CHAPTER – 3

RESEARCH DESIGN AND METHODOLOGY

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CHAPTER-3  
RESEARCH DESIGN AND METHODOLOGY

3.1.0 INTRODUCTION  

Previous chapter deals with the review of related literature in India and abroad. This chapter presents the methodology adopted by the researcher to realize objectives of the present research. It refers to the plan and procedure to be used by the researcher for conducting the present research. In this chapter researcher try to give detail of research design, population, sample, tools used in data collection and method used for analysis of data.

3.2.0 ORIGIN OF THE STUDY  

The world is fast moving from a stage where steel and miles of railways were important, to a stage where the size and complexity of information and communication system will be the barometer of a country’s development. In this information society access to the right information at the right time in a convenient form can trigger new directions in research. Present Fast Food Culture used to of play station and game station in a way that it is crucial to think for a teacher their mind without technoplosion. Someone might astonish to see them in a way they operating Joy Stick, Mouse and Key board. This makes intrigue to put computer based learning method to researcher.

Concept of CAI is not new in developed countries. It is used in either form at relevant period of time. Such computer technology has been continuously improving since its inception and similarly its role in various fields. Researcher himself related with teaching of Physics for approximately five year in Higher Secondary English as well as Gujarati medium. During that time taking exhausting 42 periods is embracing. While, working with computer and surfing on internet is always give new direction in teaching, make learning interesting and potential. This leads to develop Computer Assisted Instruction package in Wave Optics, phenomenon related with motion of waves, which is a part of Physics.
During the teaching process it is generally difficult to develop the abstract concept. This one is the biggest problem related with such abstract subject physics. On moving to market, the availability of many commercial programs is there but it is not of the adequate quality and many time lead to a misconception. This leads to development of package in Physics. In this package animation, graphics, sound, images and moreover Java is utilized in power point presentation so the live effect generated. The data and running program can be controlled so that arising effect can be realized and such simulations generate clear conceptuality.

Thus the problem under study was originated with likewise thinking and a bit discussion with concern teachers. After going through the review of related literature this research is only one of its kinds. It is an attempt to check the effectiveness of the CAI for the student of XII Science.

### 3.3.0 DESIGN OF THE STUDY

The present research was a developmental cum experimental research. The researcher has selected the topic “Computer Assisted Instruction in Physics for the student of Standard XII: An Experimental study” for the study. The researcher follows pre test post test control group design. This study conducted in two phase. During the first phase CAI package was developed on one chapter of physics of standard XII, chapter 11-Wave Optics. In the second phase effectiveness of the developed CAI package was checked. The effectiveness of developed CAI package was checked with pre test post test control group design with replication in terms of students’ achievement.

The purpose of this research design is to find out true effect of the treatment. This design control history, maturation and other factor that threat internal validity. The students of control and experimental group are administrated similar achievement test. The design of the present research is presented in the chart 3.1.
Area
SURAT DISTRICT

RURAL AREA
N = 100

GROUP - 1
CONTROL GROUP
N = 50

GROUP - 2
EXPERIMENTAL GROUP
N = 50

IQ TEST
40 MINUTE
PRE TEST
1 HOUR

TEACHING THROUGH TRADITIONAL METHOD
24 PERIOD

POST TEST
1 HOUR

OPINIONNAIRE
20 MINUTE

URBAN AREA
N = 100

GROUP - 1
CONTROL GROUP
N = 50

GROUP - 2
EXPERIMENTAL GROUP
N = 50

IQ TEST
40 MINUTE
PRE TEST
1 HOUR

TEACHING THROUGH TRADITIONAL METHOD
24 PERIOD

POST TEST
1 HOUR

OPINIONNAIRE
20 MINUTE
3.4.0 VARIABLES OF THE STUDY

Variables are the conditions or characteristics that the experimenter manipulates controls or observe. Key elements in a research problem are the variables. For the present research work variables are as below:

Independent variables : 1. learning through CAI package
                      2. Teaching through conventional method

Dependent variables : 1. Achievement score obtained by the student on post test
                      2. Area – Rural and urban
                      3. Gender – Boys and girls
                      4. IQ level

Moderator variables : 1. Area – Rural and urban
                      2. Gender – Boys and girls
                      3. IQ level

Covariant : 1. Pre test score
            2. IQ

Control variables : 1. Standard XII
                    2. Subject – Physics
                    3. Medium – Gujarati
                    4. Time

Intervening variables : 1. Innovation in experiment
                       2. Interest and excitement in subject
                       3. Maturity
                       4. Interaction among student
                       5. Extra coaching.

3.5.0 POPULATION OF THE STUDY

A “Population” is any group of individuals/units that have one or more characteristics in common which are of interest to the researcher, for a particular research. All the students studying standard XII of science stream of Gujarati medium schools of Gujarat Secondary and Higher Secondary Education Board, Gandhinagar, Gujarat constitute the population of the present research.
3.6.0 VALIDITY OF THE EXPERIMENTAL DESIGN

The main objective of planning an experiment is to maximize the treatment variance and minimize the error variance. This, in other words, is termed as ‘validity’ of the experimental design. In MES-016 Educational Research Block-02 IGNOU noted that, Campbell and Stanley (1963) have identified some such source of error. These sources of error are related to internal validity dealt in detailed regarding experiment as below:

3.6.1 INTERNAL VALIDITY

1. HISTORY

The special events that affected the dependent variable and brought in error are called history effect.

During the ongoing experiment Computer Instructor of the school instruct them regarding CAI package. At a same time as computer is one of the compulsory paper they used to go in the computer laboratory, so they acquainted with the atmosphere. The experiment was conducted at a same time in a school of Bardoli and Vankal, so it could be said that no effect of history arise during the experiment.

2. MATURATION

The time period that elapse during the experimentation may produce certain changes in the subjects. The subject may perform differently on the dependent variable due to processes like fatigue, age, interest or motivation. Therefore the effect of such changes on the dependent variable along with treatment may bring in error called as ‘Maturation’ effect.

Here, the duration of the experiment is short and group arrangements are random. Hence, results obtained are due to treatment given in the experiment.

3. PRE TESTING

The student in the experiment has been tested before and after the treatment. Due to this exposure of the subject serve as the learning experience.
This factor does not controlled during the experiment procedure as the design is so selected.

4. MEASURING INSTRUMENT

Different measuring instrument cause the threats to internal validity. Here same pre test, post test and CAI package prepared by the researcher himself was implemented. This will control the factor.

5. STATISTICAL REGRESSION

The group is chosen on the basis of extreme scores. This refers to the tendency for extreme scores to regress towards the common mean on subsequent measure.

In the experiment the groupings were done by random sampling technique, so in the groups there is an equal probability that all students get equal opportunity to be selected thus this factor has been controlled.

6. EXPERIMENTAL MORTALITY

The dropping out of the subjects during experimentation is called Mortality.

During the experiment no students were dropped out before or after the pre testing. So, there is no differential loss affect the findings of the study. Secondly the duration of the experiment is short which nullify the probability of decrease in number of subjects.

7. DIFFERENTIAL EFFECT OF SUBJECTS

The groups may differ significantly on some important variables related to the dependent variable even before the application of the experimental treatment. If the researcher had taken two different groups they may not be similar with respect to many other intervening variables. This is called selection effect.

For the present research groupings are done randomly and in statistical analysis, Analysis of Co Variance has been used as a result this factor has been controlled.
8. INTERACTIVE COMBINATION OF FACTORS

All the discussed factors do not exist in isolation rather all these occur simultaneously during experimentation. Such interaction of selection and factors may boost the scores on dependent variable even in the absence of treatment.

For the present research work groupings are done randomly and hence this factor has been controlled.

3.6.2 EXTERNAL VALIDITY

The extent to which the objective of the researcher is attained is a measure of the external validity of the experimental design. This validity is concerned with the generalizability. Braacht and Glass (1968) have classified external validity into two types: (1) Population validity (ii) Ecological validity.

1. POPULATION VALIDITY

Population validity is concerned with the identification of the population to which the result of an experiment can be generalized.

In the experiment the researcher has studied the effectiveness of CAI in physics for the students studying standard XII of science stream of Gujarati medium schools of Gujarat Secondary and Higher Secondary Education Board of Surat district. This was considered as the accessible population of the study. The target population was all the students studying standard XII of science stream of Gujarati medium schools of Gujarat Secondary and Higher Secondary Education Board, Gandhinagar, Gujarat. The researcher has strictly followed the principle of randomization in selecting the experimental sample from the experimentally accessible population.

2. ECOLOGICAL VALIDITY

It is concerned with generalizing experimental effects to the environmental condition. According to Koul (1988) the factors affecting the ecological validities are described as below:
I. INTERACTION EFFECTS OF SELECTION BIASES AND TREATMENT

It is assumed that samples taken are not necessarily representative of the target population. Consequently generalization from samples to populations is hazardous.

For the present research work a large sample was taken and groupings are done randomly to overcome this threat of ecological validity.

II. REACTIVE EFFECT OF EXPERIMENTAL ARRANGEMENT

There may be a reactive effect due to the experimental procedure. The presence of observer, experimental equipment, makes the subject aware of the fact that they are receiving experimental treatments and therefore they may change their normal behaviour.

In the experiment one group receive treatment through Computer Assisted Instruction in the computer laboratory by themselves. No specific class arrangements were done for them. Here they were acquainted to the computer laboratory as it is one of the subject during the year.

III. MULTIPLE-TREATMENT INTERFERENCE

When two or more treatments are administrated to the same group within the same or different studies, it is difficult to find the cause of the experimental results or to generalise the result to the experimental settings in which only one treatment is present.

In this experiment subjects are assigned randomly to the groups and single treatment were given to both the groups control the factor.

3.7.0 SAMPLE OF THE STUDY

As per purposive sampling technique one school, M. B. Vamdot Sarvajanik High School, Bardoli, of Higher Secondary Science stream was selected and pilot testing was made on boys and girls of XII Science. For Pilot testing of CAI package students were selected on the basis of their marks of XI in the Physics subject. Detailed regarding pilot testing is as follows with achievers category.
Table: 3.1

Achievers category for pilot testing

<table>
<thead>
<tr>
<th></th>
<th>High</th>
<th>Medium</th>
<th>Low</th>
</tr>
</thead>
<tbody>
<tr>
<td>More than 60 Marks</td>
<td>Less than 60 but more than 45</td>
<td>Less than 45</td>
<td></td>
</tr>
</tbody>
</table>

Table: 3.2

Detail of the sample for pilot testing

<table>
<thead>
<tr>
<th>Gender</th>
<th>Number of Students</th>
<th>Total Student</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boys</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Girls</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

As per the topic ‘Computer Assisted Instruction in Physics for the student of standard XII: An Experimental Study’, to check the effectiveness of the CAI package researcher used Multistage sampling technique. For the present study the city and schools was selected purposively. For it the researcher selected two schools, The N. D. Desai Sarvjanik High School, Vankal and B.A.B.S High School, Bardoli. These schools were selected with the purpose of getting all the required facilities as well one school from rural and other is form urban area was selected. From the selected school, the students are selected randomly using lottery method. In each school two groups are formed having 50 students in each. One group constituted experimental group and other as control group. Thus total 200 students were selected as sample for the present research work. The detail regarding sample is as below:
Table: 3.3
Sample for the experiment

<table>
<thead>
<tr>
<th>No</th>
<th>School Name</th>
<th>Group</th>
<th>Girls</th>
<th>Boys</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>The N. D. Desai Sarvjanik High School, Vankal</td>
<td>Traditional Group</td>
<td>17</td>
<td>33</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Experimental Group</td>
<td>18</td>
<td>32</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Total</td>
<td>35</td>
<td>65</td>
<td>100</td>
</tr>
<tr>
<td>2</td>
<td>B.A.B.S High School, Bardoli</td>
<td>Traditional Group</td>
<td>26</td>
<td>24</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Experimental Group</td>
<td>26</td>
<td>24</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Total</td>
<td>52</td>
<td>48</td>
<td>100</td>
</tr>
</tbody>
</table>

Initially pre test was implemented on the students of both the schools. Than IQ test was conducted. These groups are than randomly, by lottery method, divided in to two groups and experimental group learn through computer while traditional group learn with the help of their teacher.

3.8.0 TOOLS FOR DATA COLLECTION

The topic of the research was “Computer Assisted Instruction for the student of standard XII: An Experimental study” keeping this topic in mind the tools used are as follows:

CAI package in physics was developed by the researcher. This tool is prepared with the help of different software by researcher himself. CAI package was consisted of one chapter from text book of physics part 2 of the XII science.

The researcher constructed achievement test for the pre test post test purposes related to selected topics of Physics-Wave Optics of standard XII Gujarati medium following GS&HSEB curriculum. The achievement test was Multiple Choice Question cum short question answer type. It included Objective type questions; fill in the blanks, true or false statements, short question answer and short definitions of standard XII
Physics of GS&HSEB. The constructed test was shown to the subject expert in the field of Physics. Their suggestions were duly corporate in the achievement test. The achievement test was of 50 marks and of 1 hour.

After analyzing the unit ‘Wave Optics’ achievement test was prepared with the help of Blue Print. This achievement test was used as pre test and post test. Types of exercise in achievement test and structure of the blue print is given in the table below:

Table 3.4
Types of exercise in achievement test

<table>
<thead>
<tr>
<th>No</th>
<th>Types of Question</th>
<th>No. of Question</th>
<th>Total Mark</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Objective Type</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>2</td>
<td>Fill in the blanks</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>3</td>
<td>True and False</td>
<td>05</td>
<td>05</td>
</tr>
<tr>
<td>4</td>
<td>Short Question Answer</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>5</td>
<td>Explain the terms</td>
<td>05</td>
<td>05</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>50</td>
<td>50</td>
</tr>
</tbody>
</table>

Table 3.5
Blue Print

According to Content | According to Objective | According to Content

<table>
<thead>
<tr>
<th>Content</th>
<th>Mark</th>
<th>Objectives</th>
<th>Mark</th>
<th>Content</th>
<th>Mark</th>
</tr>
</thead>
<tbody>
<tr>
<td>History and type of light waves</td>
<td>02</td>
<td>Knowledge</td>
<td>10</td>
<td>Objective Type</td>
<td>35</td>
</tr>
<tr>
<td>Wave front and Huygens’ theory</td>
<td>08</td>
<td>Understanding</td>
<td>17</td>
<td>Short Question</td>
<td>15</td>
</tr>
<tr>
<td>Interference</td>
<td>11</td>
<td>Utility</td>
<td>21</td>
<td>Total</td>
<td>50</td>
</tr>
<tr>
<td>Diffraction</td>
<td>10</td>
<td>Skill</td>
<td>02</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Resolving power</td>
<td>05</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Polarization</td>
<td>14</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>50</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
To elicit students’ opinion about CAI an opinionnaire of 20 statements was developed. Among them statement 6, 7, 8, 11 and 17 are negative and remaining are positive. This opinionnaire was given to the students of the experimental groups after completion of experiment to know the opinion of the students of the experiment group about the developed CAI. It was constructed by the researcher in which students had to express their views on five point Likert type scale ranging from strongly agree to strongly disagree. There were four clusters of statements in the opinionnaire soliciting opinion of the students about content presentation, questioning, individualization and self pacing of CAI software.

Intelligent Quotient is a co variant for the present research work. To measure IQ Desai verbal and nonverbal group intelligence test was implicated. There are 80 items classified on 8 types. It was administrated for 40 minute.

Other tool that used during the experiment was text book of XII Science Physics in two parts Published by Gujarat State Text Book Board, Gandhinagar. Computer System having hardware configurations of 1 GB RAM, Pentium 3 processor, CD Drive. Software used is Microsoft office power Point 2003, JAVA, Macromedia Flash Player, Adobe Flash Player, Paint, Different images, Windows media Player, HTML, Web designing, Live Web etc.

3.9.0 DEVELOPMENT OF THE CAI PACKAGE

Software for use in the experiment was developed by the researcher himself using tutorial mode as well as Simulation mode of presentation. The reason for adopting this mode of CAI was that researcher wanted to compare the effectiveness of CAI with traditional method of instruction by teachers. Teachers generally present new information to the students and assess their learning through questioning. Tutorial form of CAI also presents new information to the students in segments including questions to assess student learning, The Simulation mode is a computerized model of a real or imagined system to teach how a system works. It takes inside to the model and explains working function clears up misunderstanding and develops insights. As with the help of such model data can be changed and resultant effect can be seen, Science in general and physics in particular become more interesting, joyous and life long. As initially it was
said that physics is an abstract concept difficult to explain and understood it become
crrecte and real to understand the phenomenon like light waves, diffraction, refraction
and polarization such phenomenon which never going to be visualize in normal. It allows
students to explore complex interaction.

One Chapter from the textbook of Physics (Part-2) of standard XII was
transformed into tutorial and simulation mode of Computer Software. Each slide having
animation, graphics and Java player to explain the terms and theorems was followed by
multiple choice questions at specific interval along with immediate feedback in the form
of child face informing the student whether the students response was right or wrong.

3.9.1 STAGES FOR DEVELOPMENT OF CAI PACKAGE

To develop CAI package stages follows by the researcher are:

1. SELECTION OF THE CONTENT

Content of the present CAI package was selected from the physics of the XII
Science. Physics of XII science divided in to two parts. Researcher selected Chapter 11
Wave Optics from Physics part-2. This Chapter was selected after concerning, discussing
and analyzing content of chapters with teachers of various schools. From the entire
Physics text book Optics and especially wave optics is the topic that student learn first
time. Secondly this chapter is having completely abstract content of motion of energy as
wave which one is changing its nature. Wave optics also provides the fundamental for
learning higher physics. Such and likewise points favor the content to be chosen as the
content of the CAI package.

2. ANALYSIS OF THE CONTENT

After thoroughly going through the chapter the content of the chapter has been
analyze as shown below. This analysis of the chapter has been done on the basis of main
theory included in the chapter and which are considering as the pioneering theory of the
wave optics. This theories are supportive theory to prove light has a wave nature. These
theories are then subdivided into sub topic as shown in the chart 1. They are arrange as
per the slide prepare for CAI package. There are 155 slides and 51 topics included in it.

I. History and type of light waves
II. Wave front and Huygens’ theory
III. Interference
IV. Diffraction
V. Resolving power
VI. Polarization

TABLE 3.6
Distribution of the content

<table>
<thead>
<tr>
<th>WAVE OPTICS</th>
<th>Topic</th>
<th>Sub topics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Topic</td>
<td>Sub topics</td>
<td></td>
</tr>
<tr>
<td>1. History and type of light waves</td>
<td>1. Light-history</td>
<td>2. Light its form</td>
</tr>
<tr>
<td>2. Wave front and Huygens’ theory</td>
<td>1. Wave front</td>
<td>2. Ray</td>
</tr>
<tr>
<td></td>
<td>3. Homogeneous and isotropic medium</td>
<td>4. Huygens’s principle</td>
</tr>
<tr>
<td></td>
<td>5. Refraction and reflection of waves</td>
<td>6. Snell’s law</td>
</tr>
<tr>
<td></td>
<td>7. Wave</td>
<td>8. wave train</td>
</tr>
<tr>
<td></td>
<td>9. Principle of superposition</td>
<td></td>
</tr>
<tr>
<td>3. Interference</td>
<td>1. Interference in case of two waves</td>
<td>2. Phasor’s method</td>
</tr>
<tr>
<td></td>
<td>5. Equation in case of two coherent source</td>
<td>6. Condition for constructive interference</td>
</tr>
<tr>
<td></td>
<td>7. Condition for constructive interference in terms of path difference</td>
<td></td>
</tr>
<tr>
<td></td>
<td>8. Destructive interference</td>
<td>9. Condition for destructive interference in terms of path difference</td>
</tr>
<tr>
<td>4. Diffraction</td>
<td>10. Stationary interference</td>
<td></td>
</tr>
<tr>
<td></td>
<td>11. Young’s Experiment</td>
<td></td>
</tr>
<tr>
<td></td>
<td>12. Distance between two consecutive fringes.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1. Diffraction</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2. Ripple tank experiment</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3. Why a person standing behind the door can be listen but not seen?</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4. Types of diffraction</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5. Fresnal diffraction</td>
<td></td>
</tr>
<tr>
<td></td>
<td>6. Fraunhofer diffraction</td>
<td></td>
</tr>
<tr>
<td></td>
<td>7. Fraunhofer diffraction in laboratory condition</td>
<td></td>
</tr>
<tr>
<td></td>
<td>8. Fraunhofer diffraction through single slit</td>
<td></td>
</tr>
<tr>
<td></td>
<td>9. Central Maxima</td>
<td></td>
</tr>
<tr>
<td></td>
<td>10. First Minima</td>
<td></td>
</tr>
<tr>
<td></td>
<td>11. First Maxima</td>
<td></td>
</tr>
<tr>
<td></td>
<td>12. Generalisation of fraunhofer diffraction through single slit</td>
<td></td>
</tr>
<tr>
<td></td>
<td>13. Graph of Intensity distribution</td>
<td></td>
</tr>
<tr>
<td>5. Resolving power</td>
<td>1. Resolution power of Telescope</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2. Resolution power of Microscope</td>
<td></td>
</tr>
<tr>
<td>6. Polarization</td>
<td>1. Electromagnetic Waves</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2. Unpolarized light</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3. Tourmaline plate</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4. Plane of polarization</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5. Malus’s law</td>
<td></td>
</tr>
<tr>
<td></td>
<td>6. Nicole Prism</td>
<td></td>
</tr>
<tr>
<td></td>
<td>7. Polarization through reflection</td>
<td></td>
</tr>
<tr>
<td></td>
<td>8. Brewster’s law</td>
<td></td>
</tr>
<tr>
<td></td>
<td>9. Uses of polarization</td>
<td></td>
</tr>
</tbody>
</table>
3. DECIDING THE OBJECTIVES OF THE CAI LEARNING

Following are the objectives of the CAI learning

1. Learning becomes self paced and self directed.
2. Learners can skip over a topic if information is already known, making the learning process more efficient.
3. As human are multi-sensory animals hence multi media package enhance the learning process.
4. Complex multimedia technologies give learner more control over the learning process.
5. Students feel more successful are more motivated to learn and have increased self confidence and self esteem.
6. Students learn more and more rapidly in CAI course.
7. This learning process improves the roles of teachers and administrator in education process.

4. CONTENT SCRUTINY AND SLIDE DEVELOPMENT

The chief concern of the learning process and package was the content and its scrutiny, which plays a vital role in package development. This package was prepared for the students of the XII science who are going to be appeared in public exam conducted by GS&HSEB. The content of the chapter are theories from higher physics. The theories included in it are in demand of continuity. So, by keeping this point in mind and as per programmed learning the content was divided in to possible small fragment. In between or at the end as per the need multiple choice type questions are placed. Initially slides are prepared with the help of this content. The important words are highlighted and necessary effects were given. The slide was prepared in Gujarati with the help of EKL-ARUN TTF type font.

5. DEVELOPMENT OF ANIMATION AND GRAPHICS

Animation means literally to breathe life into something. A transformation is involved to move things. It plays significant role in stimulating learning. Animation is that stimuli to the mental, physical and emotional life of people in a given area which they find higher degree of self realization. At a same time various information presented in the form of diagrams. This animation and graphics in Power point presentation was
prepared with the help of Java Applet and HTML. Software named ‘Live Web’ for Microsoft Power Point 97, available on Internet was chiefly used to add Java in power point. Macromedia flash player, Photo shop viewer, paint, power point 2003 etc. kind of software used in preparation of graphics and animation.

6. DEVELOPMENT OF SOUND FILE

Sound file are recorded after content was written on every slide. Sound icons are hidden in every slide. As the slide show start with the animation applied on statement sound file start to run. Sound files are recorded. Sound in a program can prompt, focus or reinforce students and thus enhance instruction.

7. PREPARATION OF THE CAI PACKAGE

With the help of above strategies and software CAI package was prepared. It was prepared by considering the importance of the subject, level of the student, need of the graphics and animation, depth of the content, relevancy of the graphics and animation with the content presented in the particular slide. With animation importance of the picture was considered and place at appropriate place. The questions chosen are essence of the theory which is placed at the end of certain topic. Each and every slide and topic have possible no of animation or graphics so that take it to the depth of the knowledge.

8. PILOT TESTING AND EXPERTS’ OPINION

Pilot testing was done on the student of the M. B. Vamdot Sarvajanik Higher secondary school, Bardoli. The students were familiar with use of computer, hence little instruction work effectively. The students and teacher observed the CAI package. The suggestions were obtained from the student as well as teachers. Necessary corrections were incorporated. The package was also shown to the subject expert in the field education technology as well as physics teacher. The suggestion from these subject experts duly incorporated.

9. TO DEVELOP USERS GUIDE

Users guide was develop to assist how to install program. In this guide stages are clearly indicated and instructed what to do on appearing of any instruction on screen. Without follow this stages software might not properly installed or many files could not appear on screen. Instruction regarding simulation given in it, in which on changing data functions get change.
10. FINAL DEVELOPMENT OF CAI PACKAGE.

Following the above stages, CAI package in the form of Multi Media Package was prepared by the researcher to check the effectiveness of the developed CAI. This package was implemented on experimental group of both the school.

3.10.0 PROCEDURE FOR DATA COLLECTION

The required data were collected with the help of pre test, post test and opinionnaire which were constructed by the researcher. In between pre test and post test researcher implemented the CAI package for twenty four periods on the experimental group and control group was taught the same topic with the help of their teacher. After implementation researcher administrated post test after ten days and opinionnaire was given to know the reaction of the student regarding learning with CAI and developed CAI.

In the first phase pre test constructed by the researcher administrated on all the students of both schools. Pre test included multiple choice questions related to the topics of the chapter. To complete the test the students were given one hour. On the very second day IQ test was also administrated on all the student of both school for forty minute.

In the second phase researcher implemented the developed CAI on the experimental groups for twenty four periods after the gap of ten days from pre testing. Prior arrangement regarding experimentation was made with the help of computer instructor of the school and with the permission of the principal. The same experiment was replicated in the other school.

All the topics included in the CAI were taught to the control group with traditional method by their teacher.

In the third phase researcher administrated the post test on the students of all the four groups to study the effectiveness of the developed CAI on the basis of achievement in the post test. The same pre test was used as post test. The opinionnaire developed by the researcher was administrated on the student of the experimental groups to know the opinion of the student about the developed CAI.
3.11.0 STATISTICAL ANALYSIS

The collected data were analyzed with the help of SPSS 17.0 version. Statistical technique employ for data analysis is as shown in table 3.7

Table 3.7

Objectives and the statistical technique used for the objective

<table>
<thead>
<tr>
<th>No.</th>
<th>Objectives</th>
<th>Hypothesis</th>
<th>Applied statistical technique</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>2, 3</td>
<td>1, 2, 3</td>
<td>Analysis of Co variance (ANCOVA)</td>
</tr>
<tr>
<td>2</td>
<td>4, 5</td>
<td>4, 5</td>
<td>Analysis of Co variance (ANCOVA)</td>
</tr>
<tr>
<td>3.</td>
<td>6</td>
<td>6</td>
<td>Analysis of Co variance (ANCOVA)</td>
</tr>
<tr>
<td>4.</td>
<td>7 to 12</td>
<td>7 to 12</td>
<td>Analysis of Co variance (ANCOVA)</td>
</tr>
<tr>
<td>5.</td>
<td>13</td>
<td></td>
<td>$\chi^2$ (Chi Square) Test.</td>
</tr>
<tr>
<td>6</td>
<td>14</td>
<td>13</td>
<td>Contingency Table $\chi^2$ (Chi Square) Test.</td>
</tr>
</tbody>
</table>

Above table shows that the objective no. 2, 3, 4, 5 and 6 were analyzed with the help of Analysis of Co-Variance. Objective no. 7 was for the opinion regarding developed CAI, hence its analysis was done through Chi-Square test.

3.12.0 CONCLUSION

In the present chapter researcher give details regarding origin of the study, design of the research, population of the research, sample of the study, tools for data collection, procedure for data collection and details regarding the development of the CAI package and the statistical technique employed for the data collection.

In the next chapter the analysis and interpretation of the data is described objective wise in detail.