CHAPTER – V

ANALYSIS AND INTERPRETATION

OF DATA
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ANALYSIS AND INTERPRETATION OF DATA

5.1 INTRODUCTION

‘All meanings, we know, depend on the key of interpretation.’

-George Eliot

This chapter deals with analysis and interpretation of the data collected during the study. Analysis of data means studying the tabulated material in order to determine the inherent facts or meanings. It is a process which involves breaking down the existing complex factors into simpler parts and putting the parts together in new arrangements for the purpose of the study and presents the results in an organized and meaningful form.

The purpose of the interpretation is essentially stating what the results show, what they mean, what their significance is and what the answer to the original problem is. This process calls for a critical examination of the result of one’s analysis in the light of this or the previous analysis concerning the collection of data. In accordance with the objectives of the present study, the data was gathered, tabulated, classified and analyzed statistically and objectively.

In the present investigation, the investigator uses descriptive statistics and differential statistics to determine the effectiveness of the interactive multimedia CD based learning courseware.
5.2 DESCRIPTIVE ANALYSIS

The descriptive analysis involves the measures of central tendency and measures of variability. These two are useful to study the nature of the distribution of any variable. The computed values of mean, standard deviation, co-efficient of variation and gain score are used to describe the properties of the particular sample. Also the descriptive statistics served as inputs for further inferential analysis.

5.3 DIFFERENTIAL ANALYSIS

The differential analysis involves the most important process by which the investigator is able to inference involving the determination of the statistical significant difference between the groups with reference to selected variable.

In the present study the investigator applied

(i) Wilcoxon Signed Rank Test to test the significant difference between
the scores of the control group and the scores of experimental group.

(ii) Mann-Whitney U-Test to test the significant difference between the scores of the control group and the experimental group.

5.3.1 WILCOXON SIGNED RANK TEST

It is used to test the difference between two related sets of rankable scores, the two observations being made either on the same or the matched subjects (Louis Cohen and Michael Holliday 1979).
The following steps are used in the Wilcoxon Signed Rank Test

a. For each subject of pair determine the difference in scores (d)

b. Rank these differences ignoring the plus or minus signed and differences of ‘0’ (zero). When ranks are tied assign the average of the tied ranks.

c. Assign each rank the ‘+’ or ‘-’ sign of difference it represents.

d. Mark the ranks with less frequent sign.

e. Total (T) the ranks with less frequent sign.

f. If the estimated ‘T’ value is less than that in the table there is a significant difference between the sets of scores at that level.

g. The table value for the Wilcoxon Signed Rank Test should be found out based on ‘n’. In the calculation the pairs whose ‘d’ value is zero should be dropped out to determine ‘n’.

The investigator used online calculator graphpad.com in the website graphpad.com to find the value of Wilcoxon Signed Rank Test.

5.3.2 MANN-WHITNEY U-TEST

It is useful non-parametric alternatives to the t-test for uncorrelated data when the assumptions of the t-test are not met (Louis Cohen and Michael Holliday, 1979).

The following procedure is used when Mann-Whitney U-Test is applied.

a. Rank all the scores as though they are in one group, giving rank ‘1’ to the test which are tied, assign the average of the tied ranks.

b. Sum up the ranks for each group.
c. Compute U from the formulae

\[
U = \frac{N_1N_2 + N_1(N_1+1)}{2} - R_1 \text{ (Formula A)}
\]

\[
U = \frac{N_1N_2 + N_2(N_2+1)}{2} - R_2 \text{ (Formula B)}
\]

Where \( R_1 \) = Sum of ranks for control group with \( N_1 \) subjects

\( R_2 = \) sum of ranks for experimental group with \( N_2 \) subjects

d. If the value of ‘U’ in the table is larger than the smaller estimated value for the particular size of samples, then there is a significant difference between the groups.

5.4 CLASSIFICATION AND TABULATION OF DATA

In the present investigation, the scores obtained by both control group and experimental group in their pre-test and post-test are tabulated. Moreover, the attitudes courses of the experimental groups are also tabulated for the analysis and interpretation.

5.4.1 DESCRIPTIVE ANALYSIS

Computation of Achievement of Control and Experimental Groups in the Pre-test

Table 5.1 Shows the descriptive analysis of achievement of control and experimental group in pre-test.
Table 5.1: Descriptive Analysis of Achievement of both Control and Experimental Groups in Pre-test.

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>S.D</th>
<th>C.V</th>
<th>Max. Score</th>
<th>Minimum Score</th>
<th>Mid Value</th>
<th>Mean Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>25</td>
<td>20.44</td>
<td>3.16</td>
<td>15.46</td>
<td>50</td>
<td>0</td>
<td>21</td>
<td></td>
</tr>
<tr>
<td>Experimental</td>
<td>25</td>
<td>23.52</td>
<td>5.28</td>
<td>22.45</td>
<td>50</td>
<td>0</td>
<td>22</td>
<td>3.08</td>
</tr>
</tbody>
</table>

The achievement scores of control and experimental group in the pre-test were analyzed using descriptive statistics. The mean and standard deviation of the achievement scores in the pre-test of the control group is found to be 20.44 and 3.16 respectively for N=25. The mean and standard deviation of the experimental group for the same pre-test is found to be 23.52 and 5.28 respectively for N=25. It is found that the mean achievement scores of both control and experimental group are below the mid value for the pre-test. Also the coefficient of variation for the pre-test of the control and experimental group were found to be 15.46 and 22.45 respectively which reveals that the achievement is low for the groups. Now the researcher is interested in finding out the mean difference in achievement scores between the control group and experimental group. The mean difference of experimental and control group is found to be 3.08 for the sample of 25, which is very lower compare to the mid value.
Computation of Achievement of the Control Group Post-test and Experimental Group in Post-test –II.

Table : 5.2 Shows the descriptive analysis of the achievement of both control group and experimental group in the post-test and post-test-II respectively.

Table 5.2 : Descriptive Analysis of Achievement of Control Group Post-test and Experimental Group Post-test II.

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>S.D</th>
<th>C.V</th>
<th>Max. Scores</th>
<th>Minimum Score</th>
<th>Mid Value</th>
<th>Mean Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>25</td>
<td>26.00</td>
<td>2.75</td>
<td>10.58</td>
<td>50</td>
<td>0</td>
<td>26</td>
<td></td>
</tr>
<tr>
<td>Experimental</td>
<td>25</td>
<td>37.48</td>
<td>6.02</td>
<td>16.06</td>
<td>50</td>
<td>0</td>
<td>38</td>
<td>11.48</td>
</tr>
</tbody>
</table>

The achievement of control group post-test and experimental group post-test II are analysed using descriptive analysis. The mean and standard deviation of control group post-test is 26.00 and 2.75 whereas for the experimental group is 37.48 and 6.02 for N =25 in post-test II. This shows that the mean achievement scores of the experimental group is more or less equal value. Also the co-efficient of variation of the post-test of control group and post-test II of the experimental group are 10.58 and 16.06 respectively, reveals that the achievement of the control group is low and it is highly improved in experimental group after the treatment of interactive multimedia.
CD based learning. The researcher is interested in finding the mean difference between the post-test mean score of the control group and the post-test - II mean score of the experimental group. It is obtained as 11.48 for the sample N=25, indicates that the experimental group has scored higher in post-test II than the control group post-test.
Graph: 5.2
Graph Showing Mean and Standard Deviation Difference in the Post-test Control Group and Post-test II of the Experimental Group.
Computation of Achievement of the Experimental Group for Post-test I and Post-test II.

Table: 5.3 Shows the descriptive analysis achievement of Experimental group in the post-test I and post-test II.

Table: 5.3 Descriptive Analysis of Achievement of Experimental Group for Post-test - I and Post-test - II.

<table>
<thead>
<tr>
<th>Test</th>
<th>N</th>
<th>Mean</th>
<th>S.D</th>
<th>C.V</th>
<th>Max Scores</th>
<th>Minimum Score</th>
<th>Mid-value</th>
<th>Gain Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Post-</td>
<td>25</td>
<td>32.96</td>
<td>5.78</td>
<td>17.54</td>
<td>50</td>
<td>0</td>
<td>33</td>
<td>4.52</td>
</tr>
<tr>
<td>Test I</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Post-</td>
<td>25</td>
<td>37.48</td>
<td>6.02</td>
<td>16.06</td>
<td>50</td>
<td>0</td>
<td>38</td>
<td></td>
</tr>
<tr>
<td>test II</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The achievement of post-test- I and post-test –II of the experimental group were analyzed descriptively. The mean and standard deviation of achievement scores in post-test I is 32.96 and 5.78 post-test II are found to be 37.48 and 6.02 for N=25. This indicates that the mean achievement scores of the experimental group are above more or less equal the mid-value for both post-test I and post-test II. Also the co-efficient of variation for post-test I and post-test II of the experimental group are 17.54 and 16.06 respectively, reveals that the achievement in post-test II is improved that in post-test I. The gain mean achievement score of the experimental group for post-test I and the post-test II are calculated. It is found to be 4.52 for the sample 25, reveals that the
achievement of experimental group is gradually improved during the treatment. This shows that the CD based learning course ware makes positive changes in the achievement of experimental group.

**Graph : 5.3**

*Graph Showing Mean and Standard Deviation in the Post-test I and Post-test II of Experimental Group*
Computational of Attitude of Experimental Group towards the Interactive Multimedia CD Based Learning before and after Treatment

Table : 5.4 Shows the description analysis of attitude of experimental group towards the interactive multimedia CD based learning.

Table : 5.4 Descriptive Analysis of Attitude of Experimental Group towards the Interactive Multimedia CD Based Learning

<table>
<thead>
<tr>
<th>Treatment</th>
<th>N</th>
<th>Mean</th>
<th>S.D</th>
<th>C.V</th>
<th>Max Score</th>
<th>Minimum Score</th>
<th>Mid-Value</th>
<th>Gain Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-treatment</td>
<td>15</td>
<td>135.53</td>
<td>5.58</td>
<td>4.12</td>
<td>250</td>
<td>50</td>
<td>136</td>
<td>31.2</td>
</tr>
<tr>
<td>Post-treatment</td>
<td>15</td>
<td>166.73</td>
<td>7.08</td>
<td>4.25</td>
<td>250</td>
<td>50</td>
<td>168</td>
<td></td>
</tr>
</tbody>
</table>

The attitude of the experimental group before and after treatment is analysed using descriptive statistics. The mean and standard deviation of the attitude scores in the pre and post-treatment are found to be 135.53, 5.58 and 166.73, 7.08 respectively for N=25. This shows that the mean attitude scores of the experimental group are more or less equal mid-value for both prior to treatment and after-treatment. The gain mean attitude score of the experimental group was calculated. It is obtained as 31.2. The range fixed for the attitude scale (i.e) from 50 to 250, indicates that 31.2 is a good index of gain. It is concluded that the attitude of the experimental group is improved in the after
treatment than its score on the pre-treatment. This shows that the interactive multimedia CD based learning courseware makes attitudinal changes in the experimental group.

**Graph : 5.4**

*Graph Showing Mean and Standard Deviation of Pre-Treatment and Post-Treatment of Experimental Group*
5.4. 2 DIFFERENTIAL ANALYSIS

The comparison between the pre-test mean score and the post-test mean scores of the control group and the pre-test mean scores and the post-test mean scores of the experimental group were found out by applying Wilcoxon signed Rank Test.

The comparison between the pre-test mean score of both the control group and the experimental group and the post-test mean scores of both control group and the experimental group was found out by applying Mann-Whitney U-Test. The investigator manually calculated the data.

Comparison between the Pre-test Scores and the Post-test Scores of Control Group.

Table 5.5 Shows the significant difference in the achievement of the control group.

Table 5.5 : Significant Difference in the Achievement of the Pre-test and Post-test of Control Group

<table>
<thead>
<tr>
<th>Pre-test &amp; post-test</th>
<th>Rank</th>
<th>N</th>
<th>Mean Rank</th>
<th>Sum of Ranks</th>
<th>T – Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Negative Ranks</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Positive Ranks</td>
<td>25</td>
<td>13</td>
<td>325</td>
<td>0.00 *</td>
</tr>
<tr>
<td></td>
<td>Ties</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>25</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Significant at 0.05 level

Post-test < Pretest = 0
Post-test > Pretest = 25
Post-test = Pretest = 0

The investigator calculated the ‘T-Value’ using Wilcoxon Signed Rank Test to determine the level of significance for the achievement of the control group using the pre-test and post-test mean scores. The obtained t-value is 0 which is less than, the tabulated value 25 indicates that there a significant difference between the mean achievement-scores of the pre-test and the post-test of the control group. It is concluded that there is a significant difference between the mean achievement scores of the pre-test and the post-test of the control group. Since the students are undergoing traditional methods of teaching they have shown some improvement.
Comparison between the Pre-test Mean Score and the Post-test I Mean Score of the Experimental Group.

Table : 5.6 Shows Significant difference in the achievement between the pre-test and the post-test I mean scores of the experimental group.

Table 5.6 : Significant Difference in the Achievement between the Pre-test and the Post-test I Mean Scores of the Experimental Group.

<table>
<thead>
<tr>
<th>Pre-test &amp; Post-test I</th>
<th>Rank</th>
<th>N</th>
<th>Mean Rank</th>
<th>Sum of Ranks</th>
<th>T-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Negative Rank</td>
<td>0</td>
<td>0.00</td>
<td>0.00</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Positive Rank</td>
<td>25</td>
<td>13</td>
<td>325</td>
<td>0.00 *</td>
</tr>
<tr>
<td></td>
<td>Ties</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>25</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Significant at 0.05 level.

Post-test I < Pre-test = 0

Post-test I > Pre-test = 25

Post-test I = Pre-test = 0

The T-value is found to determine the level of significant for the achievement of the experimental group, using the pre-test and the post-test I mean scores. The obtained t-value is 0.00, which is less than the tabulated value 25.00, indicates that there is a significant difference between the main achievement scores of the pre-test and post-test I of the experimental group. It
is concluded that there is a significant difference between the mean achievement scores of the pre-test and the post-test I of the experimental group.

**Comparison between the Pre-test and the Post-test II Mean Scores of the Experimental Group.**

Table 5.7 Shows significant difference in the achievement between the pre-test and post-test II mean scores of the experimental group.

**Table 5.7 Significant Difference in the Achievement between the Pre-test and Post-test II Mean Scores of the Experimental Group.**

<table>
<thead>
<tr>
<th>Rank</th>
<th>N</th>
<th>Mean Rank</th>
<th>Sum of Ranks</th>
<th>T-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Negative Rank</td>
<td>0</td>
<td>0.00</td>
<td>0.00</td>
<td></td>
</tr>
<tr>
<td>Positive Rank</td>
<td>25</td>
<td>13.00</td>
<td>325.00</td>
<td>0.00 *</td>
</tr>
<tr>
<td>Ties</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>25</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Significant at 0.05 level

Post-test I > Pre-test = 25
Post-test I < Pre-test = 0
Post-test I = Pre-test = 0

The Investigator found out the T-value to determine the level of significance for the achievement of the experimental group using the pre-test
and the post-test II mean scores. The obtained T-value is 00.00 which is less than the tabulated value 25, indicates that there is a significant difference between the mean achievement scores of the pre-test and the post-test II of the experimental group. It is concluded that there is a significant difference between the mean achievement score of the pre-test and the post-test II of the experimental group.

**Comparison between the Post-test I and the Post-test II Mean Scores of the Experiment Group.**

Table 5.8 Shows the significant difference in the achievement between the post-test I and the post-test II mean scores of the experimental group.

**Table 5.8 Significant Difference in the Achievement between the Post-test I and the Post-test II Mean Scores of the Experimental Group.**

<table>
<thead>
<tr>
<th>Pre-test &amp; Post-test II</th>
<th>Rank</th>
<th>N</th>
<th>Mean Rank</th>
<th>Sum of Ranks</th>
<th>T-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Negative Rank</td>
<td>0</td>
<td>0</td>
<td>0.00</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Positive Rank</td>
<td>25</td>
<td>13</td>
<td>325.00</td>
<td>00.00 *</td>
</tr>
<tr>
<td></td>
<td>Ties</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>25</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Significant at 0.05 level

Post-test II < Post-test I = 0

Post-test > Post-test I = 15

Post-test II = Post-test I = 3

150
The investigator found the T-Value to determine the level of Significance for the achievement of the experimental group using the post-test I and post-test II mean scores. The obtained t-Value is 0.00, which is less than the tabulated value 25, indicates that there is no significant difference between the mean achievement scores of the post-test I and the Post-test II of the experimental group. It is concluded that there is a significant difference between the mean achievement scores of the post-test I and the post-test II of the experimental group. It is found that the computed mean difference is significant at 0.05 level. This situation prevails because the learners have already mastered the lesson through the interactive multimedia CD based learning courseware during the first month of the experiment. After reaching the mastery level further improvement is found to be scanty. Because of this reason there exists no significant difference between the post-test I (first month) and the post-test II (second month) period of treatment.

**Comparison between the Pre-attitude and the Post-attitude of Experimental Group towards the Interactive Multimedia CD Based Learning.**

Table 5.9 Shows the significant difference between the pre-attitude and the post-attitude of the experimental groups towards the interactive multimedia CD-based learning.
Table 5.9: Significant Difference between the Pre-attitude and the Post-attitude of the Experimental Group towards the Interactive Multimedia CD Based Learning.

<table>
<thead>
<tr>
<th>Pre-attitude &amp; Post-attitude</th>
<th>Rank</th>
<th>N</th>
<th>Mean Rank</th>
<th>Sum of Ranks</th>
<th>T-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Negative Rank</td>
<td>0</td>
<td>15</td>
<td>0.00</td>
<td>0.00</td>
<td>00.00 *</td>
</tr>
<tr>
<td>Positive Rank</td>
<td>15</td>
<td></td>
<td>8.0</td>
<td>120</td>
<td></td>
</tr>
<tr>
<td>Ties</td>
<td>-</td>
<td></td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>15</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Significant at 0.05 level

post attitude < pre-attitude = 0

post attitude > pre-attitude = 15

post attitude = pre-attitude = 0

The Investigator calculated the T-Value using Wilcoxon Signed Rank Test, so as determine the level of significance for the attitude of the experimental group using the mean scores obtained both prior and after treatment. The obtained T-value is 00.00 which is less than the tabulated value 25 indicates, that there is a significant difference between the mean attitude scores of the experimental group prior and after treatment. It is concluded that there is a significant difference between the pre-attitude and post-attitude of the experimental group towards the interactive multimedia CD-based learning.
Comparison between the Pre-test Mean Scores of both Control and Experimental Groups.

Table 5.10 Shows the significant difference in the pre-test achievement of both control and experimental groups.

Table 5.10 : Significant Difference in the Pre-test of both the Control Group and Experimental Group with Reference to Achievement.

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>$\Sigma_R$</th>
<th>U1</th>
<th>U2</th>
<th>Region of Acceptance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>25</td>
<td>741</td>
<td>209</td>
<td>416</td>
<td>Upper</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Lower</td>
</tr>
<tr>
<td>Experimental</td>
<td>25</td>
<td>534</td>
<td>209</td>
<td>416</td>
<td>397</td>
</tr>
</tbody>
</table>

The investigator applied Mann Whitney U-test for finding the significant difference in the pre-test achievement of both control and experimental group. The calculated value of U1 and U2 are 209 and 416. These two values for between the region of acceptance that lies between 228 and 397. It indicates that the control group and the experimental group are from the identical population. It is concluded that the control group and the experimental group do not differ significantly in their pre-test achievement.
Comparison between the Post-test Mean Score of the Control Group and the Post-test II Mean Score of the Experimental Group.

Table 5.11 Shows the significant difference in the achievement of the post-test measures of the control group and the post-test II mean score of the experimental group.

Table 5.11: Significant Difference in the Achievement of the Post-test Mean Score of the Control Group and the Post-test II Mean Score of the Experimental Group.

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>$\Sigma_R$</th>
<th>U1</th>
<th>U2</th>
<th>Region of Acceptance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>25</td>
<td>909</td>
<td>41</td>
<td>584</td>
<td></td>
</tr>
<tr>
<td>Experimental</td>
<td>25</td>
<td>366</td>
<td></td>
<td></td>
<td>397</td>
</tr>
</tbody>
</table>

The Investigator applied Mann-Whitney U-test for finding the significant difference in the achievement of the post-test mean scores of the control group and the post-test II mean scores of the experimental group. The calculated value of U1 and U2 are 41 and 584 and they do not fall between the region of acceptance that lies between 228 and 39. It indicates that there is a significant difference in the achievement of the post-test mean scores of the control group and the post-test II mean scores of the experimental group.

It is concluded that the mean scores of the post-test of the control group and the post-test II of the experimental group is significant.
Comparison between the Post-test Mean Score of the Control Group and the Post-test –I Mean Score of the Experimental Group.

Table 5.12 Shows the significant difference in the achievement of post-test mean scores of the control group and the post-test-I mean scores of the experimental group.

Table 5.12 Significant Difference in the Achievement of Post-test Mean Score of the Control Group and the Post-test-I Mean Score of the Experimental Group.

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>ΣR</th>
<th>U1</th>
<th>U2</th>
<th>Region of Acceptance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>25</td>
<td>860</td>
<td>90</td>
<td>535</td>
<td>Upper</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Lower</td>
</tr>
<tr>
<td>Experimental</td>
<td>25</td>
<td>415</td>
<td>90</td>
<td>535</td>
<td>397</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>228</td>
</tr>
</tbody>
</table>

The investigator applied Mann-Whitney U-test for finding the significant difference in post-test mean scores of control group and the post-test-I mean scores of the experimental group. The calculated value of U1 and U2 are 90 and 535 and they do not fall between the region of acceptance that lies between 228 and 397. It indicates that there is a significance difference in the achievement of the post-test mean of the control group and the post-test-I mean score of the experimental group.

It is concluded that the mean scores of the post-test of the control group and post-test-I of the experimental group is significant.
5.5 GAP CLOSURE

Gap closure refers to the percentage of the gap closed (after treatment) as indicated by the distance between the post-test mean and the pre-test mean. The gap closure shows the extent to which the treatment has been effective. ‘gap’ refers to the gap between complete mastery and the initial achievement (mean of the pre-test). This technique was used by many researchers (Herbert Baskaran 1995, Sivakumar 1999 and Arulsamy 2005).

\[
\text{Gap Closure} = \frac{\text{Post-test mean – Pre-test mean}}{\text{Perfect Score – Pre-test mean}} \times 100
\]

The table 5.13 shows the percentage of gap closure.

<table>
<thead>
<tr>
<th>S.No</th>
<th>Group</th>
<th>Pre-test</th>
<th>Post-test I</th>
<th>Post-test II</th>
<th>Gap closure</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Control Group</td>
<td>20.44</td>
<td>-</td>
<td>26.00</td>
<td>18.81</td>
</tr>
<tr>
<td>2</td>
<td>Experimental Group</td>
<td>23.52</td>
<td>32.96</td>
<td>-</td>
<td>35.65</td>
</tr>
<tr>
<td></td>
<td></td>
<td>23.52</td>
<td>-</td>
<td>37.48</td>
<td>52.72</td>
</tr>
</tbody>
</table>

The investigator found out the percentage of the gap closed (after the treatment) as indicated by the distance between the post-test mean and the pre-test mean. There is an improvement in the achievement of the control group since the gap closure for the control group is 18.81%. The gap closure of the experimental group
(between the pre-test and post-test I) is 35.65%. In other words, the interactive multimedia CD based learning courseware is able to close 35.65% of the experimental group’s achievement. The gap closure of the experimental group (between the pre-test and post-test – II) is 52.72%. In other words the interactive multimedia CD based course ware is able to close 52.72% gap of the experimental group’s achievement.

5.6 RESULTS OF HYPOTHESES TESTING

In the present study, seven hypotheses are formulated. This sub-section deals with the outcomes of the hypothesis testing.

**Hypothesis – 1**: There is a significant difference on mean achievement score between the pre-test and post-test of control group.

This hypothesis was tested by using Wilcoxon Signed Rank Test. There is significant difference between the mean achievement scores of the control group in its pre and post-tests. Hence the hypothesis is accepted.

**Hypothesis – 2**: There is a significant difference on mean achievement score between the pre-test and post-test I of experimental group.

The computation of ‘T’ reveals that there exists significant difference between the mean achievement scores of the experimental group in its pre-test and post-test I. Hence the hypothesis is accepted.

**Hypothesis – 3**: There is a significant difference on mean achievement score between the pre-test and post-test II of experimental group.
The value of ‘T’ reveals that there exists significant difference between the mean achievement scores of the experimental group in its pre-test and the post-test II. So the hypothesis is accepted.

**Hypothesis – 4:** There is a significant difference on mean achievement score between the post-test I and post-test II of the experimental group.

The computation of Wilcoxon Signed Rank Test reveals that there is a significant difference between the mean scores of the experimental group in its post-test I and post-test II with reference achievement. Hence the hypothesis is accepted.

**Hypothesis – 5:** There is a significant difference on mean attitude score between the pre-test and post-test of the experimental group towards the interactive multimedia CD based learning.

The calculated ‘T’ value reveals that there exists a significant difference between the pre-attitude mean score and the post-attitude mean score of the experimental group towards the interactive multimedia CD based learning. So the hypothesis is accepted.

**Hypothesis – 6:** There is no significant difference on mean achievement score between the pre-test of control group and experimental group.

The hypothesis was tested by Mann-Whitney U-Test. There is no significant difference between the pre-test mean scores of both the control and experimental groups. Hence this hypothesis is accepted.
**Hypothesis – 7**: There is a significant difference on mean achievement score between the post-test of the control group and the post-test II of experimental group.

The computed values reveal that there is a significant difference between the post-test mean scores of both the control group and the experimental group. Hence the hypothesis is accepted.

**5.7 CONCLUSION**

The Analysis and Interpretation of data reveals the effectiveness of interactive multimedia CD based learning courseware over the traditional method in learning the concepts of Environmental Chemistry at under graduate level. Moreover, the experimental group expressed a more favourable attitude towards the courseware. The next chapter deals with Findings and Pedagogical Implications.