CHAPTER III

METHODOLOGY

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This chapter deals with the methodology of the present study. The method adopted, the data gathering instruments, the selection of sample, the procedure for data collection and the outlines of the statistical techniques employed in the analysis of data are described under appropriate heads as presented below.

3.1 Methods Adopted

The method of any study is to be determined on the basis of the objectives of the study and the data required for their realisation. 'Descriptive survey' was adopted as the major approach in the conduct of the present study.

3.2 Tools and Techniques Used

The following tools and techniques were used for collecting data relevant for the study.

3.2.1 Questionnaire
3.2.2 Achievement Tests
3.2.3 Intelligence Test
3.2.4 Socio-Economic Status Scale
3.2.5 Observation
3.2.1 Questionnaire

The questionnaire according to Barr, Davis and Johnson (1953:65) is a "systematic compilation of questions that are submitted to a sampling population from which information is desired".

The questionnaire was used for collecting data regarding the availability and utilization of educational resources for physics education in the Secondary Schools of Kerala.

The principles in framing a good questionnaire was collected from authoritative books on research (Good, and Scates, 1954; Best, 1983; Fox, 1969) and by consultation with experts. Both 'closed-form' and 'open-end' questions were asked according to the nature of data required.

3.2.1.1 Construction of questionnaire

Questionnaire for the present consisted of eight sections.

1. General information
2. Details regarding library
3. Details regarding laboratory
4. Details regarding teaching aids
5. Co-curricular activities
6. Details regarding environmental resources
7. Workload

8. Details regarding in-service programme.

In Section I general information regarding the type of school, management of school, classroom facilities, etc. and personal data of the respondent was sought.

Section II was intended to collect data regarding library facilities and the extent of their utilization. Some of the questions in this section were presented as check-list-cum-rating items. Reference materials being a very important resource for physics education, a question was included to bring out the details of availability and use of such materials.

The purpose of Section III was to elicit details regarding laboratory facilities in the school. As it was essential to bring out the extent of availability and utilization of these facilities, some of the questions were presented as rating items.

Teaching aids being one of the important resources in teaching school physics, Section IV was set aside to bring out the details regarding the extent of availability and utilization of such materials and equipments. This section was presented as a check-list-cum-rating item.

Section V of the questionnaire was intended to bring out information regarding the co-curricular activities which enhance school physics.
Effective use of environmental resources both human and natural, makes science teaching effective and meaningful. Environment provides abundant resources which are to be identified and utilised to impart concrete learning in physics. Section VI was included in the questionnaire to bring out the details regarding the availability and the extent of utilisation of environmental resources. Some possible local resources were listed to be checked for their uses.

Details of workload of the teacher was elicited through the seventh section.

The knowledge explosion in physics is massive and in order to cope with this, the teacher should have the information sought from any possible source, and the most efficient and feasible way is to provide periodic in-service courses. So the last section of the questionnaire was intended to collect data regarding in-service courses, like the agency which conducted the course, duration and type of the course, etc. The benefits and defects of the courses were also sought.

The questionnaire was finalised after considering the remarks of experts in the field of science education and an informal try-out was made with a few physics teachers in schools. A copy of the questionnaire used for the study is given as Appendix I.
3.2.2 Achievement Tests

Physics theory awareness and practical applications awareness in relation to theory awareness of pupils were measured using comprehensive tests developed by the investigator in collaboration with her supervising teacher.

This part of the study has been designed mainly with physics theory awareness and physics practical application awareness as the two major dependent variables. Intelligence, socio-economic status, resource utilization (in schools), sex, locality and management of school were treated as independent variables.

Two sets of tests (Teacher made) were prepared—one for the use of standard IX students and the other for the use of standard X students. Each set consisted of two tests namely Physics Theory Awareness Test (PTAT) and Physics Practical Application Awareness Test (PPAAT). These tests were developed on the basis of standard IX physics syllabus and standard X physics syllabus of Kerala secondary schools.

3.2.2.1 Developing draft tests

The first step in developing these tests was to analyse the physics syllabi of standard IX and standard X for identifying concepts. Based on this, two physics Theory
Awareness Tests (PTAT) were prepared - one for standard IX students and the other for standard X students. Then corresponding to each theory question, a question to measure the practical application awareness in relation to that theoretical concept was formed. Thus two Physics Practical Application Awareness Tests (PPAAT) were prepared - one for standard IX and the other for standard X. All were multiple choice items.

The preliminary draft items prepared were exposed to expert criticism. Specialists in science education belonging to Teacher Education Colleges and eminent teachers in physics education were consulted. Modifications were made on the basis of the suggestions received from experts. The original drafts were modified to yield the final draft of the tests.

The final draft form of the tests for standard IX contained a set of 47 multiple choice items for both PTAT and PPAAT with four alternatives each (included as Appendix II). The final draft form of the tests for standard X contained a set of 46 multiple choice items for both PTAT and PPAAT with four alternatives each (included as Appendix III)

3.2.2.2 Developing final tests

The tests in the final draft form were subjected
to experts for evaluation for determining the curricular validity (Ross and Stanley, 1960). List of experts is included as Appendix IV. The experts were requested to rank the questions based on the extent to which (a) each question is suited to achieve the objective of the study (b) the concept is helpful in creating practical application awareness among students (c) the question is clear and unambiguous (d) both the theory and practical application awareness questions are interrelated.

The next step was to find out how many teachers and experts had given a particular rank to each question. A question was selected if at least 50 per cent of the persons have included that question in rank one. Altogether 30 questions each from Physics Theory Awareness Test (PTAT) and Physics Practical Application Awareness Test (PPAAT) were selected for use in standard IX. In the same manner another set of 30 questions each for PTAT and PPAAT were selected for use in standard X.

The final tests namely Physics Theory Awareness Test (PTAT) and Physics Practical Applications Awareness Test (PPAAT) for standard IX and two other similar types of tests for standard X in Malayalam with directions to the students were printed in four separate booklet forms. These are included as Appendices V(A), V(B), VI(A) and VI(B). The English version of the four tests are included as Appendices
VII(A), VII(B), VIII(A) and VIII(B). Score sheets were also provided to students.

3.2.2.3 Illustrative examples

a) Item from Physics Theory Awareness Test (PTAT) for standard IX

The image formed by a convex mirror compared to the object is usually,
(a) inverted and imaginary
(b) erect and smaller
(c) real and inverted
(d) larger and virtual

Explanation

Here from among the four choices, the student has to select one which is the most accurate answer. The correct answer is (b)

Scoring

The correct answer (b) is assigned one score.

b) Item from Physics Practical Applications Awareness Test (PPAAT) standard IX

The kind of mirror that a driver uses to get a maximum vision of his backside should be
(a) convex mirror
(b) concave mirror
(c) plane mirror
(d) spherical mirror

Explanation
Here from among the four choices, the student has to select one which is the correct answer. The correct answer is (a).

Scoring
The correct answer (a). Assigned one score.

c) Item from PTAT for standard X
Which of the following light has less scattering?
(a) Violet
(b) Blue
(c) Yellow
(d) Red

Explanation
Here from among the four choices, the student has to select one which is the correct answer. The correct answer is (d).
Scoring

The correct answer (d) is assigned one score.

d) Item from PPAAT for standard X.
Red lights are often used in signal lamps because
(a) red colour is easily noticeable
(b) red light is scattered more and so it is visible at a great distance
(c) red light is scattered less and so it is visible at a great distance
(d) red light has a shorter wave length and so it is visible at a great distance

Explanation

Here from among the four choices, the student has to select which is the most accurate answer. The correct answer is (c).

Scoring

The correct answer (c) is assigned one score.

3.2.3 Intelligence Test

Since verbal tests place a premium on the language ability of the subjects, a non-verbal test was used for the study. The Kerala Non-Verbal Group Test of Intelligence for
secondary schools (Nair, 1968) was employed to classify subjects with three categories according to their level of intelligence - High Intelligence, Average Intelligence, and Low Intelligence.

This test is one of the most popular group tests in Malayalam for use with secondary school subjects in Kerala (Standards VIII, IX and X). It is an instrument for appraising general intelligence. The reliability and validity coefficients reported in the test manual indicate that the test is both a reliable and valid tool for measuring intelligence suitable for use with secondary school students of Kerala, on which it has been standardised.

3.2.4 Socio-economic Status Scale

An adapted and modified version of the Socio-economic Status Scale by Nair (1978) was used for the present study. The modified scale can be used both for rural and urban areas as it was administered to samples taken from both the areas. Taking into consideration the increased standard of living, the income limits were modified by the investigator in consultation with experts. This modified scale was used for collecting personal information about the pupil and for measuring the Socio-economic status of pupils. The details of categories and weightages given are
presented in Table 3.1. The format of the scale is given as Appendix IX.

Table 3.1 Categories and Weightages of Different Components of the Socio-Economic Status Scale

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Education</th>
<th>Weightage</th>
<th>Occupation</th>
<th>Weightage</th>
<th>Income Weightage</th>
<th>Rs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Master's degree; Profession degree, etc.</td>
<td>10</td>
<td>High Profession</td>
<td>10</td>
<td>Above 10</td>
<td>3001</td>
</tr>
<tr>
<td>2</td>
<td>Bachelor's degree; Engg. diploma, etc.</td>
<td>10</td>
<td>Semi-Profession</td>
<td>9</td>
<td>2001-3000</td>
<td>8</td>
</tr>
<tr>
<td>3</td>
<td>Pre-degree, T.T.C., etc.</td>
<td>5</td>
<td>Skilled work</td>
<td>8</td>
<td>1201-2000</td>
<td>6</td>
</tr>
<tr>
<td>4</td>
<td>S.S.L.C.</td>
<td>3</td>
<td>Semi-skilled work</td>
<td>6</td>
<td>801-1200</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>Standard VII</td>
<td>2</td>
<td>Unskilled labour</td>
<td>3</td>
<td>501-800</td>
<td>2</td>
</tr>
<tr>
<td>6</td>
<td>Illiterate</td>
<td>0</td>
<td>Unemployment</td>
<td>0</td>
<td>Below 500</td>
<td>1</td>
</tr>
</tbody>
</table>

3.2.5 Observation

Observation was another technique employed for analysing the classroom situation.
An observation schedule prepared for the purpose was used for facilitating the recording of information about the actual classroom teaching. This was used to supplement data collected through questionnaire regarding the availability and utilisation of resources in physics education.

The observation schedule (Appendix X) contains six sections and the details of which are noted below:

1. Details of school
   (name, location, management, type, etc.)
2. Details regarding the classroom
3. Methods used and objectives realised
4. Utilization of resources
5. About the teacher
6. Participation of students

3.3 Sample for the Study

A good sample is one which will reproduce the characteristics of the population. "The purpose of any sampling procedure is to obtain a sample which will reproduce the characteristics of the population with the greatest possible accuracy" (Barr, Davis and Johnson, 1953: 161, 162). Selection of the sample is done according to the purpose of investigation.
Different samples were used for different tools. The following are the details of the sample used to respond to each tool in the study.

3.3.1 Questionnaire

The samples for this part of the study consisted of 388 physics teachers of secondary schools of Kerala from the southern, central and northern districts of Kerala namely Thiruvananthapuram, Ernakulam, Thrissur and Kozhikode. The sample selection was done on the basis of 'stratified random sampling technique'. The actual numbers of secondary schools in the above four districts of Kerala are given in Table 3.2 (Department of Education, 1987).

<table>
<thead>
<tr>
<th>District</th>
<th>Government</th>
<th>Private</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thiruvananthapuram</td>
<td>114</td>
<td>111</td>
<td>225</td>
</tr>
<tr>
<td>Ernakulam</td>
<td>83</td>
<td>196</td>
<td>279</td>
</tr>
<tr>
<td>Thrissur</td>
<td>74</td>
<td>161</td>
<td>235</td>
</tr>
<tr>
<td>Kozhikode</td>
<td>64</td>
<td>101</td>
<td>165</td>
</tr>
</tbody>
</table>

In order to make the sample representative of the actual population, due consideration was given to factors
such as locality of schools (urban, rural), management of schools (government, private) and sex of teachers (male, female). Details of the sample selected are given in Tables 3.3, 3.4 and 3.5.

Table 3.3 Distribution of Sample According to Locality

<table>
<thead>
<tr>
<th>District</th>
<th>Urban</th>
<th>Rural</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thiruvananthapuram</td>
<td>47</td>
<td>65</td>
<td>112</td>
</tr>
<tr>
<td>Ernakulam</td>
<td>49</td>
<td>56</td>
<td>105</td>
</tr>
<tr>
<td>Thrissur</td>
<td>40</td>
<td>57</td>
<td>97</td>
</tr>
<tr>
<td>Kozhikode</td>
<td>29</td>
<td>45</td>
<td>74</td>
</tr>
<tr>
<td>Total</td>
<td>165</td>
<td>223</td>
<td>388</td>
</tr>
</tbody>
</table>

Table 3.4 Distribution of Sample According to Management of Schools

<table>
<thead>
<tr>
<th>District</th>
<th>Government</th>
<th>Private</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thiruvananthapuram</td>
<td>58</td>
<td>54</td>
<td>112</td>
</tr>
<tr>
<td>Ernakulam</td>
<td>45</td>
<td>60</td>
<td>105</td>
</tr>
<tr>
<td>Thrissur</td>
<td>41</td>
<td>56</td>
<td>97</td>
</tr>
<tr>
<td>Kozhikode</td>
<td>33</td>
<td>41</td>
<td>74</td>
</tr>
<tr>
<td>Total</td>
<td>177</td>
<td>211</td>
<td>388</td>
</tr>
</tbody>
</table>
Table 3.5 Distribution of Sample According to the Sex of Teachers

<table>
<thead>
<tr>
<th>District</th>
<th>Male</th>
<th>Female</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thiruvananthapuram</td>
<td>59</td>
<td>53</td>
<td>112</td>
</tr>
<tr>
<td>Ernakulam</td>
<td>51</td>
<td>54</td>
<td>105</td>
</tr>
<tr>
<td>Thrissur</td>
<td>54</td>
<td>43</td>
<td>97</td>
</tr>
<tr>
<td>Kozhikode</td>
<td>39</td>
<td>35</td>
<td>74</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>203</td>
<td>185</td>
<td>388</td>
</tr>
</tbody>
</table>

3.3.2 Achievement Tests

Sample for the administration of Achievement Tests consisted of 1016 standard IX students and 1020 standard X students from selected secondary schools of Thiruvananthapuram, Ernakulam, Thrissur and Kozhikode districts of Kerala. Sample selection was done on the basis of 'stratified sampling technique'.

As this part of the investigation was intended mainly to measure the theory and practical application awareness in physics and also to study the influence of resource utilization on practical application awareness, schools were selected accordingly. From each district, eight schools were selected which come under High Resource
Utilization, Average Resource Utilization and Low Resource Utilization Categories. The selection of the schools of these three categories was done on the basis of the analysis of the questionnaire for physics teachers.

Schools having adequate resources and where resource utilisation was found to be to a great extent were considered to be 'High' resource utilisation schools. Schools having averages resources and where utilisation was found to be not so extensive were considered to be 'Average' resource utilisation schools. Those schools having only meagre or nil resources with poor utilisation were considered to be 'Low' resource utilisation schools. The criteria followed in the selection of schools were the following:

(a) In the selection of schools as 'High', 'Average', and 'Low' resource utilisation, the total scores obtained by each school for resource availability and utilisation were taken into consideration.

(b) The scores assigned in this regard were '2' for 'More than enough and enough', '1' for 'Not enough' and '0' for 'Nil' for the availability part.

(c) For the utilisation part the score assigned were '2' for 'Always', '1' for 'Sometimes' and '0' for 'Never'.

The schools having scores above the mean (M+σ) were classified as 'High' resource utilisation schools and
those having scores below the mean \((M-\sigma)\) were classified as 'Low' resource utilisation schools. All the rest were considered as 'Average' resource utilisation schools.

On the basis of the above procedure 72 schools were found to have availability of resources at a satisfactory level. District-wise distribution of availability of resource in schools is given in Table 3.6.

Regarding the extent of utilisation, 52 schools were found to have high resource utilisation. This included some schools with low resource availability because in these schools the available resources though not satisfactory were found to be utilised. The details of schools according to the extent of resource utilisation is given in Table 3.7.

While selecting the schools for the administration of tests, availability and utilisation of resources were considered. Availability and utilisation of library facilities, laboratory, environmental resources, etc., were not found uniform in all the schools selected for the study.

Administration of the prepared tests on students of schools with inadequate resources may not help to obtain meaningful data. Hence it was decided to carry out the tests on students of schools which come under the categories of 'High', 'Average' and 'Low' resource utilisation. The tests were planned to be administered on about 1000 students each from standard IX and standard X. It was found that these
Table 3.6 District-wise Distribution of Schools According to Availability of Resource by Area and Management

<table>
<thead>
<tr>
<th>District</th>
<th>More than enough and enough</th>
<th>Not enough</th>
<th>More than enough and enough</th>
<th>Not enough</th>
<th>More than enough and enough</th>
<th>Not enough</th>
<th>More than enough and enough</th>
<th>Not enough</th>
<th>More than enough and enough</th>
<th>Not enough</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thiruvananthapuram</td>
<td>23</td>
<td>89</td>
<td>16</td>
<td>7</td>
<td>31</td>
<td>58</td>
<td>10</td>
<td>13</td>
<td>48</td>
<td>41</td>
</tr>
<tr>
<td>Ernakulam</td>
<td>19</td>
<td>86</td>
<td>13</td>
<td>6</td>
<td>36</td>
<td>50</td>
<td>7</td>
<td>12</td>
<td>38</td>
<td>48</td>
</tr>
<tr>
<td>Thrissur</td>
<td>16</td>
<td>81</td>
<td>11</td>
<td>5</td>
<td>29</td>
<td>52</td>
<td>6</td>
<td>10</td>
<td>35</td>
<td>46</td>
</tr>
<tr>
<td>Kozhikode</td>
<td>14</td>
<td>60</td>
<td>10</td>
<td>4</td>
<td>19</td>
<td>41</td>
<td>5</td>
<td>9</td>
<td>28</td>
<td>32</td>
</tr>
<tr>
<td>Total</td>
<td>72</td>
<td>316</td>
<td>50</td>
<td>22</td>
<td>115</td>
<td>201</td>
<td>28</td>
<td>44</td>
<td>149</td>
<td>167</td>
</tr>
</tbody>
</table>
Table 3.7 District-wise Distribution of Schools According to Utilisation of Resource by Locality and Management

<table>
<thead>
<tr>
<th>District</th>
<th>High resource utilisation</th>
<th>Average resource utilisation</th>
<th>Low resource utilisation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Urban</td>
<td>Rural</td>
<td>Total</td>
</tr>
<tr>
<td>Thiruvananthapuram</td>
<td>14</td>
<td>2</td>
<td>16</td>
</tr>
<tr>
<td>Ernakulam</td>
<td>12</td>
<td>3</td>
<td>15</td>
</tr>
<tr>
<td>Thrissur</td>
<td>11</td>
<td>-</td>
<td>11</td>
</tr>
<tr>
<td>Kozhikode</td>
<td>10</td>
<td>-</td>
<td>10</td>
</tr>
<tr>
<td>Total</td>
<td>47</td>
<td>5</td>
<td>52</td>
</tr>
</tbody>
</table>
many students would be available from about 30 schools. Accordingly it was decided to select 8 schools from each of the four districts giving a total of 32 schools for the administration of the prepared tests.

Thus in all, 32 schools from the above mentioned four districts of Kerala were selected from the three categories of schools for administering the tests. This was found to be about 9 percent of the schools where resource survey was conducted. Due consideration was given to factors like locality of schools, management of schools and sex of the subjects. For 'High' resource utilisation category schools, the sample consisted only of urban schools as resource availability and utilisation was found higher in them than rural schools. The investigator came to this conclusion after analysing the questionnaire for teachers for assessing the extent of availability and utilisation of resources for physics education. Only five schools from rural areas selected for the study were found to have high resource utilisation. This number was found to be inadequate for detailed study. The details of the sample selected are given in Tables 3.8 to 3.12. List of schools is included as Appendix XI.
Table 3.8 Distribution of Sample According to Resource Utilisation

<table>
<thead>
<tr>
<th>District</th>
<th>High Resource Utilisation</th>
<th>Average Resource Utilisation</th>
<th>Low Resource Utilisation</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thiruvananthapuram</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>8</td>
</tr>
<tr>
<td>Ernakulam</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>8</td>
</tr>
<tr>
<td>Thrissur</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>8</td>
</tr>
<tr>
<td>Kozhikode</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>8</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>10</strong></td>
<td><strong>10</strong></td>
<td><strong>12</strong></td>
<td><strong>32</strong></td>
</tr>
</tbody>
</table>

Table 3.9 Distribution of Sample - High Resource Utilisation Category

<table>
<thead>
<tr>
<th>District</th>
<th>Urban</th>
<th>Rural</th>
<th>Total</th>
<th>Govt.</th>
<th>Pvt.</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thiruvananthapuram</td>
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<td>-</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Ernakulam</td>
<td>3</td>
<td>-</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Thrissur</td>
<td>2</td>
<td>-</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Kozhikode</td>
<td>2</td>
<td>-</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>10</strong></td>
<td>-</td>
<td><strong>10</strong></td>
<td><strong>5</strong></td>
<td><strong>5</strong></td>
<td><strong>10</strong></td>
</tr>
</tbody>
</table>
Table 3.10 Distribution of Sample - Average Resource Utilisation Category

<table>
<thead>
<tr>
<th>District</th>
<th>Urban</th>
<th>Rural</th>
<th>Total</th>
<th>Govt.</th>
<th>Pvt.</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thiruvananthapuram</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>-</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Ernakulam</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>-</td>
<td>2</td>
</tr>
<tr>
<td>Thrissur</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Kozhikode</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>4</strong></td>
<td><strong>6</strong></td>
<td><strong>10</strong></td>
<td><strong>5</strong></td>
<td><strong>5</strong></td>
<td><strong>10</strong></td>
</tr>
</tbody>
</table>

Table 3.11 Distribution of Sample - Low Resource Utilization Category

<table>
<thead>
<tr>
<th>District</th>
<th>Urban</th>
<th>Rural</th>
<th>Total</th>
<th>Govt.</th>
<th>Pvt.</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thiruvananthapuram</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Ernakulam</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Thrissur</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Kozhikode</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>2</strong></td>
<td><strong>10</strong></td>
<td><strong>12</strong></td>
<td><strong>6</strong></td>
<td><strong>6</strong></td>
<td><strong>12</strong></td>
</tr>
</tbody>
</table>
Table 3.12  Distribution of Sample According to the Sex of Students

<table>
<thead>
<tr>
<th>Students</th>
<th>Girls</th>
<th>Boys</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Std IX</td>
<td>493</td>
<td>523</td>
<td>1016</td>
</tr>
<tr>
<td>Std X</td>
<td>523</td>
<td>497</td>
<td>1020</td>
</tr>
</tbody>
</table>

3.3.3 Intelligence Test and Socio-Economic Status Scale

The sample for the administration of these two tools was the same sample selected for the administration of achievement tests, the details of which are given above.

3.3.4 Observation

The investigator observed one physics class room each of the 32 schools selected for the administration of the achievement tests.

3.4 Procedure for Collection of Data

3.4.1 Administration of questionnaire

The investigator mailed 500 questionnaire forms to a section of the sample selected for the study with a request to the headmaster to hand over the questionnaire to any one of the physics teachers in the school without having any bias. A self-addressed and stamped envelope was provided with the form for the prompt and quick return. The
Table 3.13 Details Regarding Distribution and Collection of Questionnaire Forms

<table>
<thead>
<tr>
<th>District</th>
<th>Number Distributed</th>
<th>Urban</th>
<th>Rural</th>
<th>Respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Distri-</td>
<td>Collec-</td>
<td>Selected</td>
<td>Govt.</td>
</tr>
<tr>
<td>Thiruvananthapuram</td>
<td>200</td>
<td>123</td>
<td>112</td>
<td>23</td>
</tr>
<tr>
<td>Ernakulam</td>
<td>200</td>
<td>114</td>
<td>105</td>
<td>22</td>
</tr>
<tr>
<td>Thrissur</td>
<td>190</td>
<td>104</td>
<td>97</td>
<td>16</td>
</tr>
<tr>
<td>Kozhikode</td>
<td>160</td>
<td>84</td>
<td>74</td>
<td>14</td>
</tr>
<tr>
<td>Total</td>
<td>750</td>
<td>425</td>
<td>388</td>
<td>75</td>
</tr>
</tbody>
</table>
investigator personally distributed 250 questionnaires to the rest of the sample. After reminders, and follow-up letters, 285 filled up questionnaires were received from the mailed 500 questionnaire forms. The investigator could get back only 140 filled in forms out of the 250 forms distributed personally. 37 forms were found to be defective or incomplete. After eliminating them, the actual sample was found to be 388 from the four revenue districts of Kerala: Thiruvananthapuram, Ernakulam, Thrissur and Kozhikode. Details of distribution and collection of questionnaire forms are given in Table 3.13.

3.4.2 Administration of Achievement Tests

The investigator visited the individual institutions (secondary schools) where the tests were to be conducted, and made arrangements for testing. The students who were to take the tests were informed of the content, date and time of testing. This ensured standard performance. One week's time notice was given to all subjects. The arrangements were made with the help of the Heads of the Institutions and teachers dealing with physics.

The tests were administered following the directions in the respective test manuals. Ideal condition for administering the tests were ensured in respect of timing, seating, directions, invigilation, arrangements,
etc. Common procedures were followed in all schools and thus external testing conditions were kept almost identical. The investigator was present for all the test sessions. Teachers were available for help in administering the tests. Separate scoring sheets were used for scoring all the tests.

3.4.3 Administration of Intelligence Test and Socio-economic Status Scale

After administering achievements tests and collecting back the score sheets, Intelligence test was administered to the subjects. Score sheet for this was provided separately (Appendix XII). After collecting back the score sheets, socio-economic status scale forms were distributed and the subjects were asked to fill them up.

3.5 Consolidation of Data

The tabulation of data has been done very carefully. The data collected by questionnaire, achievement tests, intelligence test, socio-economic status scale and observation schedule were tabulated on separate sheets. Partially and improperly filled in questionnaires were discarded. Only 388 questionnaires could be used for final analysis.

The consolidated data from achievement tests, intelligence test, socio-economic status scale were taken to
the computer section for statistical computation. The rest of the data were hand computed.

3.6 Statistical Techniques Used for Analysis

The responses of the teachers were treated statistically. Percentages were calculated.

The score sheets for PTAT, PPAAT, Intelligence Test and Socio-economic status scale forms were scored and scores subjected to statistical treatment consisted of:

1. Arithmetic mean

\[
\bar{x} = A + \frac{\sum fd}{N} 
\]

\(\bar{x}\) - Arithmetic mean

A - Assumed mean

C - Class interval

f - Frequency of each class

d - Deviation of score from the assumed mean

N - Total sample

2. S.D.

\[
SD = \sqrt{\frac{\sum d^2}{N} - \left(\frac{\sum fd}{N}\right)^2}
\]

C - Class interval

f - Frequency of each class

d - Deviation of score from the assumed mean

N - Total sample
3. Analysis of variance: Two-way classification

In single classification or one-way analysis of variance, the relationship between one independent variable and one dependent variable can be examined. When the simultaneous effect of two independent variables on a dependent variable is to be studied, a two-way analysis of variance is performed.

Intelligence Quotient (IQ) is classified into three levels (High IQ; Average IQ; and Low IQ.) depending upon the mean (M) and standard deviation (σ) of the IQ. Test scores for the whole group. Thus all subjects whose IQ score is above the mean (M+σ) have been classified as High IQ level. Similarly a subject whose IQ score is below (M-σ) can be placed in the Low IQ level. All the rest of the subjects will be classified as belonging to the Average IQ level. In the same way Socio-Economic Status (SES) score were analysed and subjects were classified as High SES level, Average SES level and Low SES level.

Sex has two levels (Male and Female), locality has two levels (urban and rural) management has two levels (government and private).

To study the influence of independent variables on the dependent variable 'Physics Theory Awareness' (PTA) of standard IX students, 9 separate two-way ANOVA were found to be necessary. In the same way to study the influence of
independent variables on the dependent variable 'Physics Practical Application Awareness' (PPAA) of standard IX pupils, 9 more separate two-way ANOVA were found to be necessary.

In the same way 18 separate ANOVA were found to be necessary to study the influence of independent variables on Physics Theory Awareness (PTA) of standard X pupils and Physics Practical Application Awareness (PPAA) of standard X pupils.

4. Product-moment Correlations

Pearson's product-moment correlation method is used to calculate the relationship between PTA and PPAA of subjects.

\[
\text{Coefficient of correlation } r = \frac{\sum x^1 y^1}{N} - \frac{C_x C_y}{N}
\]

\[
\sum x^1 y^1 = \text{Sum of the product of deviation taken from the assumed means of } x \text{ and } y \text{ distributions}
\]

\[
N = \text{Total sample}
\]

\[
x = \text{Standard deviation of } x \text{ variable}
\]

\[
y = \text{Standard deviation of } y \text{ variable}
\]

\[
C_x = \text{Correlation in } x \text{ variable}
\]

\[
C_y = \text{Correlation in } y \text{ variable}
\]