Chapter IV
Method and Procedure
CHAPTER-IV
METHOD AND PROCEDURE

Method means a regular and systematic way of accomplishing anything and thus, research method is a way to systematically solve the research problem. It may be understood as a science of studying how research is done scientifically. As a general rule, the method of research depends upon the purpose for which the investigation is to be carried out. Before conducting any research, the investigator places his final choice on method; he has to make himself clear about the field or area in which the problem of research occurs.

The present study “Effect of Web Based Instruction on Achievement in Biology in relation to Learning Style and Intelligence” was experimental in nature. Experimental research aims to examine what will happen to dependent variable when certain independent variables are carefully controlled or manipulated.

The present chapter has been devoted to the identification of variables, design of the study, sample for the study, tools used, description of tools, controlling extraneous variable, procedure adopted, collection of data and statistical techniques used for the purpose of data analysis.

4.1 IDENTIFICATION OF VARIABLES

A Variable is the condition that the experimenter manipulates, controls or observes. According to D’Amato (1970), variable may be defined as those attributes of objects, events, things and beings, which can be measured. Depending upon the problem, a variable may be independent or dependent variable.

**Independent Variable:** The independent variable is the condition or characteristic that the experimenter manipulates or controls in his attempt to ascertain its relationship to observed phenomena. In the present study, instructional strategy was taken as an independent variable. Two instructional strategies- web based instruction and conventional mode of instruction were taken for this purpose.

The present study had two classifying independent variables - learning style and intelligence.
Classifying Independent Variable

The variable which identifies groups within a population based on social, physical, political, economic or other characteristics is called a classifying variable. Classifying variable is used for targeting, sub-dividing the data when exploring causality. In the present study, learning style and intelligence were identified as two classifying variables.

(a) **Learning Style**: Students with four learning styles - diverging, accommodating and assimilating (as proposed by David A.K. Kolb Learning Style Inventory) were identified.

(b) **Intelligence**: The students were divided into three levels on the basis of scores obtained on the tool of intelligence: students with high intelligence, students with average level of intelligence and students with low level of intelligence. Students with average level of intelligence were involved in the present study.

**Dependent Variable**: The dependent variable is the condition or change that appears, disappears or changes as the experimenter introduces, removes, or manipulate the independent variable. In the present investigation, achievement in Biology was used as the dependent variable.

Besides the independent and dependent variables, the present study had both extraneous and intervening variables.

**Extraneous variable**: Extraneous variable is an undesirable variable that interferes with the relationship between the variables that an experimenter is interested in. It is an unwanted variable that adds error to an experiment. In the present study, such variables were either controlled experimentally or were equalized by way of matching.

**Intervening Variable**: An intervening variable, like extraneous variable, is not the primary focus of the research, but it mediates the results of research. This variable, however, is much more difficult to control.
study, motivation, fatigue, boredom and any other factor that arose during the course of research were the intervening variables.

4.2 DESIGN OF THE STUDY

The present study ‘Effect of web based instruction on achievement in Biology in relation to learning style and intelligence’ aims to study the effect of web based instruction on achievement in Biology in relation to learning style and intelligence and was conducted in four phases as given below:

Phase-I: It involved development of web based instructional package. The package was validated (content wise) by the investigator. An achievement test in Biology was also constructed and standardized by the investigator.

Phase-II: It involved random formation of experimental and control groups. The groups were matched on the variables of achievement in Biology and intelligence. After forming equivalent groups, both the groups were given pre-test in achievement in Biology, learning style inventory and intelligence test.

Phase-III: In this phase, experimental group was taught through web based instruction whereas control group was taught through conventional mode of instruction.

Phase-IV: It involved administration of post test in achievement in Biology to both the groups. The analysis was carried out on the gain scores (obtained after subtracting post-test scores from pre-test scores) of the two groups.

In the present study, 2X4X2 factorial experimental design was employed. Instructional strategy was the first factor coded as A and its two strategies- web based instruction and conventional mode of instruction were coded as \textit{Awbi} and \textit{Acmi} respectively. The second factor was learning style coded as B and students with four learning styles coded as Bdi (diverging style), \textit{Beo} (converging style), \textit{Bae} (accommodating style) and \textit{Bas} (assimilating style) were identified on the basis of scores of the students obtained on the tool of The Kolb Learning Style Inventory by Kolb (2007).
The third factor was intelligence coded as C and its two levels i.e. high level of intelligence and low level of intelligence were coded as Chi and Cli respectively. Students were divided into three categories on the basis of the scores they obtained on the tool of intelligence - General Group Test of Intelligence (GGTI) by G.C. Ahuja (2005) - students with high level of intelligence, students with average level of intelligence and students with low level of intelligence. For the purpose of this distribution, the scores of students on the variable of intelligence were arranged in descending order. The students coming in the top 27 percent were the group of students with high level of intelligence and students in the bottom 27 percent were the group of students with low level of intelligence. The remaining students coming in the range of 28 to 72 percent were the group of students with average level of intelligence. This group was not included for the purpose of the present study.

Factors along with their codes are presented below:

<table>
<thead>
<tr>
<th>Factor</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instructional Strategy</td>
<td>A</td>
</tr>
<tr>
<td>Web Based Instruction</td>
<td>Awbi</td>
</tr>
<tr>
<td>Conventional Mode of Instruction</td>
<td>Acmi</td>
</tr>
<tr>
<td>Learning Style</td>
<td>B</td>
</tr>
<tr>
<td>Diverging Style</td>
<td>Bdi</td>
</tr>
<tr>
<td>Converging Style</td>
<td>Bco</td>
</tr>
<tr>
<td>Accommodating Style</td>
<td>Bac</td>
</tr>
<tr>
<td>Assimilating Style</td>
<td>Bas</td>
</tr>
<tr>
<td>Intelligence</td>
<td>C</td>
</tr>
<tr>
<td>High Level of Intelligence</td>
<td>Chi</td>
</tr>
<tr>
<td>Low Level of Intelligence</td>
<td>Cli</td>
</tr>
</tbody>
</table>
The factorial design 2X4X2 used in the present study for the variables of instructional strategies, learning styles and intelligence i.e. (two instructional strategies X four learning styles X two levels of intelligence) is discussed below:

**2X4X2 Factorial Design (Instructional Strategy X Learning Style X Intelligence)**

This was a three factor design involving three independent variables i.e. instructional strategy, learning style and intelligence. Instructional strategy involved two strategies- web based instruction and conventional mode of instruction. Learning style had four styles- diverging, converging, accommodating and assimilating and intelligence had two levels-high and low.

Instructional strategy X Learning Style X Intelligence

\[ A \times B \times C \]

**Formation of factorial design**

For making 2X4X2 factorial design and in order to apply ANOVA, students (N=320) were divided into two groups of 160 each – one group to be taught by web based instruction (Awbi) and the other group to be taught by conventional mode of instruction (Acmi). These two groups of students were distributed into four learning styles depending upon the learning style they employed. For having the same number of students for each learning style, only 76 students were randomly retained as per their learning style. Hence, the group taught by web based instruction (N=160) had 38 students each of diverging style (Bdi), converging style (Bco), accommodating style (Bac) and assimilating style (Bas) and the group taught by conventional mode of instruction (N=160) had 38 students each of diverging style (Bdi), converging (Bco), accommodating style (Bac) and assimilating style (Bas). Thus, students with diverging styles (N=38) taught by web based instruction had 10 students with high level of intelligence and 10 students with low level of intelligence (top 27 percent and bottom 27 percent, as stated earlier). The same procedure was followed for students with converging, accommodating and assimilating learning styles. The same procedure was followed for students with diverging, converging, accommodating and assimilating learning styles for conventional mode of instruction.
4.3 SAMPLE FOR THE STUDY

The adequacy of a sample i.e. its lack of bias depends upon our knowledge of the population as well as the method used in drawing the sample. A population is the theoretical set of all possible observations or a particular experiment (Calfee, 1975).

Various techniques have been devised for obtaining sample. In the present study, in order to satisfy the real effort in experimental research, the logical statistical inference of purposive sampling was initially employed to select those schools which have LAN facility and then random sampling technique was used.

The sample in the present study was drawn at the school and student level:

4.3.1 The School Sample

The present study was conducted in the state of Punjab. In Punjab there are 22 districts. Each district has two types of schools-rural and urban. Schools in rural area were not taken for the present study as the medium of instruction is Punjabi and there was no facility of LAN. For the purpose of the present study, only urban schools were taken. Urban schools are either privately managed or managed by the government. These schools are affiliated to one of the three examination boards i.e. Punjab School Education Board (PSEB), Indian Certificate of Secondary Education (ICSE) and Central Board of Secondary Education (CBSE). Although schools affiliated to ICSE were fulfilling the basic requirements for the present study i.e. computer facilities and English as a medium of instruction, yet these schools were not included in the study as their number is insufficient in the state to represent the total population. The science education and computer facilities in schools affiliated to PSEB are very pathetic as compared to schools affiliated to CBSE which are fairly good in terms of science education and computer facilities. Hence, a wide gap in achievement in Biology of students from PSEB and CBSE schools would have skewed the data. The investigator therefore, delimited her study to private schools affiliated to CBSE in the state of Punjab.
Figure 4.2 Map of Punjab showing District of Data Collection
The school sample comprising of class IX students (session 2) drawn from the representative Secondary Schools of Amritsar city with LAN facility. The average age of students ranged from 14-16 years, schools having LAN facility under the administration of the Amrit procured (Annexure-III).

The names of schools were written down on slips of equal size were folded into six symmetrically equal parts and put in an enclosure. The lid was then covered and the box was shaken up many times, shuffling. Then the investigator asked one of the school students to take out 60 slips.

The draw included the following schools:

1. Springdale Public School, Fatehgarh Road, Amritsar
2. Shri Guru Harkrishan Sr. Sec. Public School, G.T.Road, Amritsar
3. DAV Public School, Lawrence Road, Amritsar
4. DAV International School, Bye Pass Road, Verka Chowk, Amritsar
5. GD Goenka Public School, NH-1, Off G. T. Road, Manawala

The Principals of these schools were approached. Principals of three schools welcomed the idea of Web Based Instruction and were willing to participate in the programme. Hence the investigator chose these three schools – Springdale Public School, Fatehgarh Road, Amritsar, DAV Public School, Lawrence Road, Amritsar, Shri Guru Harkrishan Sr. Sec. Public School, G.T.Road, Amritsar for conducting the experiment.

4.3.2 The Student Sample

After selecting the schools, class IX student sample (N=330) was randomly drawn from the above said three schools. The investigator picked 120 students from two schools and 130 students from the third school as shown in table 4.1.
The sample comprising of 330 students was administered two tests—test of achievement in Biology and test of intelligence. Out of 330 students, six students did not respond to all the items of achievement and four students did not respond to some items of intelligence test i.e. total of 10 students were dropped from the sample of 330 students. The scores of these students were not considered at the time of analysis. Hence sample comprising of 320 students were randomly divided into two groups—the experimental group and the control group. In order to make equivalent groups, matching was done at the pre-test stage for two variables—variable of achievement in Biology (pre-test) and intelligence. t-test was employed to compare mean scores on the variable of achievement in Biology and Intelligence. Insignificant t-ratio showed that both the groups were matched and equivalent (detail is given in chapter V). The experimental group was taught with web based instruction and the control group was taught with conventional mode of instruction. The experiment lasted for three months.

### 4.3.3 Sample Distribution

As the present study involved two instructional strategies (web based instruction and conventional mode of instruction), four learning styles (diverging, converging, accommodating and assimilating) and two levels of intelligence (high and low), hence the students (N=320) were distributed at three stages—on the basis of instructional strategies, on the basis of learning styles and on the basis of intelligence.
Stage I: Sample Distribution on the basis of Instructional Strategy

The sample was distributed on the basis of instructional strategies into two types i.e. web based instruction and conventional mode of instruction. The distribution of the sample on the basis of these strategies is presented in table 4.2.

Table 4.2 Distribution of Sample on the basis of Instructional Strategies (N=320)

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Name of the School</th>
<th>Experimental (Group taught with WBI)</th>
<th>Control (Group taught with CMI)</th>
<th>Total No. of Students</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>No. of Students</td>
<td>No. of Students</td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>Shri Guru Harkrishan Sr. Sec. Public School, G.T.Road, Amritsar</td>
<td>63</td>
<td>62</td>
<td>125</td>
</tr>
<tr>
<td>2.</td>
<td>DAV Public School, Lawrence Road, Amritsar</td>
<td>49</td>
<td>49</td>
<td>98</td>
</tr>
<tr>
<td>3.</td>
<td>Springdale Public School, Fatehgarh Road, Amritsar</td>
<td>48</td>
<td>49</td>
<td>97</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>160</td>
<td>160</td>
<td>320</td>
</tr>
</tbody>
</table>

Stage II Sample Distribution on the basis of Learning Style

To distribute the sample on the basis of learning style, Kolb Learning Style Inventory was employed. On the basis of scores the students obtained on the inventory (as per manual), they were identified with different learning styles. Out of these 83 students had diverging style, 76 students had converging style, 80 students had accommodating style and 81 students had assimilating style. As the number of students with different learning styles varied and ranged from 76 to 83, only 76 students were retained randomly for every learning style. This was necessary to ensure that experimental group and control group had equal number of students with different learning styles. At this stage the sample comprised of 304 students divided
into four learning styles of 76 students each. Further these 76 students were randomly assigned to two groups of 38 each - experimental and the control. The distribution of sample on the basis of learning styles is shown in table 4.3.

Table 4.3 Distribution of the Sample on the basis of Learning Style (304)

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Treatment Groups</th>
<th>Learning Style</th>
<th>Total No. of Students</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Diverging</td>
<td>Converging</td>
</tr>
<tr>
<td>1.</td>
<td>WBI</td>
<td>38</td>
<td>38</td>
</tr>
<tr>
<td>2.</td>
<td>CMI</td>
<td>38</td>
<td>38</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>76</td>
<td>76</td>
</tr>
</tbody>
</table>

Stage III Sample Distribution on the basis of Intelligence

The students with four learning styles retained for the purpose of study (N=304) were to be distributed into three levels of intelligence viz. high level of intelligence, average level of intelligence and low level of intelligence. For this purpose, General Group Test of Intelligence (GGTI) was employed. On the basis of the scores obtained, students coming in the top 27 percent were the students with high level of intelligence and students in the bottom 27 percent (Kelley, 1939) were those with low level of intelligence and students coming between the range of 28 to 72 percent had average level of intelligence. The middle group of students with average level of intelligence was excluded from the study. At this stage, the sample consisted of 160 students with four different learning styles, each with 40 students and every learning style with 20 students with high level of intelligence and 20 students with low level of intelligence. Further, out of these 20 students with high level of intelligence, 10 were to be taught with web based instruction and the rest with conventional mode of instruction. The same strategy was applicable to the students with other learning styles.

The data distribution at this stage on the basis of intelligence is presented in table 4.4.
Table 4.4 Distribution of the Sample on the basis of Intelligence (N=160)

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Treatment Groups</th>
<th>Learning Style</th>
<th>Total No. of Students</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Diverging</td>
<td>Converging</td>
</tr>
<tr>
<td></td>
<td></td>
<td>High level of Intelligence</td>
<td>Low level of Intelligence</td>
</tr>
<tr>
<td>1.</td>
<td>WBI</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>2.</td>
<td>CMI</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>20</td>
<td>20</td>
</tr>
</tbody>
</table>

4.4 TOOLS USED

The following tools were used for collecting the data:

1. An achievement test in Biology for class IX was developed and standardized by the investigator to measure the performance of students before and after the treatment.
2. The Kolb Learning Style Inventory by Kolb (2007).
3. General Group Test of Intelligence (GGTI) by Ahuja (2005).
4. Web based instructional package in Biology for class IX was developed and validated (content wise) by the investigator (Appendix-IV). Lesson plans on the same chapters for delivering lectures by conventional mode of instruction were also prepared by the investigator.

4.5 DESCRIPTION OF TOOLS

4.5.1 Achievement Test

An achievement test in Biology consisting of 60 multiple choice questions covering knowledge, understanding and application objectives was developed and standardized by the investigator. The details of the development and standardization of an achievement test have been discussed in chapter II. The reliability of the test calculated by test re-test method was found to be 0.88. The content validity of the test was established. A final copy of the test is appended at the end (Appendix -I).
4.5.2 The Kolb Learning Style Inventory by Kolb (2007)

Learning Style Inventory by David. A. Kolb has been published in five versions over the last 35 years. The Kolb Learning Style Inventory Version 3.1 (KLSI 3.1), revised in 2005, is the latest revision of the original Learning Style Inventory developed by David A. Kolb. This inventory helps in classification of students on the basis of four different learning styles. It is a simple, self-explanatory and easy to administer. According to Kolb, learning can be defined as a cycle made of four basic phases. The LSI takes a learner through those four phases so that he can understand how he learns.

Reliability:

The norm group of Kolb LSI includes men and women ranging in age from 17-75 years. Reading age as mentioned in Technical Specifications of Kolb LSI is 12. Many researchers have validated and used Kolb LSI for students in age group of 12-16 years. (Clariana, 1997; Shrivastava, 2002; Kadir and Din 2006; Wang, Wang, Wang and Huang 2006; Koun-tem, Yuan-cheng and Chia-jui, 2008; Kaya, Ozabaci and Tezel, 2009 and Turan 2010). For the purpose of the present study to see whether Kolb Learning Style Inventory could be applied to a group of students (age group 14-16 studying in class IX) of Punjab, reliability of the test was calculated by test-retest method. Pearson’s product moment coefficient of correlation was calculated to find out coefficient of reliability. For each dimension, reliability coefficients are given in table 4.5.

Table 4.5 Reliability Coefficient for each dimension of Kolb LSI

<table>
<thead>
<tr>
<th>Learning Style Dimensions</th>
<th>Reliability Coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concrete Experience</td>
<td>0.78</td>
</tr>
<tr>
<td>Reflective Observation</td>
<td>0.73</td>
</tr>
<tr>
<td>Abstract Conceptualization</td>
<td>0.76</td>
</tr>
<tr>
<td>Active Experimentation</td>
<td>0.71</td>
</tr>
<tr>
<td>Abstract Conceptualization-Concrete Experience</td>
<td>0.78</td>
</tr>
<tr>
<td>Active Experimentation-Reflective Observation</td>
<td>0.72</td>
</tr>
</tbody>
</table>
Validity:

Internal and external validity of the inventory has been established by the investigator.

Administration:

The subjects were seated comfortably, at reasonable distance from each other and all within such distance that every subject could clearly hear the tester’s voice. The inventory has two sheets- sheet 1 for students and sheet 2 for scoring. The investigator distributed the inventory (sheet one) and told the students that it consists of 12 sentences that describe learning. They were told that each sentence has four endings. The investigator asked the students to rank the responses for each sentence according to how well they think each response describes the way they learn. The investigator instructed the students that they have to write 4 next to the sentence ending that describe how they learn best and so on down to 1 for the sentence ending that seems least like the way they learn. Students were made sure that they have to rank all the endings for each sentence and not to give same number to two endings. The investigator told the students that they have to complete the inventory within thirty minutes. After the students had finished ranking each item, inventories were collected.

Scoring:

For determining the learning style, investigator placed the sheet one of inventory on the sheet 2 and took scores for all the four learning phases i.e. Abstract Conceptualization (AC), Concrete Experience (CE), Active Experimentation (AE) and Reflective Observation (RO) and subtracted (AC-CE and AE-RO) for getting two combination scores. The total scores should be 120 for four learning phases. Then the investigator plotted the scores on the learning style grid. After plotting scores on the grid, individual’s particular learning style was identified from the shape of the graph.

A copy of Kolb LSI is appended (Appendix –II).
4.5.3 **General Group Test of Intelligence (GGTI) by Ahuja (2005)**

As a measure of verbal intelligence, Group Test of Intelligence (GGTI) in English by G.C. Ahuja (2005) was used in the present study. This test is meant for assessing the general mental ability of pupils of age group 13 to 17 years studying in classes VIII to IX. Being a group test, it can be administered conveniently on a number of students at a time and in a period of 45 minutes. The test is highly reliable as it was published in 1976, reprinted in 1984, 1992, 1998 and 2005 with no change in the test items.

The test consists of the test booklet and the answer sheet. The test booklet contains eight sub-tests. Test I is an additional sub-test which is meant for practice only. The remaining seven sub-tests from II to VIII are the tests proper. For each sub-test, one page is devoted to instructions and practice examples. The test contains 135 test items and 24 practice examples.

**Reliability:**

The reliability co-efficient of the test was determined by two methods:

- The Test Retest Method $= 0.84 \pm 0.21$
- The Split-Half Method $= 0.95 \pm 0.003$

**Validity:**

The empirical validity of the test was studied and the co-efficient of correlation was found by the following methods:

- Scholastic Marks $= 0.57 \pm 0.43$
- Teacher’s Judgments $= 0.61 \pm 0.40$
- Nafde’s Non-Verbal Test of Intelligence $= 0.50 \pm 0.44$

**Administration:**

The investigator distributed the answer sheets and asked the students to fill in the required information in the proper spaces on the answer sheets according to the given instructions. After ensuring that these particulars had been filled by all the students, investigator distributed booklets and told the students not to open the booklet until the investigator asked them to do so. The investigator read carefully the
main and general instructions given in the beginning of the test booklet. They were asked to attempt each and every item. Any queries and doubts were properly clarified and explained. After making the students comfortable, the investigator told the students to start the test I. After exactly four minutes they were told to stop. Then the investigator asked the students to start on the test II. After the students finished marking their responses, the test booklets were collected along with the answer sheets. The total time taken for the test was approximately 40 minutes.

**Scoring:**

The investigator placed the relevant stencil key on each page of the answer sheet and correctly marked cross marks (×) were visible through the holes of the stencil. The investigator counted the number of right answers and wrote in the left margin against each sub-test of that page. The same procedure was followed for all the sub-tests except for Test VII in which the students had to write the answers in the given space. Then, the investigator transferred scores from the different pages of the answer sheet in the table on the front page and calculated the total score.

A copy of Group Test of Intelligence is appended (Appendix –III).

### 4.5.4 Web Based Instructional Package (WBIP)

Web based instructional package in Biology for class IX from NCERT science syllabus (2010-11) was developed by the investigator. Development of WBIP has been discussed in chapter II and a compact disk (CD) containing WBIP is appended at the end (Appendix IV).

### 1.6 CONTROLLING EXTRANEOUS VARIABLES

In a well designed experiment, the various factors that may influence the outcome of experiment must be controlled if sound conclusions are to be drawn. In the present study the investigator tried to control the following extraneous variables to the maximum extent that they were likely to affect the final achievement of students:

1. **Intelligence:** Intelligence was controlled by equating both the groups by giving General Group Test of Intelligence by G.C.Ahuja. t-ratios were found to be insignificant in both the groups.
2. **Prior Knowledge:** Pre-experimental achievements of both the groups were controlled by equating the groups on pre test scores prior to the experimentation.

3. **School Environment:** All the schools selected for the experiment were affiliated to CBSE and have more or less same physical environment such as ventilation and light arrangement, LAN facility etc.

4. **Teacher Behaviour:** The investigator assisted by three M.Ed. students of her college conducted the experiment. Control groups of all the three schools were taught by the investigator herself at different times allotted by the respective schools (vide table 3.7). Hence, this eliminated inter-teacher variation.

5. **Content:** The same content was taught to both the groups-experimental and control, hence, controlling the content variable.

4.7 **PROCEDURE**

The procedure involved:

- Sample selection
- Conducting the experiment

4.7.1 **Sample selection**

The sample in the present study was drawn at two levels- the school sample and the student sample. The process of sampling has already been discussed in detail under the heading Sample for the Study (4.3) of the present chapter.

4.7.2 **Conducting the Experiment**

The present study was conducted in four phases:

**Phase I: Development of Web Based Instructional Package (WebBio) and an Achievement Test**

Web based instructional package package (WebBio) and an achievement test in Biology for class IX were developed by the investigator. The achievement test in Biology was also standardized by the investigator. The process of development of web based instructional package and achievement test has already been discussed in chapter II of the present study.
Phase II (a): Matching the Groups

Before implementing the web based instructional package, the two groups - experimental and control groups were randomly decided with the flip of coin and were matched on the basis of pre-test scores and intelligence so that equivalent groups could be formed.

Phase II (b): Administration of an Achievement Test (pre-test), Learning Style Inventory and Intelligence test.

Before administering the tests, a meeting was held with class teachers and subject teachers of three respective schools that helped in chalking out the date and time schedule for the administration of the tests and implementation of the programme. After this the investigator established a rapport with class IX students of these schools. The students of both the groups viz. experimental and control groups were then administered the following tools:

a. An Achievement test as a pre-test measure was administered on the total sample (N=320). Before starting the test, the necessary directions regarding the pre-test were given to students and it was confirmed that all the students followed those instructions. Scoring was done to obtain the information regarding knowledge of the students in Biology of class IX.

The students were told that the purpose of the test was not to evaluate their but to get useful information for some research work. They were told that the test done by them would help the researcher to get better information. They were also guided and instructed on how to take the test.

b. General Group Test of Intelligence (GGTI) by G.C. Ahuja (2005) and The Kolb Learning Style Inventory (2007) were administered to 320 students. The tests were administered on each school sample in order to identify the students with different types of learning styles and the levels of intelligence in accordance with the instructions given in the respective manuals by the concerned authors. The detail of administration for learning style and intelligence has been discussed under the heading description of tools cited in 4.5.2 and 4.5.3.

The sequence of the test was the same in all the three schools. The schedule of administration of the tests is presented in table 4.6.
Table 4.6 School-Wise Schedule for Tests Administration

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Name of School</th>
<th>Pre-testing</th>
<th>Intelligence</th>
<th>Learning Style</th>
</tr>
</thead>
</table>

Phase III: Implementation of Web Based Instructional Package

Two instructional strategies were used for the instructional programme. The total sample of 320 students of class IX was divided into two equal groups consisting of 160 students each. Strategies of instructions were assigned randomly into two groups so as to eliminate bias. The experimental group was taught through web based instruction and the control group was taught by conventional mode of instruction respectively. The same content was taught to both the groups for the same duration of time. The duration of instructional treatment was 30 sessions in each case with each session of 45 minutes. Regarding the experimental period, the investigator had already contacted with the heads of the schools taken for study and informed them that Biology portion of class IX syllabus would be taken by her. The investigator personally requested the concerned subject teachers of the schools for leaving Biology portion of class IX from NCERT science syllabus (2010-11) and had taken the time for experimental phase as per their suitability without disturbing their schedules. In experimental group, each student worked independently On-line and used web based instructional package themselves.

The investigator associated three M.Ed. students to ensure a smooth conduct of the experiment in all the three schools. Before conducting the experiment, the investigator interacted face to face with each group (experimental group and control group) separately to establish rapport. The experimental group was intimated that from tomorrow onwards they would be taught Biology by web based instruction i.e. through the web based instructional package. Web based instructional package on Biology is available on website (Webzbio.com) developed by the investigator. To
access web based instructional package, they will go to their school computer laboratory. There they will open web based instructional package after keying http://www.webzbio.com in the URL. Before starting the Module 1, they have to read the instructions carefully (mentioned in How to Use Module link) which will be displayed after they have keyed in the username (web) and password (bio). After reading the instructions, they can start with Module 1. During this period, no subject teacher will be available to the students for clearing their doubts. For interacting with the investigator in an asynchronous way at any time of the day, the course provides built-in contact us link. The control group was also intimated that from tomorrow onwards she will teach Biology.

On the first day of the treatment, M.Ed. students took the experimental groups of three respective schools to the school computer laboratories as per the time slot given by the schools. M.Ed. students were involved as to ensure that the students of experimental group remain in the computer laboratory during the treatment period. During this period, investigator herself taught the control group in three sessions in three different schools.

**Phase IV: Administration of the Achievement Test (post-test)**

After completion of all the modules, the same achievement test (as pre-test) in Biology was administered as post-test to the students of both the groups. After completion of the test, the students were thanked for their full cooperation during the entire period of the experiment.

The date schedule followed for the experiment has been given in Table 4.8

<table>
<thead>
<tr>
<th>Table 4.7 School-Wise schedule followed for the conduct of the experiment</th>
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<tbody>
<tr>
<td><strong>Phase of Experiment</strong></td>
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<tr>
<td>Clock Time→</td>
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<tr>
<td>Phase IV</td>
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</tbody>
</table>
4.8 COLLECTION OF DATA

The tests were administered and the responses of the students (N=320) were scored as per the scoring procedures. The data at this stage comprised of the following set of scores for every student:

- Pre-test achievement scores
- The Kolb Learning Style Inventory scores
- Intelligence test scores
- Post-test achievement scores

Data thus obtained was subjected to statistical analysis.

4.9 STATISTICAL TECHNIQUES USED

The following statistical techniques were employed to give a concise picture to the data so that it can be easily comprehended:

- Descriptive statistics such as Mean, Median, Mode, Standard Deviation, Skewness and Kurtosis were computed on the total sample (N=320) and their graphic representation was made to study the general nature of data.

- Three way (2X4X2) analysis of variance was employed on the sample (N=160) to test the hypotheses by finding out the main effects and interactional effects of the different variables viz. instructional strategy, learning style and intelligence on dependent variable i.e. achievement scores of secondary school students in Biology.

- For the significant F-ratio, the t-test was employed so as to find out the significance of difference between means related to different groups and different variables.