# CHAPTER-III
## METHODOLOGY

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CHAPTER – III
METHODOLOGY

3.1 Introduction

The general aim of this chapter is to present the method of investigation. One may use various devices to collect new unknown data required for the study. For each and every type of research we need certain instruments to gather new facts for successful research. It requires expert and imaginative planning, creative, ideas, careful analysis and interpretation of data gathered and logical skill.

For the successful conduct of any research, suitable methodology with specific operational steps and well constructed tools are necessary. What assures the quality of research and accuracy of results is the right research procedure chose. Hence, to ensure proper research, the researcher has to choose the right methodology, which works in coordination with the objectives the sample and the available data.

PART-I: ADVANCED VISUALIZATION TOOLS

3.2 Development of Advanced Visualization Tools

The development of Advanced Visualization Tools in the present study includes the following different stages.

(i) Selection of School Education System

The researcher has decided to select the Samacheer Kalvi as school education system for this study.
(ii) Selection of Schools

Owing to time and effort constraints, the researcher has chosen only two schools as listed in Table 3.1.

<table>
<thead>
<tr>
<th>S.No</th>
<th>Name of the School</th>
<th>Total Number of Pupils</th>
<th>School kind</th>
<th>School Management</th>
<th>School Locality</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Kalaimagal Matric Higher Secondary School, Pillaiyarpatti, Thanjavur Taluk, Thanjavur District.</td>
<td>40</td>
<td>Co-education</td>
<td>Self-financing</td>
<td>Rural</td>
</tr>
<tr>
<td>2</td>
<td>E.D Thomas Matric Higher Secondary School, Kudikadu, Papanasam Taluk, Thanjavur District.</td>
<td>40</td>
<td>Co-education</td>
<td>Self-financing</td>
<td>Rural</td>
</tr>
</tbody>
</table>

(iii) Selection of standard

The researcher has selected IX standard pupils for this experimental study.

(vi) Selection of the subject

The researcher has selected Science as the subject for this experimental study.
(v) Selection of the unit

The researcher has selected the unit namely ‘Motion and Liquids’ and ‘Addiction and Healthy Lifestyles’ of IX Standard pupils based on the textbook prescribed by Department of School Education (State of Tamil Nadu).

(vi) Selection of the Medium of Instruction

The researcher has selected English medium as the medium of instruction for this experimental study.

(vii) Framing Instructional Objectives

The researcher framed the objectives in behavioural terms as follows:

**Motion and Liquids**

The learner will be able to

- understand the concept of addiction
- classify the kinds of Addiction
- explain the prevention of Addiction
- understand the concept of healthy lifestyle

**Addiction and Healthy Lifestyles**

The learner will be able to

- understand the concept of motion
- identify the kinds of addiction
- measure the rate of motion
- calculate the rate of change of velocity
• draw the graphical representation of motion
• derive the equation of motion
• explain uniform circular motion
• understand the concept of liquid
• describe relative density
• give explanation for a body wholly or partially immersed in a Liquid

(viii) Mode for the programme

The delivery of Advanced Visualization Tools has different types of capability like web-based technology, interactive distance learning technology, CD-ROM etc. The schools selected as samples, had only CD-ROM facility. So the researcher has selected the CD-ROM as the electronic media for delivering the Advanced Visualization Tools to the pupils.

(ix) Consultation with the subject experts

The researcher had discussion with the subject experts and Software Engineers on the planning of the script in order to realize the Instructional Objectives.

(x) Consultation with the media experts and Software Engineers

Based on the outcome of the discussions made with the media experts and Software Engineers, the script has been changed here and there in terms of graphics, audio, video and content.

(xi) Preparation of the script

The researcher prepared the final script for developing the Advanced Visualization Tools on the basis of the discussion with the subject experts.
(xii) Softwares used for the Advanced Visualization Tools

The researcher decided the Flash as the suitable software for the present purpose and developed the Advanced Visualization Tools by using the flash software.

(xiii) Steps for using Advanced Visualization Tools

To open the project, we have to run the protégé 4.2 software in the system. After that open the file menu, then open the project from the saved location.

The following steps were used in the Advanced Visualization Tools.

Protege 4.2 → File → Open → Project.owl

![Screenshot 1: To Open Ontology](image-url)
After open the project, then click the Class Tab, It shows the two main classes like,

- ADDICTION AND LIFESTYLE
- MOTIONS AND LIQUIDS

Screenshot 3: Title of the Project
Select the Thing Class (Base Class), project title and other detail about project is showed in the annotation window.

To see the proper result, need to run the project. To run the project, the following steps to involved, **Reasoner → Start Reasoner.**

In the Screenshot 3.1 shows the Running steps.

![Screenshot 3.1: Start Reasoner Steps](image)

**Ontograph Visualization**

This tool shows pictures and information about particular subject. It not only expands but also collapses necessary pictures and information of the particular subjects. It seems to easily understandable for the users. Ex: screenshot 4 Ontograph visualization.
Screenshot 4: Ontograph Visualization

Screenshot 5: Expansion of Classes
If the user can select the class as visualized in the ontograph visualization, the annotation will be showed there (see Screenshot 5).

In the developed visualization tool, flash have a role to visualize the subject. The flash file visualized the steps as follows.

**Screenshot 6: Flash file Opening**

To click the link as showed in the screenshot 6, and then the flash file will open. The Flash file is showed in the screenshot 7 and screenshot 8.
Screenshot 7: Flash File for Motion and Liquid

Screenshot 8: Flash File for Addiction and Healthy Lifestyle
The owl visualization (OWL Viz) is shown in the following screenshot 8 and it includes all classes which use in the project.

![Screenshot 9: OWL Viz Image](image)

The DL Query Visualization shows the Super class, Descendant Classes, Ancestor Class, Sub Classes and Equivalent class of the selected class. It shows in the screenshot 9.
Screenshot 10: DL Query Visualization

The class hierarchy is the visualization method that shows the list of classes involved the ontology which prepared in this “Project.owl”. It shows the screenshot: 9
Screenshot 11: Class Hierarchy
xiv) Delivery of the treatment

Twenty days were allotted for the treatment of the experimental programme on the Advanced Visualization Tools in the academic year 2012-13. In the treatment, the researcher illustrated the units through Advanced Visualization Tools to the pupils. Before the treatment, the researcher administered Pre-test of the experimental study to the pupils. The researcher monitored the selected schools to ensure the conduct of the experiment without any disturbance during the experimental period.

(xv) Evaluation

The Programme facilitators administered the Post-test to the pupils who participated in the experimental programme and the Post-test was used to calculate the gain ratio of each individual pupil by the researcher.

(xvi) Construction of Achievement test

To validate the Advanced Visualization Tools used in this study, an achievement test was constructed. The test was constructed based on the Advanced Visualization Tools and structured lesson plans of the topic namely, ‘Motion and Liquids’ and ‘Addiction and Healthy Lifestyles’ The achievement test containing 30 objective (Multiple Choice) type questions was administered to the representative sample of 40 IX standard pupils. The question paper and the key of the achievement test is given in Appendix-ii and iii.

(xvii) Administration of the Achievement Test

The researcher prepared the question paper based on the Advanced Visualization Tools and got the question paper neatly printed. Ramiszowski’s (1986) concept of content validation is followed for validating the content. According to him,
an Advanced Visualization Tools is suitable if 90% of the pupils get 90% marks or more in achievement test, which is prepared based on the Advanced Visualization Tools. Validation is enclosed in Appendix-iv (Mc Guigan’s gain score ratio).

PART-II: CONSTRUCTION OF THE RESEARCH TOOLS

3.3 Preparation of Achievement Test in Science (ATS)

To measure the achievement in Science of the IX standard pupils, the researcher developed a test which considered of four cognition levels namely Knowledge, Understanding, Application and Skill, Bloom (1956).

(a) Preparation of preliminary Draft of ATS

The researcher decided to have multiple-choices items for ATS. The researcher framed the test items on four cognition levels, namely Knowledge, Understanding, Application and Skill according to Benjamin Bloom (1956) from all the topics selected for the study. To verify the suitability of the items, it was shown to some of the Science Teachers handling IX standard. It was also given to some teacher educators for verifying structure of the items. After carrying out their suggestions 75 items were finalized in the chapters ['Motion and Liquids’ and ‘Addiction and Healthy Lifestyles’] of IX standard. All the test items were multiple-choice items with four alternatives. Pupils were asked to write the correct answer in the appropriate box for every question. It was decided to give one mark for each correct answer and zero mark for each wrong and unmarked items.

The Preliminary draft of the Achievement test question paper is given in Appendix-v. The Preliminary draft of the Achievement test key is given in Appendix-vi.
(b) Item Analysis of the Preliminary draft of ATS

The preliminary draft was neatly typed and administered to the selected pupils of standard IX. Thirty pupils studying in M.R. Matriculation Higher Secondary School, Thatanoor post, Udayarpalayam Taluk, Ariyalur District were selected as sample for the Item Analysis and the test was conducted. Then the answer scripts were scored and arranged in the order from the highest to the lowest, 27% (8 pupils) of the answer scripts was selected from the highest score and 27% (8 pupils) was selected from the lowest score. The middle score 46% (14 pupils) was kept aside. The numbers of correct responses in each item for both high scoring and low scoring groups were computed. The level of Difficulty value was determined by applying appropriate formula \( \frac{R}{N} \times 100 \) where \( R \) refers to total number of items answered correctly and \( N \) refers to the total number of pupils attempted to answer the test items. To determine the Discriminative Index, the formula \( \frac{R_{Hi} - R_{Lo}}{N} \) was applied where \( R_{Hi} \) refers to the number of pupils in the higher group who answered the test item correctly and \( R_{Lo} \) refers to the number of pupils in the lower group who answered the test item correctly and \( N \) refers to the number of pupils. The difficulty value and discriminative index of the items included in the preliminary draft of Standardisation of Achievement Test (SAT) are given in Appendix-vii.

(c) Selection of items for the final draft of ATS

On the basis of the results of the Item Analysis, certain items were eliminated. As Ebels(1966) pointed out, the researcher selected items having difficulty value between 40 and 80 and discriminative index ranged between +0.40 and +0.20, which was a clear indication of the satisfactory condition of the test item. Those items, which failed to differentiate between superior and inferior pupils, were not included in
the final form of achievement. Accordingly 50 items were selected from the 75 items included in the preliminary draft. The final draft of the ATS consists of 50 items in four learning objectives such as Knowledge, Understanding, Application and Skill.

To check the reliability of the developed tool, ATS, Test-Retest method was adopted. The Test-Retest reliability of the ATS has been found to be 0.72. The tool ATS was administered among forty pupils of standard IX of Modern Matriculation Higher Secondary School, Jayamkondam post, Udayarpalayam Taluk, Ariyalur District. The reliability of the tool determined by the Split-Half Method using Spearman Brown Prophecy formula was 0.81 which revealed that the developed tool is highly reliable.

The test item in the present study was prepared with reference to the objectives related to the content area. Thus the content validity of the tool was established; moreover, the ATS was given to the subject teachers to go through them. All of them were satisfied with the test items. Thus the face validity was established. The final draft of the Achievement test question paper is given in Appendix-viii. The final draft of the Achievement test key is given in Appendix-ix.

3.4 Preparation of Science Interest Inventory (SII)

The Science Interest Inventory test is used to find the pupils’ interest in Science. The Inventory test consisting of 32 statements were constructed and standardized by Dr. S. Rajasekar.

In the Science Interest Inventory test, each statement contains three components like A, B, C. Any one of the component (A, B, C) is related to Science.
The respondents have to select one component for each statement and put a tick mark to it. Each Science related statement (answer) will be given a score of 1, and hence the maximum score of the Science Interest Inventory test is 32.

**Reliability**

Test-Retest method was applied to find out the coefficient of reliability. The reliability co-efficient was found to be 0.78 according to the manual. The reliability was found again for this situation as 0.82 by Test-Retest method.

**Validity**

The investigator consulted experts to examine the items systematically and indicate whether or not they represent sufficiently well the theoretical universe from which they were drawn. The tool was tested for its validity. The Science Interest Inventory scale is given in Appendix-x.

### 3.5 Pupils’ attitude towards Advanced Visualization Tools Scale

This scale was developed and standardized by researcher. This scale carries 30 discriminating items, out of which 16 items are positively worded and 14 items are negatively worded. The scale was administered by the researcher.

**Scoring of the scale**

The serial number of the positive items in the test are 1, 2, 4, 6, 8, 9, 12, 13, 14, 15, 18, 19, 20, 25, 29, 30.

The serial number of the negative items in the test are 3, 5, 7, 10, 11, 16, 17, 21, 22, 23, 24, 26, 27, 28.
All the 16 positively worded items are given as a score of 4, 3, 2, and 1 respectively for Strongly Agree; Agree; Disagree; Strongly Disagree. All the 14 negative items are given a score of 1, 2, 3 and 4 respectively for Strongly Agree; Agree; Disagree; Strongly Disagree. The score of an individual is taken as the sum of the scores obtained by him/her in positively and negatively worded items. The score varies from 30 to 120 showing the unfavourable attitude towards Advanced Visualization Tools to the favourable attitude towards Advanced Visualization Tools.

**Reliability of the Scale**

The Split-half reliability (Correlating the odd even items) of the scale was calculated by applying the Spearman-Brown formula \( r_{11} = 2r_{1/2.1/2} / (1+ r_{1/2.1/2} ) \); \( r_{11} \) – reliability coefficients for the length test , \( r_{1/2.1/2} \) – reliability coefficients of the half test found experimentally.]; and the reliability was found to be 0.82.

The test - retest reliability of the scale has been found to be 0.72 (N=160).

**Validity of the scale**

The validity of the tool was established by the jury council opinion. A three member jury panel was constituted with the purpose of seeking their views regarding the content and suitability of the items collected. Based on the opinion of the experts, some items were modified; some items were slightly worded and some irrelevant items were omitted; and finally, 30 items were retained for final inclusion in the attitude scale. The pupils’ attitude towards Advanced Visualization Tools Scale is given in Appendix-xi.
PART-III: RESEARCH PROCEDURE

3.6 Research procedure

In the present study, Experimental Research method was adopted for its suitability and accuracy. Two group of pupils, namely the experimental and control group were taken for the study. The control group was taught through conventional method of teaching and Advanced Visualization Tools were used for teaching the experimental group.
Figure 3.1: Research Procedure

Selection of sample

Selection of Variables

 Independent: Advanced Visualization Tools  
 Dependent: Achievement in Science, Interest in Science, Attitude towards Advanced Visualization Tools

Control group  
(40 pupils)

Experimental group  
(40 pupils)

Pre-test

Conventional Method of teaching

Teaching and Learning by developed Advanced Visualization Tools

Post-test

Analysis of Pre-test and Post-test Scores

Interpretation and Conclusion
3.7 Sample of the experiment

The sample selected for this experiment was purposive random sample. The researcher selected two groups from IX standard. One group was taken as experimental group and the other group was taken as control group. The 40 students studying IX standard in Kalaimagal Matric Higher Secondary School, Pillaiyarpatti, Thanjavur Taluk, Thanjavur District were treated as experimental group and the 40 students studying IX standard in E.D Thomas Matric Higher Secondary School, Kudikadu, Papanasam Taluk, Thanjavur District were treated as control group.

Table 3.2
Experiment sample

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Group</th>
<th>Number of Pupils</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Experimental group</td>
<td>40</td>
</tr>
<tr>
<td>2</td>
<td>Control group</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>80</td>
</tr>
</tbody>
</table>

3.8 Procedure the equating the sample groups

The sample of 80 pupils, among 40 pupils of control group and 40 pupils of Experimental group were equated in terms of their achievement scores in the Quarterly Examination. Pupils having similar range of marks in the examination were selected as sample for the control and experimental groups with a view to verify the level of significance.
3.9 Experimental procedure

To find out the difference in the effectiveness of learning through Advanced Visualization Package and through conventional method, the researcher adopts the two groups Pre-test : Treatment : Post-test experimental design.

Administration of the Pre-test

Just before the treatment, the entry behaviour test was administrated and it was found out that all the selected samples possess the entry behaviour. The personal information was also collected. The personal information is given in Appendix-i. Then the pupils’ were made to be tested conveniently. Pre-test was administered and the results were analysed. Science Interest Inventory Scale and Attitude towards Advanced Visualization Tools scale were also conducted as Pre-test to both the Experimental and the control groups.

Treatment in the Experiment

The Experimental group pupils were taught the selected unit in Science through Advanced Visualization Tools. For the control group pupils, the Science teachers who work in E.D Thomas Matric Higher Secondary School, Kudikadu, Papanasam Taluk, Thanjavur District taught the same unit in Science through Conventional Method.

Duration of the treatment

The treatment of Advanced Visualization Tools was given to forty working days, i.e., one period per day. The same period was used for the control group too. Other than the different treatment, all other factors were similar among control and Experimental groups.
Administration of the Post-test

As soon as the treatment session was over, care was taken to not allowing the pupils, to consult with each other. For the experimental group the lessons were taught using the Advanced Visualization Tools, and soon after the completion the post test was administered.

3.10 Variables in the study

The present study aimed at determining the effect of Advanced Visualization Tools on pupils’ Achievement in Science among high school pupils. The variables are,

i) **Independent variable:** Advanced Visualization Tools was the independent variable in the study.

ii) **Dependent Variable:** Achievement in Science, Interest in Science and Attitude towards Advanced Visualization Tools were the dependent variables in the study.

iii) **Control and Extraneous Variable:**

The Control and Extraneous Variables are given as follows:

1. Sex (Male / Female)
2. Parents’ Educational Qualification (Illiterate / 1<sup>st</sup> to 5<sup>th</sup> Standard / 6<sup>th</sup> to 10<sup>th</sup> Standard / 11<sup>th</sup> standard and above)
3. Parents’ Occupation (Government/Private/Self-employed/Agriculture/Others)
4. Parents’ Income (Below 60,000 / 60,000 and above)
5. Locality (Urban / Rural)
6. Study habit (Self-study / Group-study)
7. Chances for using Internet (Yes / No)
8. Experience in using Internet (Yes / No)

3.11 Statistical techniques used in the study

The researcher used the following statistical techniques for analysing the data.

(i) Mean and Standard Deviation

Mean and Standard Deviation were used to determine the central tendencies and descriptive variables on the Achievements, Interest and Attitude towards Advanced Visualization Tools in Pre-test and Post-test among control and experimental groups. This type of analysis highlights the nature of a particular group of individuals.

(ii) t-test and F-test

The t-test and F-test were used to find out the significance of the level of difference in Pre-test and Post-test on the Achievement, Interest, and Attitude towards Advanced Visualization Tools among the control and experimental groups.

(iii) Correlation

Statistical Correlation was used to find out the relationship between the (i) Achievement in Science and Interest in Science (ii) Achievement in Science and Attitude towards Advanced Visualization Tools in the Post-test scores.
3.12 Conclusion

This chapter traces the descriptive accounts of the methodology adopted for making a systematic study of the effectiveness of Advanced Visualization Tools on pupils’ Achievement and Interest in Science at High School Level. The type of research adopted, the tool selected, method of data collection, the Statistical techniques used etc. were discussed in this chapter. This helped the researcher to proceed to the study further in a comprehensive manner.