CHAPTER IV

ANALYSIS AND INTERPRETATION OF DATA

4.1 INTRODUCTION

Analysis of data is a process of inspecting, cleaning, transforming and modelling data with the goal of highlighting useful information, suggesting conclusions and supporting decision making.

Analysis of data includes two important steps as:

1. Collection of the data and 2. Analysis of the data

Data collection is an indispensable and significant part of the research problem. It helps in testing the validity of the hypothesis and for making correct generalization. Therefore, it is necessary to collect accurate and reliable data in order to accomplish the objectives of the research. (Singh, 1999, pg. 274)

Analysis of data helps in determining the tabulated material into facts or meanings. It involves breaking down the existing complex factors into simpler parts and putting together in new arrangements for the purpose of interpretation. The analysis process needs an alert, flexible and open mind. No similarities, differences and factors should overlook. Larger divisions of material should be broken down to smaller units and rearranged in new combinations to discover new factors and relationships. Data should be study from as many angles as possible to find out new facts. (Singh, 1984, pg. 276)

4.2 DATA COLLECTION

Data collection requires time and efforts for acquiring skills and making indispensable arrangements for collection and ensuring the quality of research. Collected data analyzed and interpreted in order to draw a sound conclusion and valid generalization.
The data consist of scores, frequencies or some type of responses in the form of numbers, which usually have quantitative meaning. In present research study, the researcher collected the data through experiment and through observation.

The data collected through experiment is in the form of pretest posttest scores, observation and opinionnaire.

**The researcher has used following tools to collect the data -**

A. Achievement test scores (pre-test and post-test)

B. Opinionnaire

C. Observation

The researcher used both the techniques of data collection, quantitative and qualitative. Quantitative technique was used to collect the data through scores of achievement tests administered as pretest and posttest (on each selected unit). Qualitative technique was used to collect the data through student’s opinion regarding CAI programme (Rubric) and through their observation while learning through CAI programme in pairs.

In the present research study, the researcher was able to control certain variables such as age group, class, units, time and place.

**4.3 ANALYSIS OF THE DATA:**

The researcher had selected and prepared CAI programmes for total nine units for the present research but had to eliminate two units due to the announcement of Asian Games and resulting loss of time. One unit from first semester and another from second semester were omitted. Thus, the researcher finally has collected data (in the form of pretest posttest score) for seven units.

In the present research the researcher has done both quantitative and qualitative data analysis.

For quantitative data analysis the researcher has used ‘t’ test, and chi square test ($\chi^2$).
4.3.1 QUANTITATIVE ANALYSIS:

Quantitative analysis involves gathering of data-information in the form of numbers and anything that is measurable. It includes statistics, tables and graphs often used to represent results.

Quantitative analysis is done when variables being studied are measured along a scale that indicates ‘how much’ of the variables are present. Quantitative data reported in terms of scores after instruments have been administer and have been scored and tabulated. Quantitative analysis includes two steps. The first step in quantitative data analysis is to describe it in the form of summary using one or more descriptive statistics and then interpreting such statistics.

In the present research study the researcher used quantitative analysis to collect the data through the scores of pretests and posttests. These scores were tabulated and calculated. The difference between the mean scores of the pretest and posttest and the comparison between the two groups (experimental and control group) was analyzed by using ‘t’ test. Therefore, analysis done through the difference between mean scores of achievement tests considered as quantitative method in the present research study.

“t” test: The t-test assesses whether the means of two groups are statistically different from each other. (Best and Kahn, 2002, pg )

4.3.1.1 STATISTICAL ANALYSIS OF QUANTITATIVE DATA:

**Hypothesis 1 (Directional):** To test the directional hypothesis which stated that as a result of Computer Assisted Instruction on a unit in Geography, students will score significantly higher marks at the 0.01 level of significance in the post-test (achievement test) than in the pre-test on all selected units in Geography, the researcher has analyzed the pretest and posttest scores of experimental group.

For testing hypothesis 1, the researcher had used following formulae:

1. \[ S_{ED} = \sqrt{\sigma^2 M_1 + \sigma^2 M_2 - 2r_{12} \sigma M_1 \sigma M_2} \]
2. $r = \frac{\sum xy}{\sqrt{\sum x^2 \cdot \sum y^2}}$

3. $t = \frac{\text{Difference between mean scores of pretest and posttest}}{S_{ED}}$

$t = \frac{M_1 - M_2}{S_{ED}}$

Table 4.1: Analysis of pretest and posttest scores of achievement tests of the experimental group

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Unit No.</th>
<th>Experimental group No. of students</th>
<th>Pre-test Mean score</th>
<th>Std. dev. $\sigma$</th>
<th>$\sigma M$</th>
<th>Std. error of the mean $S_{ED}$</th>
<th>Coe. of Correlation $\rho$</th>
<th>T</th>
<th>Prob. error</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Unit 1</td>
<td>Pre-test 46</td>
<td>M1- 7.7</td>
<td>$\sigma 1 = 2.16$</td>
<td>$\sigma M1 = 0.22$</td>
<td>0.22</td>
<td>0.33</td>
<td>18.29</td>
<td>1.47E-25</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Post-test 46</td>
<td>M2- 10.65</td>
<td>$\sigma 2 = 1.22$</td>
<td>$\sigma M2 = 0.16$</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Unit 2</td>
<td>Pre-test 46</td>
<td>M1- 7.87</td>
<td>$\sigma 1 = 7.11$</td>
<td>$\sigma M1 = 0.39$</td>
<td>0.33</td>
<td>0.62</td>
<td>8.22</td>
<td>1.35E-06</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Post-test 46</td>
<td>M2- 10.59</td>
<td>$\sigma 2 = 6.11$</td>
<td>$\sigma M2 = 0.36$</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Unit 3</td>
<td>Pre-test 46</td>
<td>M1- 7.70</td>
<td>$\sigma 1 = 6.95$</td>
<td>$\sigma M1 = 0.39$</td>
<td>0.22</td>
<td>0.83</td>
<td>16.48</td>
<td>5.16E-11</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Post-test 46</td>
<td>M2- 11.33</td>
<td>$\sigma 2 = 3.92$</td>
<td>$\sigma M2 = 0.29$</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The data reveals that as a result of CAI on each unit in Geography the students have scored significantly higher marks at 0.01 level of significance in the post-test than in the pre-test.
It was concluded that students who received instruction through Computer Assisted Instructional programme showed significantly higher achievement in post-test than in the pre-test. This finding depicts the effectiveness of the Computer Assisted Instructional programme in bringing about learning of all the selected units.

Another hypothesis was put forth with respect to the same objective as follows-

**Hypothesis 2:** 70% students of experimental group will obtain at least 70 % marks in the post (achievement) test in each unit as a result of study through CAI programme.
(TABLE 4.2: UNIT WISE ANALYSIS OF EXPERIMENTAL GROUP STUDENTS WHO SCORE MORE THAN 70% MARKS IN POSTTEST)

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Unit No.</th>
<th>No. of students appeared for post-test</th>
<th>Expected value (No. of students above score 70% and above 70% marks)</th>
<th>Observed value (No. of students scored above 70% marks)</th>
<th>70×70 Criterion reached</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Unit 1</td>
<td>46</td>
<td>32 or &gt; 32</td>
<td>33</td>
<td>Yes</td>
</tr>
<tr>
<td>2</td>
<td>Unit 2</td>
<td>46</td>
<td>32 or &gt; 32</td>
<td>33</td>
<td>Yes</td>
</tr>
<tr>
<td>3</td>
<td>Unit 3</td>
<td>46</td>
<td>32 or &gt; 32</td>
<td>33</td>
<td>Yes</td>
</tr>
<tr>
<td>4</td>
<td>Unit 4</td>
<td>46</td>
<td>32 or &gt; 32</td>
<td>24</td>
<td>No</td>
</tr>
<tr>
<td>5</td>
<td>Unit 5</td>
<td>46</td>
<td>32 or &gt; 32</td>
<td>33</td>
<td>Yes</td>
</tr>
<tr>
<td>6</td>
<td>Unit 6</td>
<td>46</td>
<td>32 or &gt; 32</td>
<td>32</td>
<td>Yes</td>
</tr>
<tr>
<td>7</td>
<td>Unit 7</td>
<td>46</td>
<td>32 or &gt; 32</td>
<td>37</td>
<td>Yes</td>
</tr>
</tbody>
</table>

The above result shows that all the students clearly reached or surpassed the 70×70 criterion in all the units except in unit 4. Therefore it reveals that there is no need to apply chi square test ($\chi^2$) for each unit test except for unit no. 4. This indicates that CAI was effective in bringing about learning for all units except unit 4.

The researcher applied chi square ($\chi^2$) test for unit no. 4- to ascertain if the 70×70 criterion was not reached due to chance fluctuation.
CHAPTER IV - ANALYSIS AND INTERPRETATION OF DATA

Expected value ($f_e$)

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>32</td>
<td>14</td>
</tr>
</tbody>
</table>

Observed value ($f_o$)

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>24</td>
<td>22</td>
</tr>
</tbody>
</table>

\[
(f_o - f_e) = 8 \\
\frac{(f_o - f_e)^2}{f_e} = 64 \\
\chi^2 = \frac{\sum(f_o - f_e)^2}{f_e} = 6.57 \\
df = 1 \\
\rho = 0.01
\]

The above result reveals that the computed value of chi square is equal to the critical value of chi square ($\chi^2$) at the 0.01 level of significance. Hence due to effect of CAI programme students actually achieved 70\% criterion level even in unit 4.

**Hypothesis 3 (Null hypothesis):** Mean gain score of Experimental group in achievement tests will be significantly higher than the mean gain score of Control group at the 0.01 level of significance.

*(TABLE 4.3: ANALYSIS OF MEAN GAIN SCORE OF THE CONTROL AND THE EXPERIMENTAL GROUP)*

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Unit No.</th>
<th>Total gain score</th>
<th>Mean gain score</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Control Group</td>
<td>Experimental group</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Control Group</td>
<td>Experimental group</td>
</tr>
<tr>
<td>1</td>
<td>Unit 1</td>
<td>97</td>
<td>188</td>
</tr>
<tr>
<td>2</td>
<td>Unit 2</td>
<td>54</td>
<td>125</td>
</tr>
<tr>
<td>3</td>
<td>Unit 3</td>
<td>100</td>
<td>167</td>
</tr>
</tbody>
</table>
CHAPTER IV - ANALYSIS AND INTERPRETATION OF DATA

<table>
<thead>
<tr>
<th></th>
<th>Unit 4</th>
<th></th>
<th>Unit 5</th>
<th></th>
<th>Unit 7</th>
<th></th>
<th>Unit 8</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>141</td>
<td>301</td>
<td>3.07</td>
<td>6.54</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>112</td>
<td>166</td>
<td>2.43</td>
<td>3.61</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>131</td>
<td>261</td>
<td>2.85</td>
<td>5.67</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>73</td>
<td>210</td>
<td>1.58</td>
<td>4.56</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

GRAPH 4.2 COMPARISON OF MEAN GAIN SCORES OF CONTROL AND EXPERIMENTAL GROUP

(Control Group Mean Gain Score: 2.11, 1.17, 2.17, 3.07, 2.43, 2.85, 1.59
Experimental Group Mean Gain Score: 4.09, 2.72, 3.63, 6.54, 3.61, 5.67, 4.57)
(TABLE 4.4: ANALYSIS OF MEAN GAIN SCORES OF ACHIEVEMENT
TESTS OF THE CONTROL AND THE EXPERIMENTAL GROUP)

<table>
<thead>
<tr>
<th>Sr. No</th>
<th>Unit No.</th>
<th>Group</th>
<th>Mean</th>
<th>σ</th>
<th>σd</th>
<th>t value</th>
<th>Probability error</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Unit No. 1</td>
<td>Control group</td>
<td>2.11</td>
<td>1.48</td>
<td>0.40</td>
<td>4.90</td>
<td>5.94 E⁻¹⁰</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>Experimental group</td>
<td>4.09</td>
<td>2.29</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Unit No. 2</td>
<td>Control group</td>
<td>1.17</td>
<td>2.44</td>
<td>0.56</td>
<td>2.75</td>
<td>1.42 E⁺⁰⁴</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>Experimental group</td>
<td>2.72</td>
<td>5.03</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Unit No. 3</td>
<td>Control group</td>
<td>2.17</td>
<td>3.32</td>
<td>0.49</td>
<td>2.98</td>
<td>3.91 E⁻⁰⁵</td>
</tr>
<tr>
<td>6</td>
<td></td>
<td>Experimental group</td>
<td>3.63</td>
<td>2.23</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Unit No. 4</td>
<td>Control group</td>
<td>3.07</td>
<td>2.84</td>
<td>0.61</td>
<td>5.71</td>
<td>7.61 E⁻¹²</td>
</tr>
<tr>
<td>8</td>
<td></td>
<td>Experimental group</td>
<td>6.54</td>
<td>5.99</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Unit No. 5</td>
<td>Control group</td>
<td>2.43</td>
<td>0.94</td>
<td>0.41</td>
<td>2.85</td>
<td>1.49 E⁺⁰⁴</td>
</tr>
<tr>
<td>10</td>
<td></td>
<td>Experimental</td>
<td>3.61</td>
<td>3.33</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### CHAPTER IV - ANALYSIS AND INTERPRETATION OF DATA

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>Unit No. 7</td>
<td>Control group</td>
<td>2.85</td>
<td>0.58</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td></td>
<td>Experimental group</td>
<td>5.67</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Unit No. 8</td>
<td>Control group</td>
<td>1.5</td>
<td>0.40</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td></td>
<td>Experimental group</td>
<td>4.57</td>
<td>2.48</td>
</tr>
</tbody>
</table>

**Statistical significance at 0.01 level for (df 45) t=2.69**

Table no. 4.4 indicates that mean gain score of the experimental group on each selected unit was more than the mean gain score of the control group. Table no. 4 indicates that the ‘t’ value for each unit is statistically significant at 0.01 level when compared with the standard ‘t’ value which is 2.69 at 0.01 level for the degrees of freedom 45. Hence, the null hypothesis stating that ‘there will be no significant difference at the 0.01 level of significance between the mean gain scores on achievement of students studying through CAI and through conventional classroom teaching of all selected units in Geography’ is rejected. Therefore, the performance of the experimental group students was considered as better in comparison with the control group students due to the effect of CAI programme.

**4.3.2: ANALYSIS OF QUALITATIVE DATA:**

The researcher has used Opinionnaire and Observation technique for the analysis of qualitative data.
4.3.2.1 OPINIONNAIRE (RUBRIC) TO GET EXPERIMENTAL GROUP STUDENTS OPINION ABOUT CAI PROGRAMME:

In the present research study, the researcher was interested in studying-

- The reaction of students towards Computer-Assisted-Instructional programme
- The opinions of students about the perception of using Computer Assisted Instruction in comparison with conventional classroom teaching
- The participation of students in learning through Computer Assisted Instruction

Opinionnaire technique was used to evaluate students’ opinions about the CAI programme with the help of a rubric made by the researcher. The researcher has included certain points to evaluate exact opinion of the student regarding the CAI programmes prepared and administered by the researcher are as follows-

1. Comprehensiveness of the content covered in the programme
2. Clarity and simplicity of the content
3. Language used in explaining the content
4. Quantity of the examples provided in the programme
5. Relatedness and appropriateness of the examples provided in the programme
6. Appropriateness of visual effects used in the presentation
7. Impact of animation given in the presentation
8. Students participation in learning through CAI programme
9. Students interaction with the partners
10. Usefulness of provided extra information in learning
11. Usefulness of recapitulating questions asked by the researcher in the presentation
12. Generation of motivation and interest in viewing the programme
13. Usefulness in improving students learning capabilities through use of various activities in the programme
14. Overall impact of the programme on students self-study habits

15. Students opinion regarding the CAI programme in comparison with the regular classroom teaching

**4.3.2.2 OPINION OF EXPERIMENTAL GROUP STUDENTS ABOUT CAI:**

1. The computer assisted programme conveys instruction exactly according to the content given in the textbook.

2. Computer Assisted Instructional program is a user-friendly program as students can easily operate and proceed through it.

3. This program provides the students with the facility to proceed at their own pace

4. This program is helpful in generating the interest among the students to learn in their own way.

5. Hyperlinks given in the programme provide useful descriptions of the text that add to the understanding of the students

6. This program brings clarity to the concepts of the students

7. This programme was easy to understand and interesting for the students

8. Students like the CAI program more than the conventional teaching

9. Students learn more through CAI than the conventional teaching.

10. It is an instructional program enriched with thought provoking questions followed by immediate feedback to guide, motivate and enhance learning.

11. This is an individualized program as it provides the students multiple paths to proceed according to their own abilities, skills and choice.

12. Study through CAI is more interesting than the conventional teaching.

13. This program helps in developing various computer skills.
4.3.2.3 EXPERTS’ OPINION REGARDING THE CAI PROGRAMME:

The researcher has collected expert’s opinion regarding the CAI programme on each unit before the experiment. The experts gave their opinion in two parts as

1. Comment on the programme and
2. Suggestion regarding the programme (Appendix VI)

Following are the overall comments given by the experts regarding the CAI programmes on selected units:

- The overall slides were related to the content included in the textbook
- Relevant Pictures, video clips, and diagrams were included in the programme
- The diagrams which were drawn by the researcher were good, easy to understand the concept and were drawn keeping in mind the age and capacity of the learner
- The time required for viewing the programme was up to the mark of viewer’s capacity to watch the whole programme
- Addition of extra information, animated clips and cartoon pictures are definitely helpful to generate excitement of the learner throughout the programme
- The images used in the programme were very attractive
- Explanations given on the slides were precise
- Adequate number of activities and sum up questions were provided in the programme
- The researcher has tried her level best to reach near the perfection

Suggestions given by the experts were:

- To pay a bit of attention towards the lettering (in colour of letter)
- To pay attention towards the letter size
- To pay attention towards the axis of the diagram etc.

Experimental group students responded to an Opinionnaire to rate the Computer-Assisted Instructional programme (appendix IV)

4.3.2.4 OBSERVATION OF EXPERIMENTAL GROUP STUDENTS WHILE LEARNING THROUGH CAI:
Data collected from observations consists of detailed descriptions of people’s activities, actions, and the full range of interpersonal interactions and organizational processes that are a part of observable human experiences. (Best, and Khan; 2006, pg.184)

Observation technique involves the description of verbal and non-verbal behavior of the sample.

The researcher has observed the experimental group students while learning through CAI and found that:

The students were-

- Confused on very first day of administration of Computer-Assisted Instructional programme for operating the programme but very soon they realized that it was very easy to operate and seems very excited and relaxed.
- Interested in attending the class than that of control group
- Eager to learn through CAI
- Like to view colourful photographs, pictures and images
- Actively participated in the activities assigned in the programme
- Like to view video clips repeatedly
- The time for viewing the slides differ from student to student.
- Animatedly talking and discussing topics that were ask to discuss and also helping their partner to understand the concepts if they did not understood the same.
- Eager to gather extra information provided in the programme (related to the content)
- Show cooperation while learning in pairs
- Developed mastery in handling computers
- Show cooperative behaviour and understanding nature with their partners while learning through CAI
4.3.2.5 OBSERVATION OF EXPERIMENTAL AND CONTROL GROUP STUDENTS WHILE ATTEMPTING THE ACHIEVEMENT TESTS (USED AS PRETEST AND POSTTEST):

- At the time of unit one pretest, students were very eager and ready to solve the given test, seems to be surprise for them.

- Students of experimental group were found confident at the time of posttest taken by the researcher on first unit test.

- As compare to experimental group, control group students were not so confident for the posttest.

- It was observed by the researcher that from unit two when students realized that every time they have to attempt pretest and then posttest they lost their interest in attempting the tests.

- The students of both the groups (experimental and control) were not interested in attempting the tests.

- Very few students were interested in writing the whole paper. Most the time students use to waste their time in drawing diagrams, or in writing only objective type questions.

- It was notice by the researcher that few students were interested in knowing whether these marks would be count in their result sheet or not.

- The researcher observed that, as compare to boys girls were serious about the tests given to them.

- The researcher noted that, students not attempted well in the pretests based on difficult content such as interior of earth and rocks and working of running water.

- The researcher noticed that, experimental group students were asking for questions other than textbook questions (i.e. based on extra information).

4.4 CONCLUSIONS:
On the basis of analysis of quantitative and qualitative data, the following conclusions were drawn:

1. Use of Computer-Assisted Instructional program was found to be effective in bringing about learning.

2. Computer-Assisted Instructional programme was found to be more effective for learning of subject Geography as compared to conventional teaching.

3. Students’ opinions showed that study through CAI is more interesting, motivating and helpful in enhancing learning than the conventional teaching.

4. Students learning through CAI (experimental group) were eager to learn and participate actively than the students learning through conventional teaching (control group).

5. Students active participation in learning through CAI results in better achievement.

6. Students benefited from individualization, self-pacing and interactive nature of the CAI programme.

7. Computer-Assisted Instruction proved to be better mode of instruction than conventional teaching to teach the content of physical Geography.

8. Hyperlinks of answers and questions in CAI programme direct and foster learning.

9. CAI is a powerful, useful and interesting mode of instruction.