Research Setting and Research Design

5.0 Introduction
5.1 Selection of Research Method
5.2 Selection of Experimental Design
5.3 Planning of experimentation
5.4 Implementation of the experimentation
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5.9 Problems arouse in experimentation
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5.0 **Introduction :-**

The success of every research depends on the planning of its execution. In this chapter the researcher demonstrates the planning of execution of experimentation. The researcher had planned to execute the experimentation at micro level. Each and every matter regarding the execution of experimentation is discussed in this chapter.

**5.1 Selection of Research Method**

In this research the researcher had to check effectiveness of his self-constructed virtual reality based learning material. So he had to perform an experiment on different group treating by virtual reality based learning material and then to compare it with conventional method respectively. So the researcher had chosen experimental method to perform his study.

**5.2 Selection of Experimental Design**

There are different experimental designs. The best experimental design is that by which the risk of validation of experiment should be minimized. There are three main types of experimental design.

1. Pre-experimental design
2. Virtual experimental design
3. Real experimental design

Out of these tree types of experimental design the researcher had selected pretest - posttest equivalent group design which is a real experimental design. In this design three equivalent groups are created according to their scores of pretest. Out of these groups two were experimental groups and one controlled group.
The diagram of this experimental design was as below.

![Figure 5.0 Experimental Design](image)

*Figure 5.0. This figure shows an outline of experimental design.*

### 5.3 Planning of experimentation :-

To gain pure results of any research airtight planning of whole research process is necessary.

To collect proper data it is very important to select proper methodology of research. A proper method plans objective of study, aims, necessary tool for data collection, activity and time. It should be valid and reliable for research. The merits of a proper planning of research are as follows.

1. It gives a proper direction to the research.
2. It aware researcher about problems he may has to face during research.
3. Research becomes easy, fluent and harmonic.
4. It minimizes waste of time, energy and money.
5. The researcher could be prepared to solve the problems he may have to face during experiment.
The planning of experiment for this study was as follows.

5.3.1 Selection of school :-

The researcher had selected a Gujarati medium school for implementation of experimentation. Because the researcher has created virtual reality based learning material in Gujarati medium. For this study researcher had selected Mangaldeep Higher Secondary School situated at Ranip, Ahmedabad.

Main reasons of selecting this school are as follows.

1. The medium of teaching in this school was Gujarati.
2. It was a mixed school, so the boys and girls were studying together.
3. There was a rich computer laboratory having computer more than 20 pieces.
4. The best reason to choose this school was the school had promised the researcher to co-operate everywhere he need to complete his research work with best way.

5.3.2 Selection of Standard :-

The researcher had to create a virtual reality based learning material. This learning material was in the form of software which would be run on computer only. The students must have enough knowledge to run new software on computer. The students of higher secondary school have enough knowledge about computer. There is also an optional subject of computer knowledge in which some modern application has to be learned by the students.

The researcher is M.Sc. with chemistry subject has enough teaching experience of chemistry subject in higher secondary school. So he has selected chemistry subject in which virtual reality based learning material was created. He has
two options either standard-11 or standard-12 to conduct his experiment. When the researcher had started to create virtual reality based learning material there was not semester system in science stream of higher secondary school. The students had to appear in board examination in only standard 12. So researcher had doubt about cooperating by school if experiment was conducted in standard-12. So standard-11 was selected for experiment by the researcher.

5.3.3 Selection of Unit :-

Now it was the most difficult which unit should be selected so that the researcher can justify with latest technology to create a virtual reality based learning material.

The content of chemistry should have following peculiarities so that it can be justified properly with latest software technology.

1. The content should have different concepts which are unable to understand by conventional teaching method.

2. The researcher should have enough knowledge about the content and proper understanding about the concepts so he would be able to create a highly interactive virtual reality based multimedia software.

3. The researcher should have enough capacity to transform the content in a virtual reality based learning material.

4. After transforming content to virtual reality based learning material it should be easier for students to operate it.

According to mentioned above characteristics the researcher has selected three Chapters from chemistry book of standard 11 as follows.
1. Chapter-1 : Basic Concepts of Chemistry
2. Chapter-2 : Structure of Atom
3. Chapter-7 : Basic Principles of Organic Chemistry

The researcher had selected “Chapter 7 - Basic Principles of Organic Chemistry” for the construction of virtual reality based learning material. The following reasons had inspired researcher to select the above chapter.

1. The first chapter has very less content to demonstrate it through animation. So researcher did not select this chapter.
2. In second chapter there are some conceptual theories which can also be transformed and demonstrated through animation. But the theory can also be explained very well through conventional method. So the researcher had doubt that he might not be concluded which method is better to teach the chemistry. So this chapter was excluded.
3. Among all three chapters 7th chapter is largest one. In this chapter there are many conceptual contents of 3d molecules which could not be explained through 2D images given in book. There are more than hundred different shapes and structures of molecules which can be transformed in 3D platform. In chemistry book all this molecules are demonstrated in 2D figure which are unable to explain its structure properly. So this chapter might be explained in the best way through the virtual reality platform.

For these reasons the researcher had selected 7th chapter named “Basic Principles of Organic Chemistry” for the creation of virtual reality based learning material.
5.3.4 Teaching points of Selected Unit :-

The whole chapter was divided in different small sub topics so that the process of construction of virtual reality based learning material became easy and effective. The whole chapter was divided in following sub topics.

1. Introduction of chapter
2. Tetravalency of Carbon
3. Hybridisation and Hybrid Orbitals
4. \(sp^3\) Hybridisation
5. Shape of Methane Molecule
6. Shape of Ethane Molecule
7. \(sp^2\) Hybridisation
8. Shape of Ethene Molecule
9. \(sp\) Hybridisation
10. Shape of Ethyne Molecule
11. Functional Groups
12. Homologus Series
13. Isomerism
14. IUPAC Nomenclature
15. Bond-line Nomenclature
16. IUPAC names of some structural formula
17. Common and IUPAC names based on Functional Group

5.3.6 Construction of multimedia package :-

The most difficult part of this research was to prepare virtual reality based multimedia learning package. In this package the researcher has to create different
types of software files. The following types of software files were constructed before merging all files in a VB (Visual Basic) based exe platform.

1. **Video Files :-**

   The main part of this software was video files of tutorials recorded by researcher. In this videos researcher had recorded as he was teaching topics of selected unit. The researcher had created all video files of whole unit as all topics were taught by him.

2. **3D Models :-**

   The researcher had created 3d models which were merged in virtual 3d environment (virtual classroom). All 3d models of teaching desk, demonstration screen and other 3d props were constructed and arranged to create a classroom environment.

3. **3D Applications :-**

   The other most important task of this multimedia package was 3d application. These were mouse interactive 3d application in which 3d organic molecules could be interactively rotate using a mouse. All 3d molecules were created using “Autodesk 3ds Max” software.

4. **Flash based test :-**

   The researcher had created a flash based test to let the student self-evaluation. There are three options to choose in this application.

   A. Topic Test
   
   B. Fifty 50
   
   C. All Questions

   On selecting “Topic Test” a test of current topic is generated. When choosing “Fifty 50” option the software randomly generates 50 questions out
of all questions. Option mentioning “All Questions” represents all questions embedded in flash application. The detailed process of construction of flash based test mentioned in chapter-3.

5. **Pdf files containing content of topics :-**

   The researcher also facilitated the software with printed content in form of pdf files. The researcher typed all content of topics in Microsoft word and then converted it in acrobat pdf files. The students can open these files by clicking specific button and take a printout they wanted.

6. **Flash based dictionary :-**

   A flash based directory comprised all terminological words from the unit. The dictionary is of English-Gujarati typed. By typing an alphabet or a word in search box all words having same alphabet or word appeared on screen. By clicking on proper word its meaning and definition in Gujarati language appears.

5.3.5 **Construction of Post-test :-**

   The researcher had constructed software based post-test in which 188 questions of MCQ types were comprised. The steps to construct software based post-test was as follows.

   1. The researcher had created and collected all possible MCQ type question using different references books. This way total 188 type MCQ based questions were constructed.
   2. The questions were sent to different school teachers of chemistry subjects to check and modify it wherever possible.
   3. These questions were embedded in flash based software.
4. On selecting a button given in this software the software randomly represent 50 questions out of 188 questions one by one.

![Figure 5.1 Options of Test](image)

*Figure 5.1. This figure shows options of types of tests. It is the first window of flash based post-test. By choosing 2nd option “Fifty 50” the student will appear to post-test.*

5. Each question has a radio button by clicking it the true response of the specific question was selected. Then student has to submit his response by clicking “Submit” button.

![Figure 5.2 Screen presenting Questions](image)

*Figure 5.2. The screen of test has a question and 4 options of responses. The student can select any response by clicking radio button in front of options of responses.*
6. After submitted response to question the student came to know whether their response is true or false by opening a dialogue message. On clicking button “Next Question” the student will appear to next question.

![Figure 5.3 Correct Dialogue Box](image1)

*Figure 5.3.* This dialogue shows the response given by student is correct.

![Figure 5.4 Incorrect Dialogue Box](image2)

*Figure 5.4.* This dialogue shows the response given by student is incorrect.

7. After the test was completed a result dialogue box was open in which conclusion regarding test was shown.
In this study researcher had to check effectiveness of self-constructed virtual reality based learning material. The researcher had to conduct an experiment on students of standard 11 of science stream. So he needed a school which provides every facility to researcher to conduct his experiment. For this researcher had selected a school named “Mangaldeep Higher Secondary School”, nearby his house and ready to co-operate by every means to complete his experiment.

There were about 3 classes of science stream containing 189 students. Out of which the researcher had selected his sample by random sampling technique. Every school has its own unique educational environment. Therefore the results obtained by conducting experiment in a school could not apply to another school. By this means
the students of science-stream of Mangaldeep Higher Secondary School is population of this study.

5.3.7 Sample

The researcher had to check effectiveness of his self-constructed virtual reality based learning material on the students of standard 11 of science stream in chemistry subject. He decided to distribute whole sample in three main groups experimental group 1, Experimental group 2 and controlled group each having 40 students. So out of 189 students 120 students should be selected as a sample. For this purpose researcher perform stratified random sampling technique in selection of sample.

The researcher has performed following steps in selection of sample.

1. 189 students were arranged in descending order according their scored achieved in pre-test.
2. Students having odd (1,3,5,…) number are selected in sample. 95 students were selected by this method.
3. Still the researcher needed 25 more students to be selected. Out of 189 students now there were 94 students. Once again these students were listed in descending order according to their scores in pre-test. Now every 3rd and then 4th student was selected till reached number students up to 25.
4. In this way total 120 students were selected.
5. Now 120 students were distributed in three groups in such a way that there was no significant difference among educational achievement of the three groups according to their scores in pre-test. So the groups were equivalent in educational achievement.
6. To distribute 120 students in three groups so that the groups became equivalent the researcher also perform a trick. He arranged 1\textsuperscript{st}, 2\textsuperscript{nd} and 3\textsuperscript{rd} students in group 1, group 2 and group 3 while 4\textsuperscript{th}, 5\textsuperscript{th} and 6\textsuperscript{th} students were arranged in downward as in group 3, group 2 and group 1 and so on completed the whole process. At the end of process 120 students were distributed in 3 groups each having 40 students comprising boys and girls.

7. In this research researcher has selected pretest-posttest equivalent groups experimental method. To check the effect of different teaching methods and materials on the achievement of students the groups must be equivalent on the basis of their achievement. To check equivalency among three groups ANOVA is performed by researcher. (Mentioned in Chapter – 6).

The researcher has used stratified random sampling technique in selection of sample. At last the whole sample was stratified and distributed as follows.

<table>
<thead>
<tr>
<th>Strata</th>
<th>Group 1</th>
<th></th>
<th>Group 2</th>
<th></th>
<th>Group 3</th>
<th></th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Boys</td>
<td>Girls</td>
<td>Boys</td>
<td>Girls</td>
<td>Boys</td>
<td>Girls</td>
<td></td>
</tr>
<tr>
<td>HA</td>
<td>17</td>
<td>5</td>
<td>16</td>
<td>5</td>
<td>18</td>
<td>2</td>
<td>63</td>
</tr>
<tr>
<td>LA</td>
<td>14</td>
<td>4</td>
<td>12</td>
<td>7</td>
<td>12</td>
<td>8</td>
<td>57</td>
</tr>
<tr>
<td>Total</td>
<td>31</td>
<td>9</td>
<td>28</td>
<td>12</td>
<td>30</td>
<td>10</td>
<td>120</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Boys</th>
<th>Girls</th>
</tr>
</thead>
<tbody>
<tr>
<td>40</td>
<td>40</td>
</tr>
</tbody>
</table>

*Note. HA = higher achievement, LA = lower Achievement*

5.4 Implementation of the Experimentation :-

Now it was time to implement experimentation. The researcher had treated all three groups with different teaching-learning methods.

5.4.1 Timetable of Experimentation :-
The researcher had distributed sample in three equivalent groups and all three groups were treated with different treatments. Each group was treated at different time given by the school management. The management had strictly instructed the researcher to complete his experimentation with minimum consumption of time. So each moment was very valuable for researcher. The researcher had carefully planned number of lectures he needed to complete his experimentation with different treatment to all groups. Timetables for all three groups were arranged as follows.

➢ **Timetable for Group – 1**

Group 1 was first experimental group. The students of this group had been taught by virtual reality based multimedia package that had been created by the researcher. This group had been given software as well as proper instruction and software had been demonstrated by the researcher while teaching. The time table for group 1 was as follow.

**Table – 5.0 : Timetable for Group - 1**

<table>
<thead>
<tr>
<th>No.</th>
<th>Date</th>
<th>Time</th>
<th>Topic</th>
</tr>
</thead>
</table>
| 1   | 13/08/12 | 7:15 to 8:15 | 1. Introduction of Chapter  
       |          |            | 2. Tetravalency of Carbon                      |
| 2   | 14/08/12 | 7:15 to 8:15 | 1. sp³ Hybridisation  
       |          |            | 2. Shape of Methane Molecule                   |
|     |          |            | 3. Shape of Ethane Molecule                     |
| 3   | 15/08/12 | 7:15 to 8:15 | 1. sp² Hybridisation  
       |          |            | 2. Shape Ethene Molecule                       |
|     |          |            |                                                |
| 4   | 17/08/12 | 7:30 to 8:15 | 1. sp Hybridisation  
       |          |            | 2. Shape of Ethyne Molecule                    |
| 5   | 18/08/12 | 7:30 to     | 1. Functional Groups                           |
|     |          |            |                                                |
Timetable for Group – 2

Group 2 was second experimental group. The students of this group were provided virtual reality based multimedia package software only. They had not been experiencing teaching by the researcher. They had to learn themselves using this software. Only the instructions about “how to use software” were provided to the students. Then students were allowed to learn themselves with in a period of time given by researcher.

Table – 5.1: Timetable for Group - 2

<table>
<thead>
<tr>
<th>No.</th>
<th>Date</th>
<th>Time</th>
<th>Topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>13/08/12</td>
<td>11:30 to 12:00</td>
<td>1. Introduction of Chapter to 2. Tetravalency of Carbon</td>
</tr>
<tr>
<td>Date</td>
<td>Time</td>
<td>Topic</td>
<td></td>
</tr>
<tr>
<td>------------</td>
<td>-------</td>
<td>----------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>14/08/12</td>
<td>11:30</td>
<td>1. sp³ Hybridisation</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Shape of Methane Molecule</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>3. Shape of Ethane Molecule</td>
<td></td>
</tr>
<tr>
<td>16/08/12</td>
<td>11:30</td>
<td>1. sp² Hybridisation</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Shape Ethene Molecule</td>
<td></td>
</tr>
<tr>
<td>20/08/12</td>
<td>11:30</td>
<td>1. sp Hybridisation</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Shape of Ethyne Molecule</td>
<td></td>
</tr>
<tr>
<td>21/08/12</td>
<td>11:30</td>
<td>1. Functional Groups</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Isomerism</td>
<td></td>
</tr>
<tr>
<td>22/08/12</td>
<td>11:30</td>
<td>1. Homologus Series</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Isomerism</td>
<td></td>
</tr>
<tr>
<td>25/08/12</td>
<td>11:30</td>
<td>1. IUPAC Nomenclature</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Bond-line Nomenclature</td>
<td></td>
</tr>
<tr>
<td>03/09/12</td>
<td>11:30</td>
<td>1.IUPAC names of some Structural Formula</td>
<td></td>
</tr>
<tr>
<td>04/09/12</td>
<td>11:30</td>
<td>1.Common and IUPAC names based on Functional Group</td>
<td></td>
</tr>
<tr>
<td>10/09/12</td>
<td>10:30</td>
<td>Post-test</td>
<td></td>
</tr>
<tr>
<td>11/09/12</td>
<td>7:30</td>
<td>To</td>
<td></td>
</tr>
</tbody>
</table>

- **Timetable for Group – 3**

Group 3 was controlled group of the study. The students of this group had been taught with traditional lecture method. In this method the researcher taught
chemistry with the help of chemistry book, black board and chalk only. The researcher explained each topics of selected unit by delivering lecture.

**Table – 5.2: Timetable for Group - 3**

<table>
<thead>
<tr>
<th>No.</th>
<th>Date</th>
<th>Time</th>
<th>Topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>15/08/12</td>
<td>8:30</td>
<td>1. Introduction of Chapter to 2. Tetravalency of Carbon</td>
</tr>
<tr>
<td></td>
<td></td>
<td>9:15</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>17/08/12</td>
<td>8:30</td>
<td>1. sp$^3$ Hybridisation to 2. Shape of Methane Molecule</td>
</tr>
<tr>
<td></td>
<td></td>
<td>9:15</td>
<td>3. Shape of Ethane Molecule</td>
</tr>
<tr>
<td>3</td>
<td>18/08/12</td>
<td>8:30</td>
<td>1. sp$^2$ Hybridisation to 2. Shape Ethene Molecule</td>
</tr>
<tr>
<td></td>
<td></td>
<td>9:15</td>
<td>3. sp Hybridisation 4. Shape of Ethyne Molecule</td>
</tr>
<tr>
<td>4</td>
<td>23/08/12</td>
<td>8:30</td>
<td>1. Functional Groups to 2. Homologus Series</td>
</tr>
<tr>
<td></td>
<td></td>
<td>9:15</td>
<td>3. Isomerism</td>
</tr>
<tr>
<td>5</td>
<td>24/08/12</td>
<td>8:30</td>
<td>1. IUPAC Nomenclature to 2. Bond-line Nomenclature</td>
</tr>
<tr>
<td></td>
<td></td>
<td>9:15</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>30/08/12</td>
<td>8:30</td>
<td>1. IUPAC names of some Structural Formula to 2. Common and IUPAC names based on Functional Group</td>
</tr>
<tr>
<td></td>
<td></td>
<td>9:15</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>11/09/12</td>
<td>9:00</td>
<td>Post-test</td>
</tr>
<tr>
<td></td>
<td></td>
<td>11:30</td>
<td></td>
</tr>
</tbody>
</table>

**5.5 Tools of Research**

The researcher had created flash based post-test by which data would be collected. It was self-prepared tool of data collection. The researcher had created
MCQ based questions with the help of different references books and experts. The researcher had followed the guideline for examination given by Gujarat Board of Secondary Education.

5.6 Procedure Followed for Collection of Data

The researcher had created flash based post-test. Therefore the students had to appear this examination on computer. The school’s computer laboratory was used for this examination with the help of computer instructor. There were 22 computers in computer laboratory. So the researcher had planned two days for this examination. Total six hours were planned for this examination. Both the day 60 students were appeared the examination on each day. About 120 students had appeared for examination within two days.

Before examination software of post-test was installed on each computer by the researcher. It was self-evaluation type software, so results were generated within no time after completed examination. The researcher had note down results of all students before closing the software.

5.7 Techniques of Statistical Analysis

According to objectives of this study following statistical methods were used to analyze collected data.

1. To check normality of sample distribution following statistical methods were performed.

   a. Measurement of central tendency : Mean, Median, Mode
   b. Kurtosis
   c. Skewness
2. To check homogeneity of variance between the group following statistical methods were performed.
   a. Levene’s test
   b. Brown – Forsythe test
   c. Bartlett’s test
   d. Kolmogorov Smirnov test

3. Two way ANOVA to check the equality between the groups.

4. To check hypothesis ANCOVA (Analysis of Co Variance) was performed.

5. To check interactions of variables ANOVA (Analysis of Variance- 2x2x2) was performed.

5.8 Observations of Experimentation :-

- The students were very excited on the very first day of experimentation about what the researcher will demonstrate on arranging laptop, LCD projector, speakers in the class rooms.
- The curiosity was clearly observed on the face of every students.
- The students were surprised on watching virtual reality based tutorial videos.
- The students were surprised on watching 3d molecules which could be rotated using mouse and proper structure of molecules could be seen.
- The students were very excited on giving tests comprised with software. They could see the results of their responses instantly after the tests were completed.
- The students could know total information about each element from periodic table application. So they were seen very satisfied with the software. The students also could remember all the definitions and terminology of specific chemical word through dictionary comprised in this software.
• Over all the students were surprised and totally satisfied with virtual reality based software.

5.9 Problems arouse in Experimentation :-

• It was time consuming experimentation. The students had to appear in the examination taken by the board. So the school authorities were confused to provide enough time for this experimentation.

• It was little difficult to distribute the students in different experimental group and set them together in a class room for this experimentation.

• To set up the equipment like laptop, LCD projector and speakers in the class room took too much time. During the arrangement of equipment it was little hard to control the students.

5.10 Conclusion :-

The most important parts of this research were to construct virtual reality based learning materials and to conduct the experimentation. Both parts were executed properly. A test was performed on the sample of this research to check the effectiveness of this experimentation. The results were collected. The next step of this research was to tabulate the collected data properly and analyze them with proper statistical methods. The results, findings and conclusions obtained by analysis of data are mentioned in next chapter.
Chapter – 5

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