on Scores of Learning Approaches

<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>113.319</td>
<td>2</td>
<td>567.159</td>
<td>3.54</td>
</tr>
<tr>
<td>Within Groups (Error)</td>
<td>72861.461</td>
<td>447</td>
<td>73.51</td>
<td>-</td>
</tr>
<tr>
<td>Total</td>
<td>72974.78</td>
<td>449</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

The Table shows that F – value for the difference in mean scores for Learning Approaches of three groups was not found to be significant even at the 0.05 level of significance. This reveals that the three groups of students selected for experimental treatment were not different on learning approaches scores. The
data could not provide sufficient evidence to reject the hypothesis Ho 5 *There is no difference in learning approaches of Mastery Learning Group and Control Group*. It was concluded that the three selected groups were similar with regard to learning approaches scores of students and any one of the three groups can be assigned randomly to any treatment.

$X^2$ – test was also used to assess adequacy of Deep Approach and Surface Approach students in each of the selected three groups. The results have been in table 4.10.

**Table 4.10**

<table>
<thead>
<tr>
<th></th>
<th>Deep Approach</th>
<th>Surface Approach</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group I (MLS 1)</td>
<td>83</td>
<td>67</td>
</tr>
<tr>
<td>Group II (MLS 2)</td>
<td>82</td>
<td>66</td>
</tr>
<tr>
<td>Control Group Learning</td>
<td>85</td>
<td>67</td>
</tr>
</tbody>
</table>

$X^2$ Value = 0.014

The table 4.10 shows that the calculated value of chi – square was 0.014 which is lower than the table value 0.95 for 2 degree of freedom. It may be concluded that each group had an almost equal number of Deep Approach and Surface Approach students. This was already ensured through ANOVA that levels of Perseverance were also not significantly different for the three groups.

Conclusions drawn on the basis of results reported in Section A:

- The three selected groups viz: Group I, Group II and Group III were not significantly different from each other on EB scores.
Analysis and Interpretation of Data

- The three selected groups viz: Group I, Group II and Group III were not significantly different from each other with regard to computer knowledge scores.

- Similar results were found in case of Intelligence scores. The three selected groups viz: Group I, Group II and Group III were not significantly different from each other on intelligence scores.

- The three selected groups viz: Group I, Group II and Group III were not significantly different from each other with regard to Perseverance scores.

- The three selected groups viz: Group I, Group II and Group III were not significantly different from each other on Approaches to Learning scores.

Hence, on the basis of all the above reported results, investigator randomly allocated Group I students for MLS with Computers, Group II was assigned to MLS without Computers and Group III was considered to be the control group.

The instructional treatment was imparted after Pre-Testing was over. It took almost six months to complete the experiment. Post-tests were administered on all the students, scoring was done according to prescribed Keys and data were compiled and subjected to the following analyses.

SECTION B
ANALYSIS RELATED WITH POST – CRITERION SCORES

This part deals with the descriptive analysis related with Criterion Post – Test scores, Gain Scores under following heads:

- Performance Criterion
  - Frequency Polygons
  - Inverted Ogives
B1: DESCRIPTIVE ANALYSES ON POST – CRITERIA SCORES

The criterion gain scores of all the three groups (MLS1, MLS2 and Control Group Learning) were depicted through frequency polygons in order to compare the nature of distributions depicted in the table 4.11.

Frequency polygon

A Frequency polygon was plotted for the exact mid points of class intervals on the axis of “X” and the corresponding percentage of frequencies on the axis of “Y”. The frequency polygon has been represented on the graph in the Fig 4.4f.

It may be observed from the figure that:

- The frequency polygon drawn on the post test scores of Mastery Learning 1 Group appears to be unimodal and approximately bell shaped and appears to be symmetrical about the ordinate at the score X = 142.5. The curve also appears to be normally distributed. The distribution of scores appears to be massed at the right hand end and spreads out gradually towards left hand side.

- The frequency polygon drawn on the post test scores of Mastery Learning 2 Group appears to be unimodal and approximately bell shaped and appears to be symmetrical about the ordinate at the score X = 142.5. The curve also appears to be normally distributed.

- The frequency polygon drawn on the post test scores of Conventional Group appears to be unimodal and bell shaped and appears to be symmetrical about the ordinate at the score X = 132.5. The curve also appears to be normally distributed. The distribution of scores appears to spread on both sides of the ordinate X = 132.5.
### Table 4.11

<table>
<thead>
<tr>
<th>Interval</th>
<th>MLS 1</th>
<th>MLS 2</th>
<th>MLS 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-110</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>110-120</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>120-130</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>130-140</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>140-150</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>150-160</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>160-170</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>170-180</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>180-190</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>190-200</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

**Post-Test Scores of Three Treatment Groups (MLS1, MLS2 and CGL)**

<table>
<thead>
<tr>
<th>Interval</th>
<th>MLS 1</th>
<th>MLS 2</th>
<th>MLS 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-110</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>110-120</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>120-130</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>130-140</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>140-150</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>150-160</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>160-170</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>170-180</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>180-190</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>190-200</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>
Fig 4.4f Frequency Polygon Showing Distribution of Post-Test Scores of three Treatment Groups (MLS1, MLS2 and CGL)
fig 4.5 Inverted Percentage Cumulative Ogive for Post test scores of three treatment groups (MLS1, MLS2, CGL)

Inverted Percent Frequency

Mid Points of Class Interval

- MLS1
- MLS2
- CGL
Inverted Ogive

An Inverted Ogive was drawn for the exact mid points of class intervals on the axis of “X” and the corresponding percentage of frequencies on the axis of “Y”. The frequency polygon has been represented on the graph in the Fig 4.5f.

It may be observed from the above figure that:

- As high as 86% students of MLS 1 could reach the 60% (Gain score = 135) gain criterion mark while only 74% could reach this score from MLS2 group. From conventional group 33% could achieve the gain of 60%.
- Whereas 70% gain (Gain score = 140) could be attained by 69% from MLS1, 55% from MLS2 and only 25% could reach this score from conventional group.4
- 80% (Gain score = 145) could be reached by 30% MLS 1 group, 23% MLS2 group and only 1% Conventional group.
- 90% (Gain score = 150) only 5% from MLS1 and 3% from MLS2 could gain this score.

Since the differences on various descriptive indices were observed in the three groups in respect of post criterion scores, it was considered necessary to take the gain scores rather than post-test scores. For the effectiveness of Mastery Learning or Conventional Group Learning 2 x 2 x 2 design was employed and ANOVA was planned. Some descriptive analysis were thus required separately for gain scores due to 2 x 2 x 2 design.

SECTION C
ANALYSES ON GAIN SCORES RELATED WITH THE EXPERIMENTAL TREATMENT AND ITS IMPACT ON THE LEARNING OUTCOMES

It is discussed under the following heading:

C1: A 2 x 2 x 2 Analysis of variance on Achievement gain scores, considering MLS vs CGL ( Both MLS groups pooled together).
C2: A 3 x 2 x 2 ANOVA on gain scores for MLS – I, MLS – II and CGL.

C1: 2 x 2 x 2 ANALYSIS OF VARIANCE ON ACHIEVEMENT GAIN SCORES

C1.1: Descriptive Analyses on Gain Scores (2 x 2 x 2)

The criterion gain scores of all the two groups { MLS (Pooled) and Control Group Learning} were depicted through frequency polygons in order to compare the nature of distributions depicted in table 4.12.

**Frequency polygon**

A Frequency polygon was plotted for the exact mid points of class intervals on the axis of “X” and the corresponding percentage of frequencies on the axis of “Y”. The frequency polygon has been represented on the graph in the Fig 4.6f.

It may be observed from the figure that:

- The frequency polygon drawn on the post test scores of Mastery Learning Group (Pooled) appears to be unimodal and approximately bell shaped and appears to be symmetrical about the ordinate at the score X = 131.5. The curve also appears to be normally distributed. The distribution of scores appears to be massed at the right hand end and spreads out gradually towards left hand side.

- The frequency polygon drawn on the post test scores of Conventional Group appears to be unimodal and bell shaped and appears to be symmetrical about the ordinate at the score X = 126.5. The curve also appears to be normally distributed. The distribution of scores appears to be massed at the right hand end and spreads out gradually towards left hand side.

**Inverted Ogives**

An Inverted Ogive was drawn for the exact mid points of class intervals on the axis of “X” and the corresponding percentage of frequencies on the axis of “Y”. The frequency polygon has been represented on the graph in the Fig 4.7f.
### Analysis and Interpretation of Data

**Criterion Gain Scores of Treatment Groups (MLS (Pooled) and CGL)**

<table>
<thead>
<tr>
<th>Class Interval</th>
<th>MLS (Pooled)</th>
<th>CGL</th>
<th>Inv. Cum.</th>
<th>Per. f.</th>
</tr>
</thead>
<tbody>
<tr>
<td>99-104</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>104-109</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>109-114</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>114-119</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>119-124</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>124-129</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>129-134</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>134-139</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>139-144</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Class Interval</th>
<th>MLS (Pooled)</th>
<th>CGL</th>
<th>Inv. Cum.</th>
<th>Per. f.</th>
</tr>
</thead>
<tbody>
<tr>
<td>n=300</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>o</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H—</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 4.12

*Criteria: Gain Scores of Treatment Groups (MLS (Pooled) and CGL)*

...Analysis and Interpretation of Data
Fig 4.6f Frequency Polygon Showing Distribution of Gain Scores Of Two Treatment Groups (MLS and CGL)
Fig. 4.7f Inverted Percentage Cumulative Frequency Curve for Gain Scores of Two Treatment Groups (MLS and CGL)
It may be observed from the above figure that:

- As high as 86% students of MLS (Pooled) could reach the 60% (Gain score = 124). From conventional group 36% could achieve the gain of 60%.
- Whereas 70% gain (Gain score = 129) could be attained by 70% from MLS (Pooled) and only 8% could reach this score from conventional group.
- 80% (Gain score = 134) could be reached by 32% MLS (Pooled) group and only 1% Conventional group.
- 90% (Gain score = 139) only 6% from MLS (Pooled) none could gain any score from conventional group.

C1.2: Means and S.D.'s of sample of 2 x 2 x 2 factorial design

The Means, SD’s, Skewness and Kurtosis was calculated from the sample to see the variation in mean scores, which have been depicted in the following table:

<table>
<thead>
<tr>
<th>Instructional Strategies</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>MLS</td>
</tr>
<tr>
<td>HP/DA</td>
<td>Mean = 132.10</td>
</tr>
<tr>
<td></td>
<td>SD = 3.02</td>
</tr>
<tr>
<td></td>
<td>N= 79</td>
</tr>
<tr>
<td></td>
<td>Skew=-0.702</td>
</tr>
<tr>
<td></td>
<td>Kurt=0.479</td>
</tr>
<tr>
<td>HP/SA</td>
<td>Mean = 131.88</td>
</tr>
<tr>
<td></td>
<td>SD = 3.186</td>
</tr>
<tr>
<td></td>
<td>N=71</td>
</tr>
<tr>
<td></td>
<td>Skew=-1.107</td>
</tr>
<tr>
<td></td>
<td>Kurt=0.755</td>
</tr>
<tr>
<td>LP/DA</td>
<td>Mean = 132.259</td>
</tr>
<tr>
<td></td>
<td>SD = 3.078</td>
</tr>
<tr>
<td></td>
<td>N=74</td>
</tr>
<tr>
<td></td>
<td>Skew=-1.163</td>
</tr>
<tr>
<td></td>
<td>Kurt=0.584</td>
</tr>
<tr>
<td>LP/SA</td>
<td>Mean = 131.55</td>
</tr>
<tr>
<td></td>
<td>SD = 3.11</td>
</tr>
<tr>
<td></td>
<td>N=76</td>
</tr>
<tr>
<td></td>
<td>Skew=-0.933</td>
</tr>
<tr>
<td></td>
<td>Kurt=0.070</td>
</tr>
<tr>
<td>Total</td>
<td>Mean = 131.947</td>
</tr>
<tr>
<td></td>
<td>SD = 3.0985</td>
</tr>
<tr>
<td></td>
<td>N=300</td>
</tr>
<tr>
<td></td>
<td>Skew=-0.97</td>
</tr>
<tr>
<td></td>
<td>Kurt=-0.79</td>
</tr>
</tbody>
</table>
The Table 4.13 reveals that the Means of Mastery Learning and Conventional Group are different from each other. The means of Mastery Learning group being higher (Mean = 131.947) than conventional group (Mean = 117.815).

C1.3: ANALYSIS BASED ON ANOVA (2 X 2 X 2)

A 2 x 2 x 2 analysis of variance was applied on achievement scores to study the impact of Mastery Learning Strategies on learning outcomes of the learners.

A three way analysis of variance was applied on achievement gain scores. Three way analysis was chosen as it has an advantage that simultaneously three variables can be studied. Hence, the interaction effects can also be studies through three way analysis of variance. (Robson, 1996) In a Three way ANOVA, three variables or factors are manipulated simultaneously. Such experiments in which two or more than two variables are manipulated are designated as Factorial experiments. Factorial experiments have advantage over the single factor experiments in that:

- Treatment (experimental condition) is administered to an experimental unit; while in single factor experiments, the treatment consists of administering one level of each factor (Robson, 1999).
- In factorial experiment, the treatment consists of a combination of one level of factor, referred as treatment combination (Winer, 1971).

Therefore, in a (p x q x r) factorial experiment, there will be (pq), (pr) and (qr) combinations of levels of two factors.

In the present study, a 2 x 2 x 2 factorial designs has been employed where, Achievement is dependent variable while Computer-Based Mastery Learning Strategy is the treatment variable and Perseverance and Learning Approaches are the other two classification variables. These two independent variables are used for classification of the students only. However, treatment variable (Instructional strategy) and classification variables have been studied at two levels each viz.

- MLS Vs CGL (Instructional Strategy)
...Analysis and Interpretation of Data

- High and Low Perseverance (Perseverance)
- Deep and Surface Learning Approach (Learning Approaches)

This analysis was done to test the following hypotheses:

- **Ho 6**: The instructional treatment yields equal levels of learning outcomes as measured by achievement scores.
- **Ho 7**: The Learning approaches yield equal levels of learning outcomes as measured by achievement scores.
- **Ho 8**: The Perseverance Level yields equal levels of learning outcomes as measured by achievement scores.
- **Ho 9**: The difference in achievement scores through different learning strategies are not qualified by different Learning Approaches;
  
  - **Ho 9.1**: With MLS: Deep and Surface approach students will achieve equal gain scores.
  - **Ho 9.2**: With CGL: Deep and Surface approach students will achieve equal gain scores.
  - **Ho 9.3**: For Deep Approach, Achievement scores through Mastery Learning and Conventional groups are not different.
  - **Ho 9.4**: For Surface Approach, Achievement scores through Mastery Learning and Conventional groups are not different.
  - **Ho 9.5**: For Mastery Learning with Deep Approach and Conventional Group with and Surface Approach Achievement scores are not different.
  - **Ho 9.6**: For Mastery Learning with Surface Approach and Conventional Group with and Deep Approach Achievement scores are not different.

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Ho 10: The difference in achievement scores through different learning strategies are not qualified by levels of Perseverance;

- Ho 10.1: With MLS: High and Low Perseverance students will achieve equal gain scores.
- Ho 10.2: With CGL: High and Low Perseverance students will achieve equal gain scores.
- Ho 10.3: For High Perseverance, Achievement scores through Mastery Learning and Conventional groups are not different.
- Ho 10.4: For Low Perseverance, Achievement scores through Mastery Learning and Conventional groups are not different.
- Ho 10.5: For Mastery Learning with High Perseverance and Conventional Group with Low Perseverance Achievement scores are not different.
- Ho 10.6: For Mastery Learning with Low Perseverance and Conventional Group with High Perseverance Achievement scores are not different.

Ho 11: The difference in achievement scores through different learning approaches are not qualified by levels of Perseverance;

- Ho 11.1: For Deep Approach, Achievement scores through High and Low Perseverance are not different.
- Ho 11.2: For Surface approach, Achievement scores through High and Low Perseverance are not different.
...Analysis and Interpretation of Data

♦ Ho 11.3: For High Perseverance, Achievement scores through Deep approach and Surface approach are not different.
♦ Ho 11.4: For Low Perseverance, Achievement scores through Deep approach and Surface approach are not different.
♦ Ho 11.5: For High Perseverance and Deep Approach Achievement scores are not different from Low Perseverance and Surface approach.
♦ Ho 11.6: For High Perseverance and Surface Approach Achievement scores are not different from Low Perseverance and Deep approach.

❖ Ho 12: The difference in achievement scores through different learning strategies are not qualified by different Learning Approaches and Levels of Perseverance;
❖ Ho 12.1: For Deep Approach and High Perseverance, achievement scores through Mastery Learning and Conventional groups are not different.
❖ Ho 12.2: For Deep Approach and Low Perseverance, achievement scores through Mastery Learning and Conventional groups are not different.
❖ Ho 12.3: For Surface approach and High Perseverance, achievement scores through Mastery Learning and Conventional groups are not different.
❖ Ho 12.4: For Surface approach and Low Perseverance, achievement scores through Mastery Learning and Conventional groups are not different.
Ho 12.5: Achievement scores for Deep Approach and High Perseverance through Mastery Learning and Surface Approach and High Perseverance in Conventional groups are not different.

Ho 12.6: Achievement scores for Deep Approach and Low Perseverance through Mastery Learning and Surface Approach and Low Perseverance in Conventional groups are not different.

Ho 12.7: Achievement scores for Surface Approach and High Perseverance through Mastery Learning and Deep Approach and High Perseverance in Conventional groups are not different.

Ho 12.8: Achievement scores for Surface Approach and Low Perseverance through Mastery Learning and Deep Approach and Low Perseverance in Conventional groups are not different.

Sum of squares, mean sum of squares and F-ratios for the main effects and interaction effects were computed.

A summary of Three way Anova (2 x 2 x 2) on achievement gain scores have been depicted in the following Table.
Table 4.14
Summary of 2 x 2 x 2 Analysis of Variance on Achievement gain Scores in relation to Instructional Strategy, Learning Approaches and Perseverance

<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><strong>Main Effects:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A: Instructional Strategy</td>
<td>8027.44</td>
<td>1</td>
<td>8027.44</td>
<td>69.19**</td>
</tr>
<tr>
<td>MLS vs CGL</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B: Learning Approaches</td>
<td>0.774</td>
<td>1</td>
<td>0.77</td>
<td>0.007</td>
</tr>
<tr>
<td>DA vs SA</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C: Perseverance</td>
<td>0.544</td>
<td>1</td>
<td>0.54</td>
<td>0.005</td>
</tr>
<tr>
<td>HP vs LP</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Two Order Interactions:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A x B (Instructional Strategy x Learning Approach)</td>
<td>8155.74</td>
<td>1</td>
<td>8155.74</td>
<td>70.30**</td>
</tr>
<tr>
<td>A x C (Instructional Strategy x Perseverance)</td>
<td>8432.57</td>
<td>1</td>
<td>8432.57</td>
<td>72.69**</td>
</tr>
<tr>
<td>B x C (Learning Approach x Perseverance)</td>
<td>1029.39</td>
<td>1</td>
<td>1029.39</td>
<td>8.87**</td>
</tr>
<tr>
<td><strong>Three Order Interaction:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(A x B x C)</td>
<td>2933.14</td>
<td>1</td>
<td>2933.14</td>
<td>25.28**</td>
</tr>
<tr>
<td><strong>Within Group (Error)</strong></td>
<td>51278.44</td>
<td>442</td>
<td>175.61</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td>449</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

** Significant at 0.01 Level

**MAIN EFFECTS**

**MAIN EFFECTS A:**

> **Mastery Learning vs Conventional Group Learning**

The Table 4.14 reveals that F – ratios for the difference between gain means of the instructional treatment (Mastery Learning (pooled) and Conventional) groups was found to be significant at the 0.01 level of confidence. It means that both the groups were significantly different on the achievement gain.
scores. Hence, the null hypothesis $H_0$ stating that *The instructional treatment yields equal levels of learning outcomes as measured by achievement scores* was rejected at 0.01 level of confidence. It may be inferred that the gain means of MLS and CGL may not be considered equal and are different beyond the contribution of chance.

For the confirmation of results $F$-test was followed by $t$-test and $t$-ratio for difference in means of various combination groups were computed and have been recorded in table 4.15

**Table 4.15**

$t$ – ratios for Difference Between Means of Different combination pairs of Two Treatment Groups for Achievement Gain Scores

<table>
<thead>
<tr>
<th></th>
<th>MLS</th>
<th>CG</th>
</tr>
</thead>
<tbody>
<tr>
<td>$M$</td>
<td>131.989</td>
<td>117.865</td>
</tr>
<tr>
<td>$SD$</td>
<td>3.092</td>
<td>9.37</td>
</tr>
<tr>
<td>$N$</td>
<td>300</td>
<td>150</td>
</tr>
<tr>
<td>$t$ - ratio</td>
<td><strong>6.57</strong></td>
<td><strong>6.57</strong></td>
</tr>
</tbody>
</table>

**Significant at 0.01 Level**

The table reveals that the $t$ – ratio for the difference in gain means of two treatment groups viz: MLS and CGL was significant at the 0.01 level of significance. The difference may be taken to be significant beyond the contribution of chance. This means that the Mastery Learning yields different gain mean scores than the conventional group. An examination of means of two groups suggests that MLS group achieved higher ($Mean = 131.989$) than the conventional group ($Mean = 117.865$).
MAIN EFFECT B: Learning Approaches Deep vs Surface

The table 4.14 reveals that the F-ratio for the difference in gain means of students with Deep and Surface Learning Approaches, was not found to be significant even at the 0.05 level of confidence. This indicates that the gain means of the two groups were not different beyond the contribution of chance. Hence the null hypothesis $H_0$ stating that The Learning approaches yields equal levels of learning outcomes as measured by achievement scores was not rejected at the specified level. It may be concluded that students with Deep Learning Approach and Surface Learning Approach, achieved equal levels of gain means.

MAIN EFFECT C: Perseverance High vs Low Perseverance

The table 4.14 reveals that the F-ratio for the difference in gain means of students with High vs Low Perseverance, was not found to be significant even at the 0.05 level of confidence. This indicates that the gain means of the two groups were not different beyond the contribution of chance. Hence the null hypothesis $H_0$ stating that The Perseverance level yields equal levels of learning outcomes as measured by achievement scores was not rejected at the specified level. It may be concluded that students with High and Low Perseverance level, achieved equal levels of gain means.

INTERACTION EFFECTS

TWO ORDER INTERACTION: A X B Instructional Strategy x Learning Approaches

The table 4.14 shows that the F – ratios for difference in gain means of students due to interaction between two types of Learning Approaches and Instructional Treatment (MLS & CGL) was found to be highly significant at 0.01 level of significance. The results show that different groups scored different gain
means for two types of learning approaches and Instructional Strategy. It means that the gain scores due to interaction of treatment strategy (MLS and CGL) yielded different gain means for students with Deep and Surface learning approaches. The hypothesis Ho 9 stating that The difference in achievement scores through different learning strategies are not qualified by different Learning Approaches stands rejected as the difference cannot be contributed to chance. To investigate further F – ratio was followed by t – test. t – ratio for the difference in means of different combination pairs of treatment were computed and have been recorded in Table 4.16.

Table 4.16

<table>
<thead>
<tr>
<th></th>
<th>Mastery Learning Strategy (MLS)</th>
<th>Conventional Learning Group (CGL)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean = 132.418</td>
<td>Mean = 131.616</td>
</tr>
<tr>
<td></td>
<td>SD = 3.022</td>
<td>SD = 3.057</td>
</tr>
<tr>
<td></td>
<td>N = 165</td>
<td>N = 133</td>
</tr>
<tr>
<td>MLS/DA</td>
<td></td>
<td>0.245</td>
</tr>
<tr>
<td>MLS/SA</td>
<td></td>
<td>5.355 **</td>
</tr>
<tr>
<td>CGL/DA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CGL/SA</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

** Significant at 0.01 level

Table 4.16 reveals that:

- **With MLS:**

The t- ratios for the difference in achievement gain scores of DA and SA students was not found to be significant even at the 0.05 level of confidence. It means that the Ho 9.1 stating that With MLS: Deep and Surface approach students
will achieve equal gain scores was not rejected at the specified level of confidence. It leads to conclude that students with Deep Learning Approach and Surface Learning Approach, achieved equal gain means.

- **With CGL:**
  The t-ratios for the difference in achievement gain scores of DA and SA students was not found to be significant even at the 0.05 level of confidence. Hence, *Ho 9.2* stating that *With CGL: Deep and Surface approach students will achieve equal gain scores* was not rejected at specified level of significance. It leads to conclude that students, with deep learning approach and surface learning approach achieved equal gain means through Conventional Group Learning.

- **With DA:**
  The t-ratios for the difference in achievement gain scores of MLS and CGL students was found to be significant at the 0.01 level of confidence, leading to rejection of *Ho 9.3* which stated that *For Deep Approach, Achievement scores through Mastery Learning and Control groups are not different*. It leads to conclude, that students studying through MLS or CGL did not achieve equal gain means. An examination of the two means suggests that MLS / DA achieved higher gain means (Mean = 132.418) as compared to CGL / DA (Mean = 118.833).

- **With SA:**
  The t-ratios for the difference in achievement gain scores of MLS and CGL students was found to be significant at the 0.05 level of confidence. It reveals that the *Ho 9.4* stating that *For Surface approach, Achievement scores through Mastery Learning and Control groups are not different* was rejected at specified level of significance. It leads to conclude that students with Surface Approach, studying through MLS achieved higher gain means (Mean = 131.616) as compared to students in CGL (Mean = 117.059).
• For MLS / DA and CGL / SA:
The t-ratios for the difference in achievement gain scores of MLS / DA and CGL / SA students was found to be significant at the 0.01 level of confidence, beyond the contribution of chance. Hence, the null hypothesis Ho 9.5 stating For Mastery Learning with Deep Approach and Conventional Group with and Surface Approach Achievement scores are not different was not rejected at 0.01 level of confidence. It lead to conclude that students with Deep Approach and studying through MLS and those with Surface Approach and studying in CGL situation were significantly different in their gain means. An examination of the two means suggests that MLS / DA achieved high gain means (Mean = 132.418) as compared to CGL / SA (Mean = 117.059).

• For MLS / SA and CGL / DA:
The t-ratios for the difference in achievement gain scores of MLS / SA and CGL / DA students was found to be significant at the 0.01 level of confidence, beyond the contribution of chance. Hence, the null hypothesis Ho 9.6 stating that For Mastery Learning with Surface Approach and Conventional Group with Deep Approach Achievement scores are not different was not rejected at 0.01 level of confidence. It lead to conclude that students with Deep Learning Approach and CGL and those with Surface Learning Approach in MLS group did not achieved equal gain means through MLS and CGL. MLS /SA group achieved higher gain means (Mean = 131.616) as compared to CGL / DA (Mean = 118.833).

➢ TWO ORDER INTERACTION: A X C
Treatment groups vs Perseverance:
The table 4.14 shows that the F – ratios for interaction between two levels of Perseverance and Treatment groups was found to be highly significant at 0.01 level of confidence. The hypothesis Ho 10 stating The difference in achievement scores through different learning strategies are not qualified by levels of
Perseverance stands rejected, as the difference cannot be contributed to chance. To investigate further t – ratios for the difference in means of different combination pairs of treatment were computed, given in Table 4.11 to test the following hypothesis:

Table 4.17

<table>
<thead>
<tr>
<th>Mastery Learning Strategy (MLS)</th>
<th>Conventional Group Learning (CGL)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>High Perseverance (HP)</strong></td>
<td><strong>Low Perseverance (LP)</strong></td>
</tr>
<tr>
<td>Mean = 132.081</td>
<td>Mean = 131.853</td>
</tr>
<tr>
<td>SD = 2.998</td>
<td>SD = 3.139</td>
</tr>
<tr>
<td>N = 150</td>
<td>N = 75</td>
</tr>
<tr>
<td>HP / MLS</td>
<td>-</td>
</tr>
<tr>
<td>LP / MLS</td>
<td>-</td>
</tr>
<tr>
<td>HP / CGL</td>
<td>-</td>
</tr>
<tr>
<td>LP / CGL</td>
<td>-</td>
</tr>
</tbody>
</table>

** Significant at 0.01 level

Table 4.17 reveals that:

- **With MLS:**

  The t- ratios for the difference in achievement gain scores of HP and LP students was not found to be significant even at the 0.05 level of confidence, it led to support \( Ho \) **1.1** stating **With MLS: High and Low Perseverance students will achieve equal gain scores.** It led to conclude that students with High Perseverance and Low Perseverance achieved equal gain means through MLS.

- **With CGL:**

  The t- ratios for the difference in achievement gain scores of HP and LP students was not found to be significant even at the 0.05 level of confidence. \( Ho \)
10.2 stating *With CGL: High and Low Perseverance students will achieve equal gain scores* was supported. It led to conclude that students with High Perseverance and Low Perseverance achieved equal gain means through CGL.

**With HP**

The t- ratios for the difference in achievement gain scores of *MLS and CGL* students was found to be significant at the 0.01 level of confidence, leading to rejection of *Ho 10.3*, which states that *For High Perseverance, Achievement scores through Mastery Learning and Conventional groups are not different*. It leads to conclude that students with High Perseverance achieved different gain means through MLS and CGL. An examination of means of the two groups suggested that high perseverant students with MLS achieved higher gain means (*Mean = 132.081*) than those with High Perseverance and studying through CGL (*Mean = 119.440*).

**With LP:**

The t- ratio for the difference in achievement gain scores of *MLS and CGL* students was not found to be significant even at the 0.05 level of confidence, leading to the non rejection of *Ho 10.4*, which states that *For Low Perseverance, Achievement scores through Mastery Learning and Conventional groups are not different*. It leads to conclude that students with Low Perseverance achieved equal gain means through MLS and CGL.

**For MLS / HP and CGL / LP:**

The t- ratios for the difference in achievement gain scores of *MLS / HP and CGL / LP* students was found to be significant at the 0.01 level of confidence, beyond the contribution of chance. Hence, the null hypothesis *Ho 10.5* stating *For Mastery Learning with High Perseverance and Conventional Group with and Low Perseverance Achievement scores are not different* was not rejected at 0.01
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level of confidence. It lead to conclude that students with High Perseverance and studying through MLS and those with Low Perseverance and studying in CGL situation were significantly different in their gain means. **An examination of the two means suggests that MLS / HP achieved high gain means (Mean = 132.081) as compared to CGL / LP (Mean = 115.920).**

- **For MLS / LP and CGL / HP:**

  The t-ratios for the difference in achievement gain scores of MLS / LP and CGL / HP students was not found to be significant even at the 0.05 level of confidence. Hence, the null hypothesis **Ho 10.6** stating that **For Mastery Learning with Low Perseverance and Conventional Group with High Perseverance Achievement scores are not different** was not rejected at 0.05 level of confidence. **It leads to conclude that students with High Perseverance and CGL and those with Low Perseverance in MLS group achieved equal gain means.**

➢ **TWO ORDER INTERACTION: B X C**

**Learning Approaches Vs Perseverance:**

The table 4.15 shows that the F – ratios for interaction between two types of Learning Approaches and Levels of Perseverance was found to be highly significant at 0.01 level of confidence. The hypothesis **Ho 11** stating **The difference in achievement scores through different learning approaches are not qualified by levels of Perseverance** stands rejected, as the difference cannot be contributed to chance. The results show that both the groups scored different means for two types of learning approaches. It means that the gain scores due to interaction of perseverance and learning approaches were different in the groups. To investigate further F – ratio was followed by t – test. t –ratios for the difference in means of different combination pairs of treatment were computed to test the alternate Ho 11.1 to 11.4 , given in Table 4.18.
Table 4.18

$t$ - ratios for different between Means of Different combination pairs for Achievement Gain Scores

<table>
<thead>
<tr>
<th></th>
<th>Deep Approach (DA)</th>
<th>Surface Approach (SA)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>High Perseverance (HP)</td>
<td>Low Perseverance (LP)</td>
</tr>
<tr>
<td>Mean</td>
<td>131.333</td>
<td>118.168</td>
</tr>
<tr>
<td>SD</td>
<td>3.441</td>
<td>10.414</td>
</tr>
<tr>
<td>N</td>
<td>117</td>
<td>113</td>
</tr>
<tr>
<td>DA / HP</td>
<td>-</td>
<td>4.962**</td>
</tr>
<tr>
<td>DA / LP</td>
<td>-</td>
<td>2.982**</td>
</tr>
<tr>
<td>SA / HP</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>SA / LP</td>
<td>-</td>
<td></td>
</tr>
</tbody>
</table>

** Significant at 0.01 level and * Significant at 0.05 level

The table 4.18 reveals that:

- **With Deep Approach:**
  
The $t$ - ratios for the difference in achievement gain scores of High and Low Perseverant students was found to be significant at the 0.01 level of confidence. It indicated that the two groups were different on their gain means and it was not only due to chance factor. Thus, leading to the rejection of $H_0$ for Deep Approach, achievement scores through High and Low Perseverance are not different. It leads to conclude that students with Deep Approach and High Perseverance achieved higher gain means (Mean = 131.333) as compared to those with Deep Approach and Low Perseverance conditions (Mean = 118.168).

- **With Surface Approach**
  
The $t$-ratio for the difference in achievement gain scores of High and Low Perseverant students was found to be significant even at the 0.01 level of confidence, leading to reject $H_0$ for Surface approach, achievement scores. 
through High and Low Perseverance are not different. It may be inferred that students with High and Low Perseverance achieved different gain means through Surface Approach. The means of the two groups showed that with Surface Approach, High Perseverant students achieved higher gain means (Mean = 131.000) than those with Low Perseverance (Mean = 116.910).

- **With High Perseverance**
  
The t-ratio for the difference in achievement gain scores of students with Deep and Surface Approach was not found to be significant even at the 0.05 level of confidence, leading not to the reject of Ho 11.3 stating For High Perseverance, Achievement scores through Deep approach and Surface approach are not different. It leads to conclude that students with High Perseverance and Deep Approach (Mean = 131.333) achieved equal gain means to High Perseverance with Surface Approach (131.000).

- **With Low Perseverance**
  
The t-ratio for the difference in achievement gain scores of students with Deep and Surface Approach was not found to be significant even at the 0.05 level of confidence, leading not to reject Ho 11.4 as it states that For Low Perseverance, Achievement scores through Deep approach and Surface approach are not different. It leads to conclude that students with Low Perseverance and Deep Learning Approach and those with Low Perseverance and Surface Approach achieved equal gain means.

- **For HP / DA and LP / SA:**
  
The t-ratios for the difference in achievement gain scores of HP / DA and LP / SA students was not found to be significant even at the 0.05 level of confidence. Hence, the null hypothesis Ho 11.5 stating that For High Perseverance and Deep Approach Achievement scores are not different from Low Perseverance and Surface approach was rejected at 0.01 level of confidence. It leads to conclude
that mean scores of students with High Perseverance and Deep Approach achieved higher gain means (Mean = 131.333) than Low Perseverance and Surface Approach (Mean = 116.911).

- For HP / SA and LP / DA:

The t-ratios for the difference in achievement gain scores of HP / SA and LP / DA students was not found to be significant even at the 0.05 level of confidence. Hence, the null hypothesis Ho 11.6 stating that For High Perseverance and Surface Approach Achievement scores are not different from Low Perseverance and Deep approach was rejected at 0.01 level of confidence. It leads to conclude that mean scores of students with High Perseverance and Surface Approach achieved higher gain means (Mean = 131.000) than Low Perseverance and Deep Approach (Mean = 118.168).

THREE ORDER INTERACTIONS

- A X B X C:

(MLS / CGL, Learning Approaches and Perseverance)

The table 4.14 shows that the F – ratio for interaction between two levels of Perseverance, two types of Learning Approaches and Treatment groups was found to be highly significant at 0.01 level of significance. The hypothesis Ho 12 The difference in achievement scores through different learning strategies are not qualified by different Learning Approaches and Levels of Perseverance stands rejected as the difference cannot be contributed to chance. To investigate further t – ratios for the difference in means of different combination pairs of treatment were computed to test the following Hypothesis, given in Table 4.19.
Table 4.19

t – ratios for different between Means of Different combination pairs of Two Treatment Groups in Relation to Learning Approaches and Perseverance

<table>
<thead>
<tr>
<th></th>
<th>ML</th>
<th>LG</th>
<th>DA</th>
<th>DP</th>
<th>SA</th>
<th>HS</th>
<th>CG</th>
<th>LP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>131.19</td>
<td>130.590</td>
<td>127.46</td>
<td>127.17</td>
<td>120.95</td>
<td>118.256</td>
<td>117.256</td>
<td>115.500</td>
</tr>
<tr>
<td>SD</td>
<td>3.258</td>
<td>2.900</td>
<td>5.419</td>
<td>4.980</td>
<td>8.087</td>
<td>8.919</td>
<td>10.315</td>
<td>9.805</td>
</tr>
<tr>
<td>N</td>
<td>79</td>
<td>74</td>
<td>71</td>
<td>76</td>
<td>38</td>
<td>39</td>
<td>39</td>
<td>36</td>
</tr>
</tbody>
</table>

** Significant at 0.01 level, * Significant at 0.05 level

Table 4.19 reveals that:

• With DA and HP
  MLS Vs CGL

  The t- ratio for the difference in achievement gain scores of MLS / DA / HP and CGL / DA / HP students was found to be significant at the 0.01 level of confidence. The difference in gain means was considered beyond the contribution of chance. Hence, the null hypothesis Ho 12.1 For Deep Approach and High Perseverance, achievement scores through Mastery Learning and Conventional
groups are not different was rejected at 0.01 level of confidence. It leads to conclude that students with Deep Learning Approach and High Perseverance achieved higher gain means (M = 131.190) through MLS and than those with Deep Learning Approach and High Perseverance studying through CGL (M = 120.950).

- With DA and LP
  MLS Vs CGL
  The t-ratio for the difference in achievement gain scores of MLS / DA /LP and CGL / DA /LP students was found to be significant at the 0.01 level of confidence and this difference is beyond the contribution of chance. Hence, the null hypothesis Ho 12.2 which states that For Deep Approach and Low Perseverance, achievement scores through Mastery Learning and Conventional groups are not different, was rejected at 0.01 level of confidence. It lead to conclude that students with Deep Learning Approach and Low Perseverance did not achieved equal gain means through MLS and CGL. An examination of the means of the two groups suggested that MLS / DA / LP achieved higher gain means (M = 130.590) than those with CGL and DA / LP (Mean = 118.256).

- With SA and HP
  MLS Vs CGL
  The t-ratio for the difference in achievement gain scores of MLS / SA / HP and CGL / SA / HP students was found to be significant at the 0.01 level of confidence, beyond the contribution of chance. Hence, the null hypothesis Ho 12.3 For Surface approach and High Perseverance, achievement scores through Mastery Learning and Conventional groups are not different, was not rejected at 0.01 level of confidence. It leads to conclude that students with Surface Learning Approach and High Perseverance achieved higher gain means through MLS (Mean = 127.460) and as compared to SA / HP students in CGL (Mean = 117.256).
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- **With SA and LP**
  
  **MLS Vs CGL**
  
  The t- ratio for the difference in achievement gain scores of MLS / SA /LP and CGL / SA /LP students was found to be significant at the 0.01 level of confidence, beyond the contribution of chance. Hence, the null hypothesis Ho 12.4 stating *For Surface approach and Low Perseverance, achievement scores through Mastery Learning and Conventional groups are not different* was not rejected at 0.01 level of confidence. It lead to conclude that students with Surface learning approach and Low Perseverance did not achieved equal gain means through MLS or CGL. The means of the two groups suggested that SA / LP group of students achieved higher through MLS (Mean = 127.170) as compared to CGL condition (Mean = 115.500).

- **With MLS / DA and HP Vs CGL / SA and HP**
  
  The t- ratio for the difference in achievement gain scores of MLS / DA /HP and CGL / SA /HP students was found to be significant at the 0.01 level of confidence. The difference in gain means was considered beyond the contribution of chance. Hence, the null hypothesis Ho 12.5 *Achievement scores for Deep Approach and High Perseverance through Mastery Learning and Surface Approach and High Perseverance in Conventional groups are not different* was rejected at 0.01 level of confidence. It leads to conclude that students with Deep Learning Approach and High Perseverance achieved higher gain means (M = 131.190) through MLS and than those with Surface Learning Approach and High Perseverance studying through CGL (M = 117.256).

- **With MLS / DA and LP Vs CGL / SA and LP**
  
  The t- ratio for the difference in achievement gain scores of MLS / DA /LP and CGL / SA /LP students was not found to be significant even at the 0.05 level of confidence. Hence, the null hypothesis Ho 12.6 which states that *Achievement
scores for Deep Approach and Low Perseverance through Mastery Learning and Surface Approach and Low Perseverance in Conventional groups are not different, was not rejected at 0.01 level of confidence. It leads to conclude that students with Deep Learning Approach and Low Perseverance through MLS and Surface Approach and Low Perseverance in CGL achieved equal gain means.

- With MLS / SA and HP Vs CGL / DA / HP

The t- ratio for the difference in achievement gain scores of MLS / SA / HP and CGL / DA / HP students was found to be significant at the 0.01 level of confidence, beyond the contribution of chance. Hence, the null hypothesis $H_0$ 12.7 Achievement scores for Surface Approach and High Perseverance through Mastery Learning and Deep Approach and High Perseverance in Conventional groups are not different was not rejected at 0.01 level of confidence. It leads to conclude that students with Surface Learning Approach and High Perseverance achieved higher gain means through MLS (Mean = 127.460) and as compared to DA / HP students in CGL (Mean = 120.950).

- With MLS / SA and LP Vs CGL / DA and LP

The t- ratio for the difference in achievement gain scores of MLS / SA /LP and CGL / DA /LP students was found to be significant at the 0.05 level of confidence, beyond the contribution of chance. Hence, the null hypothesis $H_0$ 12.8 Achievement scores for Surface Approach and Low Perseverance through Mastery Learning and Deep Approach and Low Perseverance in Conventional groups are not different was not rejected at 0.01 level of confidence. It lead to conclude that students with Surface Learning Approach and Low Perseverance through MLS did not achieved equal gain means to the students with Deep Approach and Low Perseverance in CGL group. The means of the two groups suggested that SA / LP group of students achieved higher through MLS (127.17) as compared to CGL / DA / LP condition (Mean = 118.256).

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Apart from these t-ratios, there were significant differences in means due to following combinations:

- Mastery Learning Strategy / Deep Approach / High Perseverance Vs Conventional Group Learning / Surface Approach / Low Perseverance
- Mastery Learning Strategy / Deep Approach / Low Perseverance Vs Conventional Group Learning / Surface Approach / High Perseverance
- Mastery Learning Strategy / Deep Approach / Low Perseverance Vs Conventional Group Learning / Surface Approach / High Perseverance
- Mastery Learning Strategy / Surface Approach / High Perseverance Vs Conventional Group Learning / Surface Approach / Low Perseverance
- Mastery Learning Strategy / Deep Approach / Low Perseverance Vs Conventional Group Learning / Surface Approach / Low Perseverance
- Mastery Learning Strategy / Surface Approach / High Perseverance Vs Conventional Group Learning / Surface Approach / Low Perseverance
- Mastery Learning Strategy / Surface Approach / Low Perseverance Vs Conventional Group Learning / Deep Approach / High Perseverance
- Mastery Learning Strategy / Surface Approach / Low Perseverance Vs Conventional Group Learning / Surface Approach / High Perseverance

Conclusions drawn on the basis of results reported in Section C:

- The Mastery Learning group yields significantly higher gain mean scores than the Conventional Group.
- The students with Deep Learning Approaches and Surface Learning Approaches, achieved equal levels of gain means.
• The students with High and Low Perseverance level achieved equal levels of gain means.

• The interaction effect of Instructional Strategy and two types of learning approaches yielded significant differences in achievement gain means scores.
  ▪ **Through CGL**, Students, with deep learning approach and surface learning approach achieved equal gain means.
  ▪ **Deep Approach** Students with Mastery Learning Strategy achieved higher gain means as compared to Conventional Group Learning.
  ▪ **Surface Approach** Students with Mastery Learning Strategy achieved higher gain means as compared to Conventional Group Learning.
  ▪ Students with **Deep Approach** and studying through **MLS** and those with **Surface Approach** and studying in **CGL** situation were significantly different in their gain means.
  ▪ Students with **Surface Approach** and studying through **MLS** and those with **Deep Approach** and studying in **CGL** situation were significantly different in their gain means.

• The interaction effect of Instructional Strategy and two levels of Perseverance yielded significant differences in achievement gain means scores.
  ▪ **With MLS**, students with High Perseverance and Low Perseverance achieved equal gain means.
  ▪ **With CGL**, students with High Perseverance and Low Perseverance achieved equal gain means.

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- **High Perseverance** students with MLS achieved higher gain means than those through CGL.

- **Low Perseverance** students achieved equal gain means through MLS and CGL.

- **High Perseverance** and studying through **MLS** and those with **Low Perseverance** and studying in **CGL** situation differ significantly in their gain means.

- **Low Perseverance** and studying through **MLS** and those with **High Perseverance** and studying in **CGL** situation differ significantly in their gain means.

- The interaction effect of two levels of Perseverance and two types of learning approaches yielded significant differences in achievement gain means scores.

  - **With Deep Approach**, students with High Perseverance did not achieve equal gain means as compared to those with Low Perseverance.

  - **With Surface Approach**, High Perseverant students achieved higher gain means than those with Low Perseverance.

  - **With High Perseverance** students with Deep Approach achieved equal gain means as compared to with Surface Approach.

  - **With Low Perseverance** students with Deep Approach achieved equal gain means as compared to with Surface Approach.

  - **With High Perseverance and Deep Approach** students achieved higher gain means than students with **Low Perseverance and Surface Approach**.
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- **With High Perseverance and Surface Approach** students achieved higher gain means than students with **Low Perseverance and Deep Approach**.

- The interaction effect of two Instructional Strategies, two levels of Perseverance and two types of learning approaches yielded significant differences in achievement gain means scores.
  - **Deep Learning Approach** and **High Perseverance** achieved higher gain means through **MLS** and than those with **CGL**.
  - **Deep Learning Approach** and **Low Perseverance** achieved higher gain means through **MLS** and than those with **CGL**.
  - **Surface Learning Approach** and **High Perseverance** achieved higher gain means through **MLS** and than those with **CGL**.
  - **Surface Learning Approach** and **High Perseverance** achieved higher gain means through **MLS** and than those with **CGL**.
  - Students with **Deep Learning Approach and High Perseverance** achieved higher gain means through **MLS** than those with **Surface Learning Approach and High Perseverance** studying through **CGL**.
  - Students with **Deep Learning Approach and Low Perseverance** through **MLS** and **Surface Approach and Low Perseverance** in **CGL** achieved equal gain means
  - Students with **Surface Learning Approach and High Perseverance** achieved higher gain means through **MLS** as compared to **Deep Learning Approach and High Perseverance** students in **CGL**.
  - **Deep Learning Approach and Low Perseverance** group of students achieved higher through **MLS** as compared to **Deep Learning Approach and Low Perseverance** in **CGL**.

Since \(2 \times 2 \times 2\) analysis showed significantly different results for mastery learning and control group, it was considered relevant to explore effect of these variables through \(3 \times 2 \times 2\) analysis also.
C2 3 x 2 x 2 ANALYSIS OF VARIANCE ON ACHIEVEMENT GAIN SCORES

C2.1: Descriptive Analyses on Gain Scores (3 x 2 x 2)

The criterion gain scores of all the three groups { MLS1, MLS2 and Control Group Learning} were depicted through frequency polygons in order to compare the nature of distributions depicted in table 4.20.

A Frequency polygon was plotted for the exact mid points of class intervals on the axis of “X” and the corresponding percentage of frequencies on the axis of “Y”. The frequency polygon has been represented on the graph in the Fig 4.8f.

It may be observed from the figure that:

- The frequency polygon drawn on the post test scores of Mastery Learning 1 Group appears to be unimodal and approximately bell shaped and appears to be symmetrical about the ordinate at the score X = 131.5. The curve also appears to be normally distributed. The distribution of scores appears to be massed at the right hand end and spreads out gradually towards left hand side.

- The frequency polygon drawn on the post test scores of Mastery Learning 2 Group appears to be unimodal and approximately bell shaped and appears to be symmetrical about the ordinate at the score X = 131.5. The curve also appears to be normally distributed.

- The frequency polygon drawn on the post test scores of Conventional Group appears to be unimodal and bell shaped and appears to be symmetrical about the ordinate at the score X = 126.5. The curve also appears to be normally distributed. The distribution of scores appears to be massed at the right hand end and spreads out gradually towards left hand side.
<table>
<thead>
<tr>
<th>Class Interval</th>
<th>MLS1</th>
<th>MLS2</th>
<th>CGL</th>
</tr>
</thead>
<tbody>
<tr>
<td>139-144</td>
<td>11</td>
<td>153</td>
<td>0</td>
</tr>
<tr>
<td>134-139</td>
<td>73</td>
<td>113</td>
<td>13</td>
</tr>
<tr>
<td>129-134</td>
<td>14</td>
<td>92</td>
<td>17</td>
</tr>
<tr>
<td>124-129</td>
<td>1</td>
<td>62</td>
<td>2</td>
</tr>
<tr>
<td>120-124</td>
<td>8</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>109-104</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>104-100</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>99-102</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>94-97</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Note: The table details the criterion gain scores for three treatment groups (MLS1, MLS2, and CGL) across different class intervals.
Fig 4.8f Frequency Polygon Showing Distribution Of Gain Scores Of Three Treatment Groups (MLS 1, MLS2 and CGL)
Fig 4.9f: Inverted Percentage Cumulative Frequency Curve for Gain Scores of Three Treatment Groups (MLS1, MLS2 and CGL)
Inverted Ogives

An Inverted Ogive was drawn for the exact mid points of class intervals on the axis of “X” and the corresponding percentage of frequencies on the axis of “Y”. The frequency polygon has been represented on the graph in the Fig 4.9f.

It may be observed from the above figure that:

- As high as 91% students of MLS 1 could reach the 60% (Gain score = 124) gain criterion mark while only 82% could reach this score from MLS2 group. From conventional group 36% could achieve the gain of 60%.
- Whereas 70% gain (Gain score = 129) could be attained by 78% from MLS1, 62% from MLS2 and only 8% could reach this score from conventional group.
- 80% (Gain score = 134) could be reached by 30% MLS 1 group, 28% MLS2 group and only 1% Conventional group.
- 90% (Gain score = 139) only 7% from MLS1 and 5% from MLS2 could gain this score.

C2.2: Means and S.D.’s of sample of 2 x 2 x 2 factorial design
Table 4.21
Means ans S.D.’s, Skewnness and Kurtosis of the Samples of a 3 x 2 x 2
Factorial Design for achievement scores

<table>
<thead>
<tr>
<th>INSTRUCTIONAL STRATEGY</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>MLS1</td>
</tr>
<tr>
<td>HP/DA</td>
<td>Mean = 132.179</td>
</tr>
<tr>
<td></td>
<td>SD = 3.448</td>
</tr>
<tr>
<td></td>
<td>N= 39</td>
</tr>
<tr>
<td></td>
<td>Skew=-0.502</td>
</tr>
<tr>
<td></td>
<td>Kurt=-0.499</td>
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<tr>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>HP / SA</td>
<td>Mean = 130.667</td>
</tr>
<tr>
<td></td>
<td>SD = 2.828</td>
</tr>
<tr>
<td></td>
<td>N= 36</td>
</tr>
<tr>
<td></td>
<td>Skew=-1.507</td>
</tr>
<tr>
<td></td>
<td>Kurt=0.824</td>
</tr>
<tr>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>LP / DA</td>
<td>Mean = 124.973</td>
</tr>
<tr>
<td></td>
<td>SD = 7.581</td>
</tr>
<tr>
<td></td>
<td>N=37</td>
</tr>
<tr>
<td></td>
<td>Skew=-1.173</td>
</tr>
<tr>
<td></td>
<td>Kurt=0.58</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
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<tr>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>LP / SA</td>
<td>Mean = 123.179</td>
</tr>
<tr>
<td></td>
<td>SD = 9.708</td>
</tr>
<tr>
<td></td>
<td>N=39</td>
</tr>
<tr>
<td></td>
<td>Skew=-0.933</td>
</tr>
<tr>
<td></td>
<td>Kurt=0.070</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
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<td></td>
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<tr>
<td></td>
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<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>Mean = 127.749</td>
</tr>
<tr>
<td></td>
<td>SD = 5.891</td>
</tr>
<tr>
<td></td>
<td>N=151</td>
</tr>
<tr>
<td></td>
<td>Skew=-1.028</td>
</tr>
<tr>
<td></td>
<td>Kurt=0.709</td>
</tr>
</tbody>
</table>

The Table 4.21 reveals that the Means of Mastery Learning and Conventional Group are different from each other. The means of Mastery Learning group1 being higher (Mean = 127.749, SD = 5.891) than conventional group (Mean = 117.815), the means and SD of Mastery Learning group2 is also higher (Mean = 126.644, SD = 3.0985) than conventional group (Mean = 117.815, SD = 9.4465).

C2.3: Analysis Based on ANOVA (3 x 2 x 2)

The achievement scores for Mastery Learning 1, Mastery learning 2 and control group were studied through this analysis to test the following hypotheses:
...Analysis and Interpretation of Data

- **Ho 13:** The instructional treatment will yield equal level of learning outcomes as measured by achievement scores.
  - **Ho 13.1:** MLS 1 and MLS 2 will yield equal gain means.
  - **Ho 13.2** MLS 1 and MLS 2 will yield equal gain means.
  - **Ho 13.3** MLS 2 and CGL will yield equal gain means.

- **Ho 14:** The Learning Approaches will yield equal level of learning outcomes as measured by achievement scores.

- **Ho 15:** The Perseverance will yield equal level of learning outcomes as measured by achievement scores.

- **Ho 16:** The difference in achievement gain scores through different learning strategies are not qualified by different Learning Approaches
  - **Ho 16.1:** With MLS1: Deep and Surface approach students will achieve equal gain scores.
  - **Ho 16.2:** With MLS2: Deep and Surface approach students will achieve equal gain scores.
  - **Ho 16.3:** With CGL: Deep and Surface approach students will achieve equal gain scores.
  - **Ho 16.4:** For Deep Approach, Achievement gain scores through Mastery Learning 1 and Control groups are not different.
  - **Ho 16.5:** For Deep Approach, Achievement gain scores through Mastery Learning 2 and Control groups are not different.
  - **Ho 16.6:** For Surface approach, Achievement gain scores through Mastery Learning 1 and Control groups are not different.
Ho 16.7: For Surface approach, Achievement gain scores through Mastery Learning and Control groups are not different.

Ho 17: The difference in achievement gain scores through different learning strategies are not qualified by levels of Perseverance;

- Ho 17.1: With MLS1: High and Low Perseverance students will achieve equal gain scores.
- Ho 17.2: With MLS2: High and Low Perseverance students will achieve equal gain scores.
- Ho 17.3: With CGL: High and Low Perseverance students will achieve equal gain scores.
- Ho 17.4: For High Perseverance, Achievement gain scores through Mastery Learning and Control groups are not different.
- Ho 17.5: For High Perseverance, Achievement gain scores through Mastery Learning and Control groups are not different.
- Ho 17.6: For Low Perseverance, Achievement gain scores through Mastery Learning and Control groups are not different.
- Ho 17.7: For Low Perseverance, Achievement gain scores through Mastery Learning and Control groups are not different.

Ho 18: The difference in achievement scores through different learning approaches are not qualified by levels of Perseverance;

- Ho 18.1: For Deep Approach, Achievement gain scores through High and Low Perseverance are not different.
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♦ Ho 18.2: For Surface approach, Achievement gain scores through High and Low Perseverance are not different.

♦ Ho 18.3: For High Perseverance, Achievement gain scores through Deep approach and Surface approach are not different.

♦ Ho 18.4: For Low Perseverance, Achievement gain scores through Deep approach and Surface approach are not different.

♦ Ho 18.5: For High Perseverance and Deep Approach Achievement scores are not different from Low Perseverance and Surface approach.

♦ Ho 18.6: For High Perseverance and Surface Approach Achievement scores are not different from Low Perseverance and Deep approach.

❖ Ho 19: The difference in achievement scores through different learning strategies are not qualified by different Learning Approaches and Levels of Perseverance;

• Through MLS 1

♦ Ho 19.1: HP / DA students and LP / DA will achieve equal gain means.

♦ Ho 19.2: HP / SA students and LP / SA will achieve equal gain means.

♦ Ho 19.3: HP / DA students will achieve equal gain means as compared to HP/SA students through MLS 1.
Ho 19.4: LP/DA students will achieve equal gain means as compared to LP/SA students through MLS 1.

Through MLS 2

- Ho 19.5: HP / DA students and LP / DA will achieve equal gain means.
- Ho 19.6: HP / SA students and LP / SA will achieve equal gain means.
- Ho 19.7: HP / DA students will achieve equal gain means as compared to HP/SA students through MLS 2.
- Ho 19.8: LP / DA students will achieve equal gain means as compared to LP/SA students through MLS 2.

Through CGL

- Ho 19.9: HP / DA students and LP / DA will achieve equal gain means.
- Ho 19.10: HP / SA students and LP / SA will achieve equal gain means.
- Ho 19.11: HP / DA students will achieve equal gain means as compared to HP / SA students through CGL.
- Ho 19.12: LP / DA students will achieve equal gain means as compared to LP / SA students through CGL.
A summary of Three way analysis of variance is depicted in the following table:

**Table 4.22**

Summary of Three - Way Analysis of Variance (3 x 2 x 2) on Achievement gain Scores

<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>Main Effect</td>
<td>1347.49</td>
<td>2</td>
<td>673.74</td>
<td>87.54 **</td>
</tr>
<tr>
<td>A: Instructional Strategy</td>
<td>1347.49</td>
<td>2</td>
<td>673.74</td>
<td>87.54 **</td>
</tr>
<tr>
<td>MLS 1 vs MLS2 vs CG</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B: Learning Approaches DA vs SA</td>
<td>20.372</td>
<td>1</td>
<td>20.372</td>
<td>2.64</td>
</tr>
<tr>
<td>C: Perseverance</td>
<td>18.988</td>
<td>1</td>
<td>18.988</td>
<td>2.46</td>
</tr>
<tr>
<td>HP vs LP</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Two Order Interactions: A x B</td>
<td>86.20</td>
<td>2</td>
<td>43.10</td>
<td>5.60 **</td>
</tr>
<tr>
<td>Instructional Strategy X Learning Approaches</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A x C</td>
<td>248.95</td>
<td>2</td>
<td>124.47</td>
<td>16.17 **</td>
</tr>
<tr>
<td>Instructional Strategy X Perseverance</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B x C</td>
<td>221.03</td>
<td>1</td>
<td>221.03</td>
<td>28.71 **</td>
</tr>
<tr>
<td>Learning Approaches X Perseverance</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Three Order Interaction: (A x B x C )</td>
<td>324.6</td>
<td>2</td>
<td>162.3</td>
<td>21.08 **</td>
</tr>
<tr>
<td>Within Group (Error)</td>
<td>3371.02</td>
<td>438</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>5668.30</td>
<td>449</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Significant at 0.01 level**

**MAIN EFFECTS**

**MAIN EFFECT A**

MLS 1 Vs MLS 2 Vs CGL

The Table 4.22 reveals that F – ratios for the difference among gain means of the instructional treatment groups (MLS 1, MLS 2 and CGL) groups was found to be significant at 0.01 level of confidence. It means that all the three groups were
significantly different on the achievement gain scores. Hence, the null hypothesis $H_0$ stating that the *instructional treatment yields equal levels of learning outcomes as measured by achievement scores*, was rejected at 0.01 level of confidence. *It may be inferred that the gain means of MLS1, MLS2 and CG may not be considered equal and are different beyond the contribution of chance.*

For the confirmation of results of F - test, t - test was employed and t - ratios for difference in means of various groups were computed and have been recorded in table 4.23.

**Table 4.23**

<table>
<thead>
<tr>
<th></th>
<th>MLS 1</th>
<th>MLS 2</th>
<th>CGL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>131.453</td>
<td>125.460</td>
<td>118.153</td>
</tr>
<tr>
<td>SD</td>
<td>3.150</td>
<td>8.140</td>
<td>9.301</td>
</tr>
<tr>
<td>N</td>
<td>150</td>
<td>150</td>
<td>150</td>
</tr>
<tr>
<td>MLS 1</td>
<td>-</td>
<td>1.776</td>
<td>3.282 **</td>
</tr>
<tr>
<td>MLS 2</td>
<td>-</td>
<td>-</td>
<td>3.842 **</td>
</tr>
<tr>
<td>CG</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

** Significant at 0.01 level; * Significant at 0.05 level

The table 4.23 reveals that the t - ratio for the difference in gain means of MLS1 and MLS2 are not significant even at 0.05 level of confidence concluding that the both the groups did not differ in achievement scores.

- The hypothesis 13.1 stating *MLS 1 and MLS 2 will yield equal gain means* therefore could not be rejected. *It may be inferred that two groups were equal on gain means*
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• The t – ratio for the difference in gain means of MLS1 and CGL was found to be significant at the 0.01 level of confidence suggesting that the differences in gain means were not due to chance factors. The Ho 13.2 MLS 1 and MLS 2 will yield equal gain means was therefore rejected. The means of the two groups were examined and it may be concluded that MLS1 group outperformed (m = 131.453) the CGL group (Mean = 118.153).

• The t – ratio for the difference in gain means of MLS2 and CGL was found to be significant at the 0.01 level of confidence suggesting that the differences in gain means were not due to chance factors. The Ho 13.3 MLS 2 and CGL will yield equal gain means was therefore rejected. It may be concluded that MLS2 group outperformed (Mean = 125.460) the CGL group (Mean = 118.153).

> MAIN EFFECT B:

Deep vs Surface Learning Approaches

The table 4.22 reveals that the F- ratio for the difference in gain means of students with Deep and Surface Learning Approaches, was found to be significant even at the 0.01 level of confidence. This indicates that the gain means of the two groups were not different beyond the contribution of chance. Hence the null hypothesis Ho 14 stating that The Learning Approaches will yield equal level of learning outcomes as measured by achievement scores was not rejected at the specified level. It may be concluded that students with Deep Learning Approaches and Surface Learning Approaches, achieved equal levels of gain means. It may be inferred that the gain means of MLS1, MLS2 and CG may be considered equal and are not different beyond the contribution of chance.

> MAIN EFFECT C:

High Vs Low Perseverance

The table 4.22 reveals that the F- ratio for the difference in gain means of students with High Vs Low Perseverance was not found to be significant even at
the 0.05 level of confidence. This indicates that the gain means of the two groups were not different beyond the contribution of chance. Hence the null hypothesis 
Ho 15 stating that *The Perseverance will yield equal level of learning outcomes as measured by achievement scores* could not be rejected at the specified level. It may be concluded that students with High and Low Perseverance level, achieved equal levels of gain means. It may be inferred that the gain means of DA and SA for the three treatment groups may be considered equal and not different beyond the contribution of chance.

**TWO ORDER INTERACTIONS:**

**TWO ORDER INTERACTION: A x B**

*Instructional Strategy x Learning Approaches*

The table 4.22 shows that the F - ratios for difference in gain means of students due to interaction between two types of Learning Approaches and Instructional Treatment groups (MLS1, MLS 2 & CGL) was found to be highly significant at 0.01 level of significance. The results show that different groups scored different gain means for two types of Learning Approaches and Instructional Strategy. It means that the gain scores due to interaction of treatment strategy (MLS1, MLS2 and CGL) yielded different gain means for students with Deep and Surface learning approaches. The hypothesis *Ho 16 The difference in achievement gain scores through different learning strategies are not qualified by different Learning Approaches* stands rejected as the difference cannot be contributed to chance. To investigate further F – ratio was followed by t – test. t – ratio for the difference in means of different combination pairs of treatment were computed and have been recorded in Table 4.24.
Table 4.24

**t – ratios for different between Means of Different combination pairs of Two Treatment Groups for Achievement Gain Scores**

<table>
<thead>
<tr>
<th>Combination Group</th>
<th>DA</th>
<th>MLS2</th>
<th>CGL</th>
<th>SA</th>
<th>MLS2</th>
<th>CGL</th>
</tr>
</thead>
<tbody>
<tr>
<td>MLS1 Mean</td>
<td>132.398</td>
<td>124.939</td>
<td>118.612</td>
<td>Mean=</td>
<td>131.597</td>
<td>125.969</td>
</tr>
<tr>
<td>SD</td>
<td>3.056</td>
<td>8.077</td>
<td>3.065</td>
<td>SD</td>
<td>8.333</td>
<td>SD</td>
</tr>
<tr>
<td>N</td>
<td>83</td>
<td>82</td>
<td>85</td>
<td>N</td>
<td>67</td>
<td>N</td>
</tr>
<tr>
<td>DA / MLS1</td>
<td>–</td>
<td>4.504**</td>
<td>1.184</td>
<td>0.113</td>
<td>6.811**</td>
<td>4.547**</td>
</tr>
<tr>
<td>DA / MLS2</td>
<td>–</td>
<td>9.637**</td>
<td>–</td>
<td>2.184*</td>
<td>0.449</td>
<td>2.271*</td>
</tr>
<tr>
<td>DA / CGL</td>
<td>–</td>
<td>–</td>
<td>1.1869</td>
<td>1.681</td>
<td>0.252</td>
<td>–</td>
</tr>
<tr>
<td>SA / MLS1</td>
<td>–</td>
<td>–</td>
<td>8.053**</td>
<td>–</td>
<td>2.598*</td>
<td></td>
</tr>
<tr>
<td>SA / MLS2</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>7.515**</td>
<td>–</td>
<td>–</td>
</tr>
</tbody>
</table>

** Significant at 0.01 level * Significant at 0.05 level

Table 4.24 reveals that:

- **With MLS1:**
  
The t-ratios for the difference in achievement gain scores of DA and SA students was not found to be significant even at the 0.05 level of confidence, leading to support the Ho 16.1 With MLS1: Deep and Surface approach students will achieve equal gain scores. It leads to conclude that students with Deep Learning Approach and Surface Learning Approach achieved equal gain means through MLS 1.

- **With MLS2:**
  
The t-ratios for the difference in achievement gain scores of DA and SA students was not found to be significant even at the 0.05 level of confidence, leading to the non rejection of Ho 16.2 With MLS2: Deep and Surface approach...
students will achieve equal gain scores. It may be concluded that students with Deep Learning Approach and Surface Learning Approach achieved equal gain means through MLS 2.

- **With CGL:**
  The t-ratios for the difference in achievement gain scores of DA and SA students was not found to be significant even at the 0.05 level of confidence, leading not to reject Ho 16.3, which state that *With CGL: Deep and Surface approach students will achieve equal gain scores*. It lead to conclude that students with Deep Learning Approach and Surface Learning Approach achieved equal gain means in CGL group.

- **With DA:**
  - The t-ratio for the difference in achievement gain scores of MLS 1 and CGL students was not found to be significant even at the 0.05 level of confidence, leading to not to reject Ho 16.4 *For Deep Approach, Achievement gain scores through Mastery Learning 1 and Conventional groups are not different*. It may be concluded that students with Deep Approach achieved equal gain means through MLS 1 and CGL.
  - The t-ratio for the difference in achievement gain scores of MLS 1 and MLS 2 students was found to be significant even at the 0.01 level of confidence, leading to reject the Ho 16.5 *For Deep Approach, Achievement gain scores through Mastery Learning 1 and MLS 2 groups are not different*. It may be concluded that students with Deep Approach did not achieved equal gain means through MLS 1 and MLS 2. The students with DA / MLS 1 achieved higher gain means (Mean = 132.398) than students with DA / MLS 2 (Mean = 124.939).
  - The t-ratio for the difference in achievement gain scores of MLS 2 and CGL students was found to be significant even at the 0.01 level of confidence and the difference in gain means is beyond the contribution of
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chance. It led to reject the Ho 16.6 For Deep Approach, Achievement gain scores through Mastery Learning 2 and Conventional groups are not different. It may be concluded that students with Deep Approach did not achieved equal gain means through MLS 2 and CGL. The students with DA / MLS 2 achieved higher gain means (Mean = 124.939) than students with DA / CGL (Mean = 118.612)

• With SA:

• The t- ratio for the difference in achievement gain scores of MLS1 and CGL students was found to be significant even at the 0.01 level of confidence, leading to reject the Ho 16.7 For Surface Approach, Achievement gain scores through Mastery Learning 1 and CGL groups are not different. It may be concluded that students with Surface Approach did not achieved equal gain means through MLS 1 and CGL. The students with SA / MLS 1 achieved higher gain means (Mean = 131.597) than students with SA / CGL (Mean = 117.059)

• The t- ratio for the difference in achievement gain scores of MLS1 and MLS 2 students was found to be significant at the 0.01 level of confidence and the difference in gain means is beyond the contribution of chance. It led to reject the Ho 16.8 For Surface Approach, Achievement gain scores through Mastery Learning Strategy 1 and Mastery Learning Strategy 2 groups are not different. It may be concluded that students with Surface Approach did not achieved equal gain means through MLS 1 and MLS 2. The students with SA / MLS 1 achieved higher gain means (Mean = 131.597) than students with SA / MLS 2 (Mean = 125.969).
The t-ratio for the difference in achievement gain scores of MLS2 and CGL students was found to be significant at the 0.01 level of confidence and the difference in gain means is beyond the contribution of chance. It led to reject the Ho 16.9 For Surface Approach, Achievement gain scores through Mastery Learning 2 and Conventional groups are not different. It may be concluded that students with Surface Approach did not achieve equal gain means through MLS 2 and CGL. The students with SA / MLS 2 achieved higher gain means (Mean = 125.969) than students with SA / CGL (Mean = 117.059).

TWO ORDER INTERACTION:  A X C

Instructional Strategy X Perseverance

The table 4.22 shows that the F-ratios for difference in gain means of students due to interaction between two levels of Perseverance and Instructional Treatment groups (MLS1, MLS 2 & CGL) was found to be highly significant at 0.01 level of significance. The results show that different groups scored different gain means for two levels of Perseverance and Instructional Strategy. It means that the gain scores due to interaction of treatment strategy (MLS1, MLS2 and CGL) yielded different gain means for students with High and Low Perseverance. The hypothesis Ho 17 The difference in achievement gain scores through different learning strategies are not qualified by levels of Perseverance stands rejected as the difference cannot be contributed to chance. To investigate further F-ratio was followed by t-test. t-7 ratio for the difference in means of different combination pairs of treatment were computed and have been recorded in Table 4.25.
Table 4.25

**t** – ratio for different between Means of Different combination pairs of Two

Treatment Groups for Achievement Gain Scores

<table>
<thead>
<tr>
<th>Combination Group</th>
<th>High Perseverance (HP)</th>
<th>Low Perseverance (LP)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>MLS1</td>
<td>MLS2</td>
</tr>
<tr>
<td>Mean = Mean = Mean = Mean = Mean =</td>
<td>132.387</td>
<td>122.507</td>
</tr>
<tr>
<td>SD = 2.986</td>
<td>SD = SD = SD = SD =</td>
<td>8.875</td>
</tr>
<tr>
<td>N = 75</td>
<td>N = 75</td>
<td>N = 75</td>
</tr>
<tr>
<td>HP /MLS1</td>
<td>4.527**</td>
<td>1.547</td>
</tr>
<tr>
<td>HP /MLS2</td>
<td>0.070</td>
<td>4.932**</td>
</tr>
<tr>
<td>HP /CGL</td>
<td>1.821</td>
<td>6.195**</td>
</tr>
<tr>
<td>LP /MLS1</td>
<td>2.625**</td>
<td>1.606</td>
</tr>
<tr>
<td>LP /MLS2</td>
<td>6.943**</td>
<td></td>
</tr>
<tr>
<td>LP /CGL</td>
<td>6.195**</td>
<td></td>
</tr>
</tbody>
</table>

** Significant at 0.01 level * Significant at 0.05 level

Table 4.25 reveals that:

- **With MLS1:**
  
  The **t**-ratios for the difference in achievement gain scores of HP and LP students was not found to be significant even at the 0.05 level of confidence, leading to support Ho 17.1 *With MLS1: High and Low Perseverance students will achieve equal gain scores.* It leads to conclude that students with High Perseverance and Low Perseverance achieved equal gain means through MLS 1.

- **With MLS2:**
  
  The **t**-ratio for the difference in achievement gain scores of HP and LP students was not found to be significant even at the 0.05 level of confidence, leading to not to reject of Ho 17.2 which states *With MLS2: High and Low Perseverance students will achieve equal gain scores.*
Perseverance students will achieve equal gain scores. It leads to conclude that students with High Perseverance and Low Perseverance achieved equal gain means through computer based MLS 2.

- **With CGL:**
  
  The t-ratio for the difference in achievement gain scores of HP and LP students was not found to be significant even at the 0.05 level of confidence. It led to the reject the Ho 17.3 *With CGL, High and Low Perseverance students will achieve equal gain scores.* It leads to conclude that students with High Perseverance and Low Perseverance achieved equal gain means in CGL.

- **With HP:**
  
  The t-ratio for the difference in achievement gain scores of MLS1 and CGL students was found to be significant at the 0.01 level of confidence, leading to reject the Ho 17.4 *For High Perseverance, Achievement gain scores through Mastery Learning 1 and Conventional groups are not different.* It may be concluded that students with High Perseverance did not achieved equal gain means through MLS 1 and CGL. The students with HP / MLS 1 achieved higher gain means (Mean = 132.387) than students with HP / CGL (Mean = 119.920).

  The t-ratio for the difference in achievement gain scores of MLS1 and MLS 2 students was found to be significant at the 0.01 level of confidence, leading to reject the Ho 17.5 *For High Perseverance, Achievement gain scores through Mastery Learning 1 and MLS 2 groups are not different.* It may be concluded that students with High Perseverance did not achieved equal gain means through MLS 1 and MLS 2. The students with HP / MLS 1 achieved higher gain means (Mean = 132.387) than students with HP / MLS 2 (Mean = 122.507).
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- The $t$-ratio for the difference in achievement gain scores of MLS2 and CGL students was not found to be significant even at the 0.05 level of confidence. It led to not to reject the \textbf{Ho 17.6 For High Perseverance, Achievement gain scores through Mastery Learning 2 and Conventional groups are not different.} It may be concluded that students with Deep Approach achieved equal gain means through MLS 2 and CGL.

- With LP:
  - The $t$-ratio for the difference in achievement gain scores of MLS1 and CGL students was not found to be significant even at the 0.05 level of confidence, leading to not to reject \textbf{Ho 17.7 For Low Perseverance, scores through Mastery Learning 1 and Conventional groups are not different.} It may be concluded that students with Low Perseverance achieved equal gain means through MLS 1 and CGL.
  - The $t$-ratio for the difference in achievement gain scores of MLS1 and MLS 2 students was found to be significant at the 0.01 level of confidence, leading to reject the \textbf{Ho 17.8 For Low Perseverance, Achievement gain scores through Mastery Learning 1 and MLS 2 groups are not different.} It may be concluded that students with Low Perseverance did not achieved equal gain means through MLS 1 and MLS 2. The students with LP / MLS 1 achieved higher gain means (Mean = 131.883) than students with LP / MLS 2 (Mean = 126.726)
  - The $t$-ratio for the difference in achievement gain scores of MLS2 and CGL students was found to be significant at the 0.01 level of confidence. It led to reject the \textbf{Ho 17.9 For Low Perseverance, Achievement gain scores through Mastery Learning 2 and Conventional groups are not different.} It may be concluded that students with Low Perseverance did not achieved equal gain means through MLS 2 (Mean = 126.726) and CGL (115.920).
TWO ORDER INTERACTION: B X C
Learning Approach X Perseverance

The table 4.22 shows that the F-ratios for interaction between two types of Learning Approaches and Levels of Perseverance was found to be highly significant at 0.01 level of significance. The hypothesis Ho 18 The difference in achievement scores through different learning approaches are not qualified by levels of Perseverance stands rejected, as the difference cannot be contributed to chance. The results show that both the groups scored different means for two types of learning approaches. It means that the gain scores due to interaction of perseverance and learning approaches were different in the groups. To investigate further F-ratio was followed by t-test. $t$-ratio for the difference in means of different combination pairs of treatment were computed to test the alternate Ho 18.1 to 18.4 given in Table 4.26.

Table 4.26
$t$-ratios for different between Means of Different combination pairs for Achievement Gain Scores

<table>
<thead>
<tr>
<th></th>
<th>Deep Approach (DA)</th>
<th>Surface Approach (SA)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>High Perseverance</td>
<td>Low Perseverance</td>
</tr>
<tr>
<td></td>
<td>(HP)</td>
<td>(LP)</td>
</tr>
<tr>
<td>Mean = 131.333</td>
<td>Mean = 118.168</td>
<td>Mean = 131.000</td>
</tr>
<tr>
<td>SD = 3.441</td>
<td>SD = 10.414</td>
<td>SD = 3.057</td>
</tr>
<tr>
<td>N = 117</td>
<td>N = 113</td>
<td>N = 108</td>
</tr>
<tr>
<td>DA / HP</td>
<td>4.962**</td>
<td>0.442</td>
</tr>
<tr>
<td>DA / LP</td>
<td>-</td>
<td>2.982 **</td>
</tr>
<tr>
<td>SA / HP</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>SA / LP</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

** Significant at 0.01 level and * Significant at 0.05 level
The table 4.26 reveals that:

- **With Deep Approach:**

  The t-ratios for the difference in achievement gain scores of **High and Low Perseverant** students was found to be significant at the 0.01 level of confidence. It indicated that the two groups were different on their gain means and it was not only due to chance factor. Thus, leading to the rejection of **Ho 18.1**, which states that **For Deep Approach, Achievement scores through High and Low Perseverance are not different.** It leads to conclude that students with Deep Approach and High Perseverance did not achieve equal gain means (1321.333) as compared to those with Deep Approach and Low Perseverance conditions (131.000).

- **With Surface Approach**

  The t-ratio for the difference in achievement gain scores of High and Low Perseverant students was found to be significant even at the 0.01 level of confidence, leading to reject **Ho 18.2 For Surface approach, Achievement scores through High and Low Perseverance are not different.** It may be inferred that students with High and Low Perseverance achieved different gain means through Surface Approach. The **means of the two groups showed that with Surface Approach, High Perseverant students achieved higher gain means (Mean = 131.000) than those with Low Perseverance (Mean = 116.910).**

- **With High Perseverance**

  The t-ratio for the difference in achievement gain scores of students with Deep and Surface Approach was not found to be significant even at the 0.05 level of confidence, leading not to the reject of **Ho 18.3 stating For High**
Perseverance, Achievement scores through Deep approach and Surface approach are not different. It leads to conclude that students with High Perseverance and Deep Approach (Mean = 131.333) achieved equal gain means to High Perseverance with Surface Approach (131.000).

- **With Low Perseverance**

  The t-ratio for the difference in achievement gain scores of students with Deep and Surface Approach was not found to be significant even at the 0.05 level of confidence, leading not to reject Ho 18.4 as it states that For Low Perseverance, Achievement scores through Deep approach and Surface approach are not different. It leads to conclude that students with Low Perseverance and Deep Learning Approach and those with Low Perseverance and Surface Approach achieved equal gain means.

- **For HP / DA and LP / SA:**

  The t-ratios for the difference in achievement gain scores of HP / DA and LP / SA students was not found to be significant even at the 0.05 level of confidence. Hence, the null hypothesis Ho 11.5 stating that For High Perseverance and Deep Approach Achievement scores are not different from Low Perseverance and Surface approach was rejected at 0.01 level of confidence. It leads to conclude that mean scores of students with High Perseverance and Deep Approach achieved higher gain means (Mean = 131.333) than Low Perseverance and Surface Approach (Mean = 116.911).

- **For HP / SA and LP / DA:**

  The t-ratios for the difference in achievement gain scores of HP / SA and LP / DA students was not found to be significant even at the 0.05 level of confidence. Hence, the null hypothesis Ho 11.6 stating that For High Perseverance and
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Surface Approach Achievement scores are not different from Low Perseverance and Deep approach was rejected at 0.01 level of confidence. It leads to conclude that mean scores of students with High Perseverance and Surface Approach achieved higher gain means (Mean = 131.000) than Low Perseverance and Deep Approach (Mean = 118.168).

➢ THREE ORDER INTERACTIONS

A x B x C:

Instructional Strategy X Learning Approaches X Perseverance

The table 4.22shows that the F – ratio for interaction between two levels of Perseverance, two types of Learning Approaches and Three Treatment groups was found to be highly significant at 0.01 level of significance. The hypothesis Ho 19 The difference in achievement scores through different learning strategies are not qualified by different Learning Approaches and Levels of Perseverance stands rejected as the difference cannot be contributed to chance. To investigate further t – ratios for the difference in means of different combination pairs of treatment were computed to test the following Hypothesis, given in Table 4.27.

Table 4.27 reveals that:

Through MLS 1:

• The t- ratio for the difference in achievement gain scores of HP / DA and LP / DA students was found to be significant at the 0.01 level of confidence, leading to reject the Ho 19.1 HP / DA students and LP / DA will achieve equal gain means. It may be concluded that students with High Perseverance and Deep Approach did not achieved equal gain means from Low Perseverance and Deep Approach. The students with HP / DA achieved higher gain means (Mean = 132.179) than students with LP / DA (Mean = 124.973).
Table 4.27: t-ratio for difference between Means of different combination pairs of three treatment groups in relation to Learning Approaches and Perseverance

<table>
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<tr>
<th>Treatment Combination</th>
<th>t-ratio</th>
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CGL = Conventional Group Learning
MLS1 = Mastery Learning Strategy (with Computer)
MLS2 = Mastery Learning Strategy (without Computer)
...Analysis and Interpretation of Data

- The t-ratio for the difference in achievement gain scores of HP / SA and LP / SA students was found to be significant at the 0.01 level of confidence, leading to reject the Ho 19.2 HP / SA students and LP / SA will achieve equal gain means. It may be concluded that students with High Perseverance and Deep Approach did not achieve equal gain means from Low Perseverance and Deep Approach. The students with HP / SA achieved higher gain means (Mean = 130.667) than students with LP / SA (Mean = 123.179).

- The t-ratio for the difference in achievement gain scores of HP / DA and HP / SA students was not found to be significant even at the 0.05 level of confidence, leading to not reject Ho 19.3 HP / DA students and HP / SA will achieve equal gain means. It may be concluded that students with High Perseverance and Deep and Surface Approach of Learning achieved equal gain means through MLS 1.

- The t-ratio for the difference in achievement gain scores of LP / DA and LP / SA students was not found to be significant even at the 0.05 level of confidence, leading to not reject Ho 19.4 LP / DA students and LP / SA will achieve equal gain means. It may be concluded that students with Low and High Perseverance and Deep and Surface Approach of Learning achieved equal gain means through MLS 1.

Through MLS 2:

- The t-ratio for the difference in achievement gain scores of HP / DA and LP / DA students was found to be significant at the 0.05 level of confidence, leading to reject the Ho 19.5 HP / DA students and LP / DA will achieve equal gain means. It may be concluded that students with High Perseverance and Deep Approach did not achieve equal gain means from Low Perseverance and Deep Approach. The students with HP / DA
achieved higher gain means (Mean = 127.75) than students with LP / DA (Mean = 119.971).

- The t-ratio for the difference in achievement gain scores of HP / SA and LP / SA students was not found to be significant even at the 0.05 level of confidence, leading to support reject Ho 19.6 HP / SA students and LP / SA will achieve equal gain means. It may be concluded that students with High and Low Perseverance and Surface Approach of Learning achieved equal gain means through MLS 2.

- The t-ratio for the difference in achievement gain scores of HP / DA and HP / SA students was not found to be significant even at the 0.05 level of confidence. So, Ho 19.7 HP / DA students and HP / SA will achieve equal gain means., stands not rejected. It may be concluded that students with High Perseverance and Deep and Surface Approach of Learning achieved equal gain means through MLS 2.

- The t-ratio for the difference in achievement gain scores of LP / DA and LP / SA students was not found to be significant even at the 0.05 level of confidence, leading to not to reject Ho 19.8 LP / DA students and LP / SA will achieve equal gain means. It may be concluded that students with Low Perseverance and Deep and Surface Approach of Learning achieved equal gain means through MLS 2.

Through CGL:

- The t-ratio for the difference in achievement gain scores of HP / DA and LP / DA students was not found to be significant even at the 0.05 level of confidence, leading to not to reject Ho 19.9 HP / DA students and HP / SA will achieve equal gain means. It may be concluded that students with High and Low Perseverance and Deep Approach of Learning achieved equal gain means through CGL.
Analysis and Interpretation of Data

- The t-ratio for the difference in achievement gain scores of HP / SA and LP / SA students was found to be significant at the 0.01 level of confidence, leading to reject the Ho 19.10 \( HP / SA \) students and LP / SA will achieve equal gain means. It may be concluded that students with High Perseverance and Deep Approach did not achieve equal gain means from Low Perseverance and Deep Approach. The students with HP / SA achieved higher gain means (Mean = 120.243) than students with LP / SA (Mean = 111.166) through CGL.

- The t-ratio for the difference in achievement gain scores of HP / DA and HP / SA students was not found to be significant even at the 0.05 level of confidence, leading to not to reject Ho 19.11 \( HP / DA \) students and HP / SA will achieve equal gain means. It may be concluded that students with High Perseverance and Deep and Surface Approach of Learning achieved equal gain means through CGL.

- The t-ratio for the difference in achievement gain scores of LP / DA and LP / SA students was found to be significant at the 0.05 level of confidence, leading to reject the Ho 19.12 \( LP / DA \) students and LP / SA will achieve equal gain means. It may be concluded that students with Low Perseverance and Deep Approach did not achieve equal gain means from Low Perseverance and Surface Approach. The students with LP / DA achieved higher gain means (Mean = 119.420) than students with LP / SA (Mean = 111.166) through CGL.

Apart from these t-ratios there were significant differences in means due to following combinations:

- Mastery Learning Strategy1 / Deep Approach / High Perseverance Vs / Mastery Learning Strategy2 / Surface Approach / Low Perseverance
...Analysis and Interpretation of Data

- Mastery Learning Strategy 1 / Deep Approach / High Perseverance Vs / Mastery Learning Strategy 2 / Surface Approach / Low Perseverance
- Mastery Learning Strategy 1 / Surface Approach / High Perseverance Vs / Conventional Group Learning / Surface Approach / High Perseverance
- Mastery Learning Strategy 2 / Surface Approach / High Perseverance Vs / Conventional Group Learning / Surface Approach / Low Perseverance
- Mastery Learning Strategy 2 / Deep Approach / Low Perseverance Vs / Conventional Group Learning / Surface Approach / Low Perseverance
- Mastery Learning Strategy 2 / Deep Approach / Low Perseverance Vs / Conventional Group Learning / Surface Approach / Low Perseverance
- Conventional Group Learning / Deep Approach / High Perseverance Vs / Conventional Group Learning / Surface Approach / Low Perseverance
Conclusions drawn on the basis of results reported in Section C2:

- The achievement gain scores were different for groups of students learning in three different instructional situations.
  - Students of MLS1 and MLS2 did not differ significantly in their achievement gain scores.
  - Students of MLS1 differ significantly in their achievement gain scores from students in CGL.
  - Students of MLS2 and CGL did not differ significantly in their achievement gain scores.

- The students with Deep Learning Approaches and Surface Learning Approaches, achieved equal levels of gain means.

- The students with High and Low Perseverance level achieved equal levels of gain means.

- The interaction effect of three Instructional Strategies and two types of learning approaches yielded significant differences in achievement gain means scores.
  - Through MLS1, Students with Deep Learning Approach and Surface Learning Approach achieved equal gain means.
  - Through MLS2, Students with Deep Learning Approach and Surface Learning Approach achieved equal gain means.
  - Through CGL, Students, with deep learning approach and surface learning approach achieved equal gain means.
  - Deep Approach Students with Mastery Learning Strategy achieved higher gain means as compared to Conventional Group Learning.
...Analysis and Interpretation of Data

- Students with **Deep Approach** achieved equal gain means through **MLS 1 and CGL**.
- Students with **Deep Approach** through **MLS1 and MLS2** differ significantly on gain means.
- Students with **Deep Approach** through **MLS2 and CGL** differ significantly on gain means.
- **Surface Approach** Students with Mastery Learning Strategy achieved higher gain means as compared to Conventional Group Learning.
- Students with **Surface Approach** with **MLS1** differ significantly on gain means from **CGL**.
- Students with **Surface Approach** through **MLS1 and MLS2** differ significantly on gain means.
- Students with **Surface Approach** with **MLS2** differ significantly on gain means from **CGL**.

- The interaction effect of Instructional Strategy and two levels of Perseverance yielded significant differences in achievement gain means scores.
  - **With MLS1**, students with High Perseverance and Low Perseverance achieved equal gain means.
  - **With MLS2**, students with High Perseverance and Low Perseverance achieved equal gain means.
  - **With CGL**, students with High Perseverance and Low Perseverance achieved equal gain means.
High Perseverance students with MLS1, MLS2 and CGL differ significantly in their achieved higher gain means.

Students with MLS1 achieved higher gain means than students with CGL.

Students with MLS1 achieved higher gain means than students with MLS2.

Students with MLS2 achieved higher gain means than students with CGL.

Low Perseverance students achieved equal gain means through MLS and CGL.

Students with MLS1 achieved equal gain means to students with CGL.

Students with MLS1 achieved higher gain means than students with MLS2.

Students with MLS2 achieved higher gain means than students with CGL.

The interaction effect of two levels of Perseverance and two types of learning approaches yielded significant differences in achievement gain means scores.

With Deep Approach, students with High Perseverance did not achieve equal gain means as compared to those with Low Perseverance.

With Surface Approach, High Perseverant students achieved higher gain means than those with Low Perseverance.

With High Perseverance students with Deep Approach achieved equal gain means as compared to with Surface Approach.
Analysis and Interpretation of Data

- With Low Perseverance students with Deep Approach achieved equal gain means as compared to with Surface Approach.

- High Perseverance and studying through MLS and those with Low Perseverance and studying in CGL situation differ significantly in their gain means.

- Low Perseverance and studying through MLS and those with High Perseverance and studying in CGL situation differ significantly in their gain means.

- The interaction effect of three Instructional Strategies, two levels of Perseverance and two types of learning approaches yielded significant differences in achievement gain means scores.

- Through MLS1
  - Students with High Perseverance / Deep Approach achieved higher gain means than students with Low Perseverance / Deep Approach.
  - Students with High Perseverance / Surface Approach achieved higher gain means than students with Low Perseverance / Surface Approach.
  - Students with High Perseverance / Deep Approach did not differ on gain means from students with High Perseverance / Deep Approach.
  - Students with Low Perseverance / Deep Approach achieved equal gain means to students with Low Perseverance / Surface Approach.
...Analysis and Interpretation of Data

- **Through MLS2**
  - Students with **High Perseverance / Deep Approach** achieved higher gain means than students with **Low Perseverance / Deep Approach**.
  - Students with **High Perseverance / Surface Approach** achieved equal gain means to students with **Low Perseverance / Surface Approach**.
  - Students with **High Perseverance / Deep Approach** did not differ on achieved gain means from students with **High Perseverance / Deep Approach**.
  - Students with **Low Perseverance / Deep Approach** achieved equal gain means than students with **Low Perseverance / Surface Approach**.

- **Through CGL**
  - Students with **High Perseverance / Deep Approach** achieved equal gain means to students with **Low Perseverance / Deep Approach**.
  - Students with **High Perseverance / Surface Approach** achieved equal gain means to students with **Low Perseverance / Surface Approach**.
  - Students with **High Perseverance / Deep Approach** did not differ on achieved gain means from students with **High Perseverance / Deep Approach**.
  - Students with **Low Perseverance / Deep Approach** achieved higher gain means than students with **Low Perseverance / Surface Approach**.

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DISCUSSION ON RESULTS

Discussion of the results based on the Gain scores

In the present investigation achievement gain scores were studied in respect of three learning situations i.e. Mastery Learning 1, Mastery Learning 2 and Conventional Group Learning. The analysis was done:

(i) Gains due to Mastery Learning (MLS 1 and MLS 2 pooled together) as against Conventional Group in relation to Perseverance and Learning Approaches.

(ii) Gains due to MLS1 and MLS2 as against Conventional Group in relation to Perseverance and Learning Approaches.

➤ Discussion on Gain scores of 2 X 2 X 2 Analysis

The results of this study pertaining to MLS Vs CGL were found to impact the gain scores. Pooled gain scores of all students learning through Mastery Learning (With and Without computers) performed better as compared to Conventional Group Learning situation. The Ho 6: The instructional treatment yields equal levels of learning outcomes as measured by achievement scores were rejected in favour of superiority of MLS over CGL. The results also reveal that there is consistently a positive effect of strategy on learning. The results of the presentation investigation were supported by research findings of:

Kulik, Chen-Lin C. et al (1990) did a meta-analysis of findings from 108 controlled evaluations. It showed that mastery learning programs have positive effects on the examination performance of students in colleges, high schools, and the upper grades in elementary schools.

Reezigt, Gerry J.; Weide, Marga G. (1990) did a study as a part of an educational reform in the Netherlands, in which teachers were required to
implement models of adaptive instruction, including group-based mastery learning. When the effects of other forms of adaptive learning (ability grouping and individualized instruction) were studied, mastery learning was the only form that did not lead to lower achievement scores than did class instruction.

Obando, Ligia Torres; Hymel, Glenn M. (1991) studied the relationship between instructional treatment manifested as mastery learning and non-mastery learning strategies and various measures of Spanish proficiency was studied with 41 freshmen at an all-female high school in the New Orleans (Louisiana) area. Analysis of covariance and correlated groups t-tests suggest significant achievement scores and time invested favoring the mastery approach, but non-significant differences regarding perseverance.

Anderson, Stephen A. et al (1992) conducted a field experiment in Yale Public Schools (Yale, Michigan) in implementing mastery learning. Significant gains in achievement were found for both mastery learning units and self-efficacy.

Blakemore, Connie L. et al (1992) compared psychomotor skill performance in isolation and in competitive game situations with seventh grade boys taught basketball using Bloom's mastery learning model or non-mastery procedures. Mastery subjects surpassed control and non-mastery groups on all skills performed in isolation.

Obach, Mifrando S.; Moely, Barbara E. (1993) did a study of metacognition and motivation exploring variations over time in the relationships between children's metacognitions about their study activities and various components of motivation for achievement. Results confirmed a positive relationship between reported strategy use and task mastery orientation; children who reported strategy use in the fall tended to be task-mastery oriented in the spring; and children who were mastery oriented in the fall reported greater strategy use in the spring.
Mevarech, Zemira R.; Susak, Ziva (1993) examined the effects of cooperative-mastery learning (CML) on student's questioning behavior, creativity, and achievement. Comparisons of controls and students trained to generate questions under CML, mastery learning, and cooperative learning (CL) indicated that CML and ML students scored higher on measures of higher order questioning skills and originality.

Lazarowitz, Reuven; and Others (1994) reported on a study designed to determine whether academic achievement of students taught in the cooperative group mastery mode would be different from the achievement of students who learn in an individualized method and to determine whether gains or losses would be seen in nonacademic outcomes such as social relations, self-esteem, and classroom learning environment. Results support cooperative learning.

Whiting, Bryan; et al (1994) while studying Mastery Learning: Thousands of Students, Thousands of Excellent Learners investigated that the level of mastery had no effect on students' grades. Mastery learning produced successful learning experiences for at least 80 percent of the students. The study results supported the concept that mastery learning can be effective in subjects other than those that are hierarchically organized.

Waddington, Tad S. H (1995) investigated that it is argued that mastery learning is one explanation for the documented differences in mathematics achievement between Japanese and American students. A meta-analysis of studies of elementary mathematics achievement supports the research findings of H. W.

Lange, Garrett W.; Adler, Francesca (1997) examined the role of motivational factors on the academic achievement of children in the 3rd, 4th, and 5th grades. Results of parent, teacher, and child measures indicated that intrinsically goal-oriented children tended to have high academic self-concepts, exhibited high levels of mastery behaviors in the classroom, and scored well on
school achievement tests. Achievement levels were found to be a joint result of ability and motivation, and mastery behaviors in the classroom were the link between intrinsic goal orientation and achievement, and between self-concept in the classroom and achievement. The behavioral measure of children's mastery was the most important indicator of achievement. When judgments of the children's abilities were taken from classroom teachers and from parents, it was found that teachers views were more highly associated with achievement levels.

**Litteral, Diana B (1998)** designed practicum to increase concept mastery of 11th grade chemistry students by improving instruction, motivation, and writing skills. There was an increase in the number of correct multiple choice items on content-mastery tests and an increase in volunteered answers. Student essay writing scores improved as well.

**Aviles, Christopher B. (2001)** did a study of Mastery Learning versus Non-Mastery Learning Instruction in an Undergraduate Social Work Policy Class. All of the students preferred mastery instruction. Mastery and non-mastery instruction involved similar amounts of instructor time, but the mastery instructor reported increased classroom time efficiency and coordination between teaching and testing. Mastery learning should be considered a promising instructional method for social work education.

**He, Tung-Hsien (2005)** studied the Effects of Mastery and Performance Goals on the Composition Strategy Use of Adult EFL Writers. This study examines the combined effects of contrasting mastery and performance goals on the use of composition strategies by adult writers of English as a Foreign Language (EFL). Evidence from think-aloud protocols indicated that (a) participants used 20 distinctive strategies classified into five categories; (b) the HMLP group used monitoring/evaluating, revising, and compensating strategies significantly more often than the LMHP group; and (c) the frequency of revising
strategies and mastery orientations served as two significant positive predictors for better writing outcomes.

**Singer-Dudek, Jessica; Greer, R. Douglas (2005)** did a *Long-Term Analysis of the Relationship between Fluency and the Training and Maintenance of Complex Math Skills*. In 2 experiments, each involving different mathematical operations, we compared 2 training procedures for teaching component math skills in terms of their effects on the learning and long-term maintenance of composite skill. Results showed that fluency instruction did not result in fewer learn units to criterion on the composite task. However, 2 months later, the fluent students performed between 83% and 100% correct on the composite task, while the mastery students performed between 17% and 83% correct.

**Thompson, Ted; Musket, Sarah (2005)** studied *Does Priming for Mastery Goals Improve the Performance of Students with an Entity View of Ability?*. Participants were 48 students with an entity view of ability, and 48 students with an incremental view of ability. Method. Conclusions: These findings confirm theeffects consequences of social comparison goals for participants with an entity view of ability, suggesting benefits in encouraging these students to pursue mastery goals.

**Tanaka, Ayumi; Takehara, Takuma; Yamauchi, Hirotsugu (2006)** did a study to test the linkages between achievement goals to task performance, as mediated by state anxiety arousal. Performance expectancy was also examined as antecedents of achievement goals. A presentation task in a computer practice class was used as achievement task. Fifty-three undergraduates (37 females and 16 males) were administered self-report questionnaire measures before and immediately following the task performance. As expected, results of regression analyses showed that performance-avoidance goals were positively related to state anxiety. State anxiety was related to poor task performance. The positive relationship between mastery goals and the task score was shown to be
independent of anxiety processes. Performance expectancy was related to state anxiety through achievement goals.

But some of the researchers reported that the achievement of the students is not different through MLS or CGL. The achievement of the students do not differ, even if they study either through MLS or CGL. It is supported by Blakemore, Connie L. et al (1992) compared psychomotor skill performance in isolation and in competitive game situations with seventh grade boys taught basketball using Bloom's mastery learning model or non-mastery procedures. Mastery subjects surpassed control and non-mastery groups on all skills performed in isolation. No significant differences existed in skill performance in competitive game situations.

Stevenson and S. Y. Lee (1990) explored that the overlapping confidence intervals of Japanese mathematics performance and mastery learning do not support a positive conclusion that mastery learning caused the differences, but they do indicate that there is a potential relationship.

In this set of analysis too, gain means due to MLS1 or MLS2 were found to be higher than the conventional group learners. So, the **Ho 13: The instructional treatment will yield equal level of learning outcomes as measured by achievement scores** was rejected emphasizing that the achievement of the students is effected by Learning strategy. Even the research studies support that MLS1 (MLS with computers) impact the achievement of the students. The results of present investigation too support the effectiveness of Mastery Learning using computers as a measure to teach in the classroom. The students with MLS1 outshined conventional group as the students work at their own pace till the task is accomplished.

It may be argued that the MLS provide a better platform to learn as student is not asked to go further till he/she achieves the mastery of the previous lesson. Hence, enhancing the performance of the students. An inbuilt structure in Mastery Learning Strategy involves quality instruction → Diagnostic Formative Testing
Remediations ➔ Retesting till each student is able to achieve 100 percent. Hence, in almost all the scores the students exhibit higher strides of achievement. An additional component in this study was the Computer assistance for implementing Mastery Learning. This in turn seems to have imparted achievement positively. It was absolutely a novel experience for the students to go through Mastery Learning, that too through computers. In fact the enthusiasm, which was around due to this strategy, perhaps their level of performance. This proved through 3 x 2 x 2 ANOVA on gain scores.

**Hicken, Sam (1991)** conducted a study on *learner control and incentive in CAI*. This study investigated the effects of two general approaches to the provision of learner control and of two types of incentive on achievement use of options and attitude in CAI. Learner control results indicated that posttest scores for the FullMinus treatment were higher than those for Leanplus treatment and that the FullMinus groups had more positive attitudes.

**Clayton, Ida Long (1992)** conducted a study entitled *the relationship between CAI in reading and mathematics achievement and selected student variables*. This study was designed to determine the effectiveness of CAI on reading and mathematics achievement, attitude toward reading and mathematics, and the effect of CAI on reading and mathematics achievement, attitude for low socioeconomic students. The study involved students in grade 2-5 in five elementary schools. Findings indicate that CAI improved reading for students at the fourth-grade level, and increased positive attitude toward reading for third and fourth grade students in the low socioeconomic category. The CAI students in grade 2, 4 and 5 made significant gains in mathematics achievement.

**Abadir, Laila et al (1993)** discussed the effects of mastery learning strategies, interactive video mathematics (IVM), individualized instruction (IND), and the lecture method on mathematics achievement of community college students was studied. IVM and IND methods had a positive educational influence
on students' achievement on mathematics basic skills posttest scores, but, because many of these students did not complete the course in 10 weeks, grade success rate was significantly lower for these methods than for the lecture method. No significant difference was found for gender on the main effects, but a significant difference for simple effects shows that males favor the IVM method. Those over 22 years old had higher achievement than did those in the traditional college age group.

**Pamula, Frederick (1994)** discussed the use of a computer simulation program in teaching the concepts of spectrophotometry. It introduces several parts of the program and program usage. This presents an assessment activity to evaluate students' mastery of material. It concludes with the advantages of this approach to the student and to the assessor.

**Lamb, C.M. (1995)** studied computer - integrated learning system and elementary student achievement in mathematics: an evaluation study. The results showed that the gains of students using the computer were greater than the gains of earlier classes. Higher achieving student's mean scores increased more than average student's scores. Average achieving student's scores increased more than the low achieving students. Females in low achieving groups had greater gains than males.

**Laney, James D. et al (1995)** explored the effects of cooperative and mastery learning methods, alone and in combination, on first and second grade students' learning and retention of basic economic facts. The study suggests that the cooperative-mastery learning method is in line with current early childhood practices and has the capacity for simultaneously boosting the conceptual development and language development of young children.

**Schalago-Schirm, Cynthia (1995)** investigated does the Computer-Assisted Remedial Mathematics Program at Kearny High School Lead to Improved Scores on the N.J. Early Warning Test? The computer instruction
provided is specifically designed to help students attain proficiency on the mathematics portion of a state-mandated high school proficiency exam. Results indicated a statistically significant gain but more than 50% of the sample still needed further remediation.

Lafronza, V.N. (1997) conducted a study on the interaction of adult learning styles and instructional design: implications for the design of computer assisted instruction. The results indicate that cognitive styles play a significant role in adult learner's performance, at least in CAI learning environment.

Clawford, Oliver Gahlen (1998) did an analysis of the effects of a learning style seminar and a computer assisted instruction package on the academic achievement of selected seminary students. The results concluded that the student's academic achievement was positively affected by participation in the learning style seminar, utilization of the CAI package, and combining the participation in the learning style seminar with the utilization of the CAI package.

Ford, Barbara; Klicka, Mary Ann (1998) An individualized Computer Assisted Instruction (CAI) mastery learning format was offered to sections of Fundamentals of Mathematics and Basic Algebra courses over four semesters (two academic years). The effectiveness of this method compared to a traditional lecture approach was examined in the areas of passing the course, passing the final examination, course retention, and passing the next math course CAI sections had significantly higher exam pass rates.

Brophy, K.I. (1999) while studying "Is computer assisted instruction effective in the science classroom?" concluded that CAI can be effective in the classroom if used properly by the teacher.

Chan, J.S. (1999) studying the predictors of achievement using CAI: self efficacy for achievement and control of learning beliefs concluded that there was no significant positive relation between time spent using CAI and prior
knowledge, self efficacy and control of learning beliefs. From the results of the exploratory analyses, rehearsal, elaboration and critical thinking were more likely to be used by students using CAI.

**Kuchler, J.M. (1999)** studied the effectiveness of using computers to teach secondary school (grade 6-12) mathematics: A meta-analysis. The results suggest that CAI has only an overall small positive effect on mathematics achievement but a possible medium positive effect on retention of mathematical concepts and skills of secondary school students. The most effective CAI mode appears to be 'drill and practice'. CAI appears to be equally effective across gender and grade level, but has a greater positive impact on students from low socio-economic backgrounds.

**Penn & Nedeff (2000)** describe a Web-based system for organic chemistry. They demonstrate higher earned test scores for those students making the largest number of attempts on Web-based practice system.

**Rick Mills (2001)** conducted *A comparison study of learning effectiveness of CAI vs. Classroom lecture*. He investigated the effectiveness of using CAI for skill training in the workplace. Manufacturing employees received electrical training using CAI or classroom lecture. Learning, satisfaction, and cost of each method were measured. CAI was found as effective as classroom for factual topic, but not as effective theoretical topics. CAI learning required less time for factual topics, but more time overall and for theoretical topic.

**Panarat Sangvichit (2002)** conducted a study entitled *The development of CAI in higher vocation certificate curriculum for business computer of computer network*. With the 35 students who have never learned computer network. The computer assisted instructions for business computer of computer network in higher vocational certificate curriculum concluded that researcher had built and developed take the effectiveness of standard 85.7/85.44. so, this CAI can be used in classes.
**Anderson Mark Busey (2003)** conducted a study entitled *Features of Programmed Logic for the Automatic Teaching Operations (PLATO), a CAI learning system, that promote student’s mathematics achievement. A literature review.* Studies and analyses sought evidence in support of computer assisted instruction (CAI) program, in general. PLATO, specifically, has gathered much attention as an alternative educational solution to traditional instruction. However, a limited population of students seemed to have benefited from the use of PLATO program. Hence, questions of equity and access were addressed.

**Pol, Henk; Harskamp, Egbert; Suhre, Cor (2005)** developed a computer program about the subject of forces containing hints for the various different episodes of problem-solving. It appeared that pupils involved in the experiment made better use of their declarative knowledge in solving problems than pupils from the control group.

**Cepni, Salih; Tas, Erol; Kose, Sacit (2006)** conducted a study to investigate the effects of a Computer-Assisted Instruction Material (CAIM) related to "photosynthesis" topic on student cognitive development, misconceptions and attitudes. After the treatment, general achievement in PAT increased by 10% in favour of experiment group (EG) at (p<0.05) significant level. Although the increase in cognitive development at knowledge level was 14.8% in the EG and 18.2% in the control group (CG), the development at comprehension and application levels were 19.8-18.5 in the EG and 1.75-0.86 in the CG, respectively. This result showed that using CAIM in teaching photosynthesis topic was very effective for students to reach comprehension and application levels of cognitive domain. However, CAIM did not change major misconceptions related to photosynthesis topic in EG as expected. Meanwhile, same misconceptions in EG about source of energy for plants and their nutrition were decreased more than CG.

But, there are research studies, which support this hypothesis that the achievement of the students do not differ in MLS1 and CGL situations. The
findings that support are: Coorough, Randall Phillip (1990) conducted a study entitled *the effects of program control, learner control and learner control with advisement lesson control strategies on anxiety and learning from CAI*. The purpose of this study was to examine the effects of three CAI locus of instructional control strategies on anxiety and learner achievement. The three CAI locus of instructional control strategies examined were learner control (LC), learner control with advisement (LCA) and program control (PC). The subjects in this study (N = 106) were undergraduate students enrolled in a general humanities course. The results of the study indicated that there was no significant achievement difference between subjects assigned to PC, LC and LCA locus of instructional control strategies.

Rick Mills (2001) conducted *A comparison study of learning effectiveness of CAI vs. Classroom lecture*. He investigated the effectiveness of using CAI for skill training in the workplace. It was revealed that CAI was found as effective as classroom for factual topic, but not as effective theoretical topics.

Zhang, Yixin (2005) determined the effectiveness of computer-assisted instruction (CAI) versus traditional lecture-type instruction on triangles. The analysis revealed that there was no statistically significant difference between the students' achievement in the control and experimental groups. The result implies that teachers could use computer-assisted instruction software only as a supplemental tool.

Cepni, Salih; Tas, Erol; Kose, Sacit (2006) conducted a study to investigate the effects of a Computer-Assisted Instruction Material (CAIM) related to "photosynthesis" topic on student cognitive development, misconceptions and attitudes. The result showed that using CAIM in teaching photosynthesis topic was very effective for students to reach comprehension and application levels of cognitive domain. However, CAIM did not change major misconceptions related to photosynthesis topic in EG as expected. Meanwhile, same misconceptions in
EG about source of energy for plants and their nutrition were decreased more than CG.

The results of analysis performed on achievement gain scores for on types of Learning Approaches (Deep and Surface) were not significantly different. The mean scores of two groups were equal however both the groups worked in different learning situations i.e. Mastery Learning or Conventional Group Learning. Hence, students showed difference in gain scores. So, this led to rejection of the Ho 9: The difference in achievement scores through different learning strategies are not qualified by different Learning Approaches and Ho 14: The Learning Approaches will yield equal level of learning outcomes as measured by achievement scores.

The interaction effect of these variables was significant. The interaction effect of Mastery Learning and different types of learning approaches was significant, inferring that the achievement gain scores for Deep and Surface Approaches of Learning were higher through MLS as compared to CGL. This can be explained with the fact that learning approaches alone could not affect the achievement of the students. But, when it gets a support from the learning situation (MLS), its impact was conspicuous. There is ample evidence to support this interaction. The results of the present investigation are supported by: Garcia, Teresa; Pintrich, Paul R. (1992); Lai, Patrick; Biggs, John (1994); Drew, Po Yin; Watkins, David (1997); Chin, C. Hui Li (1998); Humphreys, B. K. (1998); Kajic, S. I. (1998); Watkins and Wong (1998); Yildirim, Ali; Somuncuoğlu, Yesim (1998); Chin, Christine (1999); Van Melle, Elaine Patricia (2000); Behrens, Holly Marie (2001); Evans, Christiana Janet (2001); Byrne, Marann; Flood, Barbara; Willis, Pauline (2004); Karagiannopoulou, E.; Christodoulides, P. (2005); Murphy, Suzanne M.; Tyler, Sheila (2005); Wilson, Keithia; Fowler, Jane (2005); Moos, Daniel C.; Azevedo, Roger (2006); Spada, Marcantonio M. et al (2006); Struyven, Katrien et al (2006).
Analysis and Interpretation of Data

However, some evidences of research studies are there which support that achievement is not affected by types of Learning Approaches or the Learning Strategy. The studies that support this are: Britton, L.A (1999); Salinkumar, C (1999); Yin, Lai Po (1999).

It may be argued that the approach to learning (Deep and Surface) do affect achievement with different instructional strategies. When, one has to master the concepts and retain it for a longer time, one has to employ a particular approach to learning. This seems to be more applicable in case of Mastery Learning Strategy rather than for Conventional Group Learning.

Similarly, analysis on performed on achievement gain scores for on levels of Perseverance (High and Low) were not significantly different. The gain mean scores of two groups (Main effect) were equal however both the groups when worked in different instructional situations i.e. Mastery Learning or Conventional Group Learning. The results were significantly higher. So, this led to rejection of the Ho 10: The difference in achievement scores through different learning strategies are not qualified by levels of Perseverance and Ho 15: The Perseverance will yield equal level of learning outcomes as measured by achievement scores.

The interaction effect of these variables was however, significant. The interaction effect of Instructional strategies (Mastery Learning Strategy 1, Mastery Learning Strategy 2 Conventional Group Learning) and different levels of Perseverance was significant, inferring that the achievement gain scores for High and Low Perseverance were higher through MLS as compared to CGL. The students showed difference in gain scores. High persistence students performed than low Persistence students. It may be because persistence may help the learner to remain on the task and complete it even if with more time. In MLS1 (CAI) the learner works till he achieve 100 percent and this is allowed through self-pacing and the actual time that he needs to accomplish the task. There is ample evidence...

The interaction between Learning Strategy, Learning Approach and Perseverance was also significant leading to reject the Ho 12: The difference in achievement scores through different learning strategies are not qualified by different Learning Approaches and Levels of Perseverance and Ho 19: The difference in achievement scores through different learning strategies are not qualified by different Learning Approaches and Levels of Perseverance.

The relationship between these three variables has rarely been considered before, as they emanate from research areas that have remained distinct. It may be argued that Persistence level and Learning Approach of the learner gives a boost to accomplish a task. Requirement of each individual task in Mastery Learning requires not to be persistent but also an appropriate learning approach. If a students with deep approach of learning has a high perseverance level and tries Mastery Learning Startegyl (MLS with Computer Assisted Instruction), it is bound to give extraordinary results which is really true in this case.

Looking at the results in the global way, MLS (with computers) has not only proved to be a better strategy but may also lead to enhance persistence and Learning approaches. But this kind of generalization is possible if such kind of research studies are conducted on larger samples at varied levels.

The results of the present investigation have triggered a thought in this direction which should be carried further.