CHAPTER: IV
ANALYSIS & INTERPRETATION OF DATA
4.0 INTRODUCTION

Analysis and interpretation of data refers to the heart of any research. On one hand, the set of data collected is considered as a base upon which the structure of the research rests, and on the other hand, analysis and interpretation is considered as the wheels of the whole research machinery without which the data and other material have no specific function to perform. It involves breaking down of existing complex factors in simple and putting the parts together in new arrangement for the purpose of interpretation.

Investigators often find data analysis as the most enjoyable part of carrying out a study, as after all the hard work and long wait it provides the chance to find out the answers. Here the investigator should be cautious not to make error in analyzing and interpretation of the data as indicated by G.J. Mouly (1958) that among the more common errors in the interpreting of the results of research are; failing to see the significance of data, failing to see the limitations of research design, overlooking contrary evidences, mistaking coincidence for cause and effect and reversing the effect and cause.

The fundamental aim of any analysis is to organize the data in a meaningful form, so that valid conclusions drawn them. The analysis and interpretation give shape and form to aims and objectives of the study. The best safeguard against such errors are common sense insight into the field.
In the word of Wolf (1956), "the process of analysis and synthesis of the collected data is the foundation stone of all specific methods. Thus, for any successful study the task of analysis and interpretation should be designed before the data are actually collected so that valid conclusion can be drawn from them."

This Chapter deals with the analysis and interpretation of data collected in relation to achieve the objectives of investigation. In the empirical research the structure of research is based on the set of data collected. While the analysis and interpretation is considered as the wheel of whole research activities. Without empirical data and other related evidence. It is impossible to draw verifiable results which may lead to the final conclusion and authentic generalization regarding the population under study.

As with the most other aspects of a study, Analysis and interpretation of the study should be relate to the study objective and research qualities.

The main aim of present study was "Development of Instructional Material Based on Constructivist Approach in Teaching of Biology at Senior Secondary Level".

Therefore, keeping in view the objectives of the study the data was analyzed under following heads.

4.1- Content Analysis of Biology text book of Class XI.

4.2- Development of Instructional Material for adopting Constructivist approach in teaching of Biology.

4.3-Nature of distribution of the intelligence and achievement score of the experimental and controlled Group of Biology students of class XI.

4.4-comparision of pre-test achievement scores of experimental and controlled group.

4.5- Comparison of gained achievement of experimental and controlled group.
4.6- Comparison of scores of post-test on reaction scale of controlled and experimental group of Pupil teachers.

4.7- Comparison of scores of post-test on willingness scale of controlled and experimental group of Pupil teacher.

4.1 Content Analysis of Biology text book of Class XI

The nature of educational phenomena is different from the nature of physical phenomena. Physical phenomena are numerical or quantitative. On the other hand, social phenomena are abstract or qualitative. Qualitative phenomena in their turn are ambiguous and complex. It is due to this fact that clear, results are not easily available in social research. In order to achieve results from facts gathered through survey and other methods, several techniques are utilized; content analysis is one of them. In order to arrive at results from the collected data, it is necessary to classify it. Content analysis is the reduction of data into categories. It is different from coding which is used in the plans of research while content analysis is the analysis of qualitative data collected in research. This content analysis reduces quantitative social data into scientific and objective facts. In the words of Beselosor “Content analysis is a research technique for objective, systematic and quantitative description of the manifest content of communication”.

Main steps of Content analysis

The following steps were used for content analysis in present study.
The following book was taken in research for the Content Analysis:

**Title of Book**– Modern Biology (Zoology)

**Author.** Dr Ramesh Gupta

**Publication.** Prakash Publication Muzaffarnagar UP

**Year.** 2007
List of Units selected after Content Analysis.

A. Respiratory System
B. Circulatory System
C. Cell and its Types
D. Reproductive system
E. Cell division and Cell cycle
F. Nervous System
G. RNA and Protein synthesis
H. DNA

4.2- Development of Instructional Material for adopting Constructivist approach in teaching of Biology.

The detailed procedure of development of Instructional Material has been given in chapter III page no. 152 to 161.

Two types of lesson plans were developed one is based on Blooms' taxonomy for controlled group and second based on Constructivist Approach for experimental group. Some Developed sample lesson plans based on the Constructivist Approach have been enclosed with this thesis report. List of the developed lesson plans is given below.

1. Cell and cell types
2. Cell division and cell Cycle
3. Reproductive system
4. Respiratory system
5. Circulatory System
6. DNA
7. RNA and Protein Synthesis
8. Nervous System
9. Nutrition
10. Cell Membrane
11. Nucleus
12. Digestive System

4.3- Nature of distribution of the intelligence score of the experimental and Controlled Group of Biology students of class XI.

The Nature of distribution of scores obtained in relation to various variables under study is studied as it helps to decide the appropriateness of inferential statistics for the analysis of data and to test the various hypotheses framed in relation to the objectives which are to be achieved by the study. Therefore, description of the nature of score of variables namely willingness and achievement are given here. The verbal intelligence test developed by Prof. S. S. jalota was administered on both the groups. The test was scored mean, S.D. for experimental and controlled group were calculated. Mean of two groups were compared by using CR value Mean, SD, CR and P value of experimental and controlled group are given in table 4.1

Table 4.1 – Showing Mean, S.D., CR and P value of experimental and controlled group of XI grades Students on Intelligence Test.

<table>
<thead>
<tr>
<th>Groups</th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
<th>df</th>
<th>CR Value</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental</td>
<td>30</td>
<td>48.73</td>
<td>15.48</td>
<td>58</td>
<td>.41</td>
<td>P &gt; .01</td>
</tr>
<tr>
<td>Controlled</td>
<td>30</td>
<td>50.73</td>
<td>15.22</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The Above table shows that the mean of experimental group is slightly lesser than the mean of controlled group. Variability among both the groups seems to be almost equal. The CR calculated to find the significance of difference between mean of experimental and controlled group was found 0.41 which is insignificant at .01 level which reveals that experimental and controlled groups are not significantly different in intelligence from each other. Thus both the groups can be said equal on this variable. This can also be observed by looking at fig. no. 4.1.

Fig.4.1- Smoothed frequency curves of students score of Intelligence Test
4.4- Nature of distribution of the achievement score of the experimental and Controlled Group of Biology students of class XI.

As one of the hypothesis of the study is to test the significant difference between controlled and experimental group scores. Here it is necessary to equate both the groups on academic achievement. In order to know whether both the groups are equal on the achievement variable, an achievement test developed by the researcher was administered on the both groups, on the topics selected for development of Instructional material the mean of both the groups were compared by using CR value The mean, SD, CR value and P value of pre-test achievement scores of experimental and controlled are given in table 4.2

<table>
<thead>
<tr>
<th>Groups</th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
<th>df</th>
<th>CR value</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental</td>
<td>30</td>
<td>14.1</td>
<td>3.62</td>
<td></td>
<td>.28</td>
<td>P &gt; .01</td>
</tr>
<tr>
<td>Controlled</td>
<td>30</td>
<td>14.37</td>
<td>3.85</td>
<td>58</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 4.2 shows that values of achievement of pre-test of experimental and controlled group are found 14.1 and 14.37 respectively. Which are very much near to each other, variability among both the groups is almost negligible.

In order to test the significance difference between mean of experimental and controlled group CR value was calculated which was found 0.28. This value is insignificant at .01 level.
Therefore it can be said that experimental and controlled groups are not significantly different from each others on pre-test achievement score or both the groups are treated as equal. This can also be seen through the Fig. no.4.2

![Graph showing smoothed frequency score of pre-test achievement test](image)

**Fig. 4.3 Smoothed frequency score of pre test of Achievement Test**

4.5- To Experiment the effectiveness of Constructivist approach as compared to traditional approach

After development of instructional Material based on constructivist approach, researcher wanted to know its effectiveness as compared to the traditional methods in real class room conditions.
Therefore, the experimental group was taught by using Constructivist Approach in classroom teaching with the help of developed Instructional material where as controlled group was taught by traditional approach. The mean gain achievement score was calculated by finding difference between pre-test and post-test scores. This mean gain achievement was compared by using CR value.

The mean, SD, CR value and P value of mean gain achievement of experimental and controlled group are given in table 4.3.

**Table- 4.3 Showing Mean, S.D., CR Value and P Value of the gain achievement of experimental and controlled group.**

<table>
<thead>
<tr>
<th>Groups</th>
<th>No.</th>
<th>Mean gain Achievement</th>
<th>SD</th>
<th>df</th>
<th>CR</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students</td>
<td>30</td>
<td>11.33</td>
<td>4.97</td>
<td>58</td>
<td>4.104</td>
<td>P &lt; .01</td>
</tr>
<tr>
<td>Controlled</td>
<td>30</td>
<td>6.9</td>
<td>3.13</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

It is evident from above table that the mean gain achievement of experimental group (11.33) is higher than the mean gain achievement of controlled group (6.9). The experimental group shows higher variability than controlled group.

In order to test the significance of mean difference between mean gain achievement of experimental and controlled group CR value was calculated which was found 4.104. This value is higher than the table value at 58 df at .01 level of significance. This can be concluded by mean gain achievement of experimental group which was significantly higher that of controlled group. Thus the hypothesis H₀₁, “There will be no significant difference in mean gain achievement scores of the students taught through constructivist approach and traditional Lecture cum Demonstration Method” is rejected.

Amit Gautam
Therefore, it can be concluded that developed instructional material based on constructivist approach is effective because if it is used in classroom teaching the students mean gain achievement will be higher than that of the students taught through traditional approach. This can also be observed by looking at fig. no. 4.3.

Fig. 4.4 Smoothed frequency score of post test of Achievement Test

4.6- To Study the Effect of Developed Instructional Material on Reaction of Pupil Teachers

The fourth objective of study was to study the effect of developed instructional material on reactions of pupil teachers towards teaching and learning of Biology through Constructivist approach as compared to traditional approach.
In order to achieve this objective experimental and controlled group each contain 20 pupil teachers were oriented towards the use of constructivist approach in classroom teaching. The experimental group was given orientation with the help of developed instructional material. This group was exposed to the developed instructional material during orientation given for 10 days. The controlled group was also given orientation for the same periods but they were not exposed to the developed instructional material.

After orientation programme a reaction scale towards the constructivist approach in teaching and learning of Biology was administered. This scale measures the level of reaction of pupil teachers towards the constructivist approach.

In order to know whether the developed instructional material is helpful in improving the reaction of pupil teachers towards this approach or not, the mean of both the groups were compared by using ‘t’ test. The mean, SD ‘t’ value and ‘P’ value have been given in the table 4.4.

**Table-4.4 Showing Mean, S.D., CR and p value of post test score of controlled and experimental group of pupil teacher on reaction scale towards constructivist approach**

<table>
<thead>
<tr>
<th>Groups</th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
<th>df</th>
<th>CR value</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental</td>
<td>20</td>
<td>118</td>
<td>6.38</td>
<td>38</td>
<td>4.03</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>Controlled</td>
<td>20</td>
<td>110.55</td>
<td>12.73</td>
<td>38</td>
<td>4.03</td>
<td>&lt;.01</td>
</tr>
</tbody>
</table>

The above table shows that the mean score of the experimental group is higher than that of the controlled group. The experimental group consists of lesser variability than the controlled group. ‘t’ value calculated to test significance difference between mean of
experimental and controlled group was found to be 4.03 which is significant at .01 level of significance.

Thus the null hypothesis Ho2, “there will be no significance difference between reaction of pupil teachers towards teaching and learning of Biology through constructivist approach as compared to traditional approach” is rejected.

Therefore, it can be concluded that the developed instructional material is helpful in changing the reaction of pupil teachers towards the use of constructivist approach in teaching Biology at senior secondary level.

4.7- To Study the Effect of Developed Instructional Material on Willingness of Pupil Teachers

The fifth objective of present study was to study the effect of developed instructional material on willingness of pupil teachers to use the constructivist approach in Biology teaching. In the process to achieve the above mentioned objectives, the experimental and controlled group of pupil teachers was given orientation for 10 days. The experimental group was orientated with the help of developed instructional material whereas the controlled group was oriented without the help of developed instructional material. In order to know the effect of orientation with the help of developed instructional material on willingness of pupil teachers to use the constructivist approach in teaching of Biology a willingness scale was developed and administered on controlled group. The mean, SD, CR value and P value of post test score on willingness scale of controlled and experimental group are given in table 4.5.
Table-4.5 Showing Mean, S.D., CR and p value of post test score of controlled and experimental group of pupil teacher on Willingness Scale towards Constructivist Approach

<table>
<thead>
<tr>
<th>Groups</th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
<th>df</th>
<th>CR</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental</td>
<td>20</td>
<td>104.9</td>
<td>5.629</td>
<td>38</td>
<td>2.98</td>
<td>P &lt; .01</td>
</tr>
<tr>
<td>Controlled</td>
<td>20</td>
<td>99.35</td>
<td>6.109</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

It is evident from table 4.5 that the mean score on willingness scale of experimental group is higher than that of controlled group. Both the groups have shown lesser variability which reveals that there is homogeneity is both the groups. ‘t’ value was calculated to test the significance of difference between mean of experimental and controlled groups. The calculated CR value (2.98) is higher than that of table value (2.71) at 0.01 level of significance.

Therefore null hypothesis Ho3, “there will be no significant different between scores on willingness scale for constructivist approach of experimental and controlled group of pupil teachers” is rejected. It reveals that the experimental group has shown higher willingness to use constructivist approach in teaching Biology than that of controlled group.

It also shows that the developed instructional material is helpful in improving willingness to use constructivist approach among pupil teachers. If such material is available to pupil teachers or teachers they will be more willing to use the Constructivist Approach in their routine classroom teaching.
4.8 CONCLUSION-

The analysis made in the present study reveals that after rigorous content analysis, 12 topics were found suitable for developing instructional material based on constructivist approach for teaching of Biology at senior secondary level. Researcher developed lesson plans based on constructivist and traditional approach on all the topics. Effectiveness of developed instructional material was tested through its effect on academic achievement, reaction and willingness to use the developed instructional material was found effective through all the bases. The developed instructional material was helpful in improving academic achievement of students of Biology. Reaction of pupil teachers towards constructivist approach and willingness to use constructivist approach in teaching Biology at Senior Secondary level.