3.1 INTRODUCTION

In the previous chapter, a critical review of research related to the objective of the study is given. Based on such a review, a justification has also been made for formulating hypothesis of the study.

This chapter gives a clear view of the methodology employed in order to test the hypothesis of study. This chapter includes the details regarding the tools employed in each stage of the study in order to achieve the objectives. Along with the description of the tool, the standardization procedures followed by the investigator while developing tools are also discussed.

3.2 VARIABLES OF THE STUDY

The enrichment programme developed by the investigator is the independent variable of the study. Performance on achievement test in Physical science is the dependent variable. The variable and the tools employed are given in table 3.1.
Table 3.1: Details of variables and tools employed

<table>
<thead>
<tr>
<th>Variables</th>
<th>Tools/Techniques</th>
<th>Authors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scientific aptitude</td>
<td>Scientific Aptitude Test Battery</td>
<td>Dr. K.K Agarwal and Saroj Arora (1998)</td>
</tr>
<tr>
<td>Achievement in Physical science in selected topic of Physical science</td>
<td>Achievement test in selected topic of Physical science</td>
<td>Investigator</td>
</tr>
<tr>
<td>Understanding of the concept in selected topic of Physical Science</td>
<td>Achievement test in selected topic of Physical science</td>
<td>Investigator</td>
</tr>
<tr>
<td>Understanding of the principles in selected topic of Physical science</td>
<td>Achievement test in selected topic of Physical science</td>
<td>Investigator</td>
</tr>
<tr>
<td>Solving the problems in selected topic of Physical science</td>
<td>Achievement test in selected topic of Physical science</td>
<td>Investigator</td>
</tr>
<tr>
<td>Attainment of graphical skills. in selected topic of Physical science</td>
<td>Achievement test in selected topic of Physical science</td>
<td>Investigator</td>
</tr>
</tbody>
</table>

These variables are related to selected topic in Physical science.

3.3 SAMPLE

In order to achieve the objectives and verify the hypothesis of the study, it was essential to identify students with superior level of intelligence and scientifically talented. A multi-stage sampling technique was adopted in the study. According to the list given in the Karnataka State Government website there were 52 schools in Mysore city. While selecting the schools for the study certain criteria were taken into consideration. The details regarding the criteria, the number of schools who met them are given in table 3.2.
Table 3.2: Criteria for selecting the schools

<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>Criteria</th>
<th>Number of school excluded for not meeting the criteria</th>
<th>Number of school retained who met the criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>School following English medium</td>
<td>20</td>
<td>32</td>
</tr>
<tr>
<td>2</td>
<td>Schools following CBSE or State Syllabus</td>
<td>7</td>
<td>25</td>
</tr>
<tr>
<td>3</td>
<td>Schools with good academic performance in SSLC</td>
<td>5</td>
<td>20</td>
</tr>
<tr>
<td>4</td>
<td>Schools who extended co-operation to conduct the study</td>
<td>5</td>
<td>15</td>
</tr>
</tbody>
</table>

Thus from 52 schools only 15 schools were selected who satisfied all the criteria. Out of these 15 schools six were following CBSE and nine were following state syllabus. The study was restricted to grade IX students only. The reasons being - Students should be there in the present school at least for one year, they will have maturity for planning their future educational course. In addition to that there should be total involvement from the selected students. There were totally 1232 students in the 15 schools. The distribution of the same are given in Table 3.3.

Table 3.3: The distribution of students in the selected schools

<table>
<thead>
<tr>
<th>Gender</th>
<th>CBSE</th>
<th>State</th>
<th>No.of students</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boy</td>
<td>248</td>
<td>358</td>
<td>606</td>
</tr>
<tr>
<td>Girl</td>
<td>248</td>
<td>368</td>
<td>626</td>
</tr>
<tr>
<td>Total</td>
<td>496</td>
<td>726</td>
<td>1232</td>
</tr>
</tbody>
</table>

The sample above was used for identification of scientifically talented students.
3.4 PROCEDURE FOR IDENTIFICATION OF THE SCIENTIFICALLY TALENTED STUDENTS

In order to identify the Scientifically Talented Students the following criteria were stipulated

a) Students should be nominated at least twice from the peers.

b) Students should be nominated by at least two teachers.

c) Students should be intellectually superior.

d) Students should be above average in scientific aptitude.

All the 1232 students were subjected to the above criteria. The following procedures were adopted during the Identification phase for testing the criteria.

Stage 1: Peer nomination

Stage 2: Teacher nomination

Stage 3: Assessment of intellectual level

Stage 4: Assessment of scientific aptitude

Descriptions of these stages are given below.

Stage 1: Peer nomination: For all the 1232 students peer nomination form (Episten, 1992) was administered. The purpose of the tool is to identify the students who are academically talented as per the perception of their peers and self. The details about the description of the Peer Nomination Form and the administration procedure are given in the section 3.5.1. The tool was administered to the entire class of a school at a time. Instructions were given clearly. After 15 minutes the form was collected back. A copy of the form is given in the Appendix I. The responses given by the students were analyzed keeping in mind the Criterion I. The students who were nominated by
their classmates at least twice were retained for the next stage. The number of students who were considered as academically talented is given in the Tables 3.4.

Table 3.4: Number of Academically Talented Students as per Peer Nomination

<table>
<thead>
<tr>
<th>Gender</th>
<th>CBSE Syllabus</th>
<th>STATE Syllabus</th>
<th>Total</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boys</td>
<td>160</td>
<td>222</td>
<td>382</td>
<td>61%</td>
</tr>
<tr>
<td>Girls</td>
<td>150</td>
<td>226</td>
<td>376</td>
<td>62%</td>
</tr>
<tr>
<td>Total</td>
<td>310</td>
<td>448</td>
<td>758</td>
<td></td>
</tr>
</tbody>
</table>

**Stage II:** For all the 52 teachers (class teachers, Science and mathematics teacher) of the 15 schools Teacher Nomination form (Renzulli, 1988) was administered. The purpose of the tool is to identify the students who are academically talented as per the opinion of teachers. The details about the description of the Teacher Nomination Form and the administration procedure are given in the section 3.5.2. The tool was given to the teachers. Instructions were given clearly. The teachers were asked to nominate the academically talented students from the entire group of 1232 students. After a week the forms were collected back. A copy of the form is given in the Appendix II. The responses given by the teacher were analyzed keeping in mind the Criterion II. The students who were nominated by at least two teachers were retained for the next stage. The number of students who were considered as academically talented as per the opinion of the teachers is given in the Table 3.5.
Table 3.5: Number of Academically Talented Students as per Teacher Nomination

<table>
<thead>
<tr>
<th>Gender</th>
<th>CBSE Syllabus</th>
<th>STATE Syllabus</th>
<th>Total</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boys</td>
<td>18</td>
<td>26</td>
<td>44</td>
<td>7%</td>
</tr>
<tr>
<td>Girls</td>
<td>24</td>
<td>52</td>
<td>76</td>
<td>12%</td>
</tr>
<tr>
<td>TOTAL</td>
<td>42</td>
<td>78</td>
<td>120</td>
<td></td>
</tr>
</tbody>
</table>

**Stage III:** For all 120 Students Raven’s Standard Progressive Matrices (SPM, 1997) test was given for 40 minutes. The details about the description of Students Raven’s Standard Progressive Matrices and the administration procedure are given in the section 3.9.3 The tool was administered, the responses were scored by following the instructions given in the manual. For converting the raw scores in to percentile points the norms given in the Table SPM18 of Raven’s manual smoothed (1997) Norms for Pune and Mumbai was considered. The students who scored at or above 95th percentile were considered as “Intellectually Superior” and were retained for further study. Table 3.6 shows the distribution of the students who are “Intellectually superior”.

Table 3.6: Number of Intellectually Superior Students

<table>
<thead>
<tr>
<th>Gender</th>
<th>CBSE Syllabus</th>
<th>STATE Syllabus</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boys</td>
<td>6</td>
<td>6</td>
<td>8</td>
</tr>
<tr>
<td>Girls</td>
<td>4</td>
<td>5</td>
<td>9</td>
</tr>
<tr>
<td>TOTAL</td>
<td>10</td>
<td>11</td>
<td>21</td>
</tr>
</tbody>
</table>

**Stage IV:** For all the 21 students, the Scientific Aptitude Test (Agarwal and Saroj Arora, 1992) was administered. The Scientific aptitude Test consists of four sub tests namely Reasoning tests, Numerical ability test, Science vocabulary test and Science information subtest. The details about the description of the test and the
administration procedure are given in the section 3.9.4. The tool was administered, and the responses were scored by following the instructions given in the manual. The raw scores were converted into weighted score and the levels of scientific aptitude were computed by the following the norms given in the manual. Out of the 21 students those with “Above Average” and “High” scientific aptitude were only retained for further study. They were considered as scientifically talented in the study. Table 3.7 shows the distribution of the students who are Scientifically Talented. The results are given in the Table 3.7.

Table 3.7: Distribution of Scientifically Talented students

<table>
<thead>
<tr>
<th>Gender</th>
<th>CBSE</th>
<th>STATE</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boys</td>
<td>3</td>
<td>5</td>
<td>8</td>
</tr>
<tr>
<td>Girls</td>
<td>4</td>
<td>5</td>
<td>9</td>
</tr>
<tr>
<td>TOTAL</td>
<td>7</td>
<td>10</td>
<td>17</td>
</tr>
</tbody>
</table>

From among 1232 students only 17 were considered scientifically talented.

Table 3.8: Percentage of Scientifically Talented Students

<table>
<thead>
<tr>
<th>Total number of schools = 15</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
</tr>
<tr>
<td>--------</td>
</tr>
<tr>
<td>Total number of students</td>
</tr>
<tr>
<td>Percentage</td>
</tr>
<tr>
<td>Number of scientifically talented students</td>
</tr>
<tr>
<td>Percentage of scientifically talented students</td>
</tr>
</tbody>
</table>

Above table shows that 1.3% of the students were found to be scientifically talented. It can also be noticed that the percentage of students with respect to gender is more or less same.
Table 3.9: Number of scientifically talented students studying CBSE and STATE syllabus

<table>
<thead>
<tr>
<th>Curriculum of study</th>
<th>CBSE</th>
<th>STATE</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total number of students</td>
<td>496</td>
<td>726</td>
<td>1232</td>
</tr>
<tr>
<td>Percentage</td>
<td>40.2</td>
<td>58.9</td>
<td></td>
</tr>
<tr>
<td>Number of students with scientifically talented</td>
<td>7</td>
<td>10</td>
<td>17</td>
</tr>
<tr>
<td>Percentage of students with scientifically talented</td>
<td>1.4%</td>
<td>1.3%</td>
<td>1.3%</td>
</tr>
</tbody>
</table>

From the above table it can be noticed that the percentage of students who are scientifically talented is same in both the streams. i.e. CBSE and STATE.

Table 3.10: Distribution of Scientifically talented students with different levels of scientific aptitude in studying State syllabus

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Gender</th>
<th>Type of syllabus</th>
<th>Level of scientific aptitude</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>High</td>
</tr>
<tr>
<td>1</td>
<td>Boy</td>
<td>State</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>Girl</td>
<td>State</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>Boy</td>
<td>State</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>Girl</td>
<td>State</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>Girl</td>
<td>State</td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>Girl</td>
<td>State</td>
<td>0</td>
</tr>
<tr>
<td>7</td>
<td>Girl</td>
<td>State</td>
<td>0</td>
</tr>
<tr>
<td>8</td>
<td>Girl</td>
<td>State</td>
<td>0</td>
</tr>
<tr>
<td>9</td>
<td>Boy</td>
<td>State</td>
<td>0</td>
</tr>
<tr>
<td>10</td>
<td>Boy</td>
<td>State</td>
<td>0</td>
</tr>
<tr>
<td>11</td>
<td>Boy</td>
<td>State</td>
<td>0</td>
</tr>
<tr>
<td>total</td>
<td></td>
<td></td>
<td>5</td>
</tr>
<tr>
<td>Percentage</td>
<td></td>
<td></td>
<td>45.4</td>
</tr>
</tbody>
</table>
Table 3.11: Distribution of Scientifically talented students with different levels of scientific aptitude in studying CBSE syllabus

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Gender</th>
<th>Type of syllabus</th>
<th>Level of scientific aptitude</th>
<th>High</th>
<th>Above average</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Boy</td>
<td>CBSE</td>
<td>0</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>Girl</td>
<td>CBSE</td>
<td>1</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>Girl</td>
<td>CBSE</td>
<td>0</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>Boy</td>
<td>CBSE</td>
<td>0</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>Girl</td>
<td>CBSE</td>
<td>0</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>Girl</td>
<td>CBSE</td>
<td>0</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Total (%)</td>
<td>1 (16.6%)</td>
<td>5 (82.4%)</td>
</tr>
</tbody>
</table>

From the Tables 3.10 and 3.11 it is very clear that the percentage of students with high scientific aptitude is more in state syllabus schools compared to that of CBSE schools.

The responses of the students for the item on the subject of interest included in the SATB were analyzed. The subjects of interest of the scientifically talented students are given below.

Table 3.12: Subject of interest of the Scientifically Talented Students

<table>
<thead>
<tr>
<th>Students</th>
<th>Subject of Interest</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Science</td>
</tr>
<tr>
<td>2</td>
<td>Science and maths</td>
</tr>
<tr>
<td>3</td>
<td>Science</td>
</tr>
<tr>
<td>4</td>
<td>Science</td>
</tr>
<tr>
<td>5</td>
<td>Astro physics</td>
</tr>
<tr>
<td>6</td>
<td>Science</td>
</tr>
<tr>
<td>7</td>
<td>Physics and maths</td>
</tr>
<tr>
<td>8</td>
<td>Maths and physics</td>
</tr>
<tr>
<td>9</td>
<td>Science</td>
</tr>
<tr>
<td>10</td>
<td>Physics</td>
</tr>
<tr>
<td>11</td>
<td>Physics</td>
</tr>
<tr>
<td>12</td>
<td>Science</td>
</tr>
<tr>
<td>13</td>
<td>Science and maths</td>
</tr>
<tr>
<td>14</td>
<td>Science</td>
</tr>
<tr>
<td>15</td>
<td>Physics and maths</td>
</tr>
<tr>
<td>16</td>
<td>Maths and science</td>
</tr>
<tr>
<td>17</td>
<td>Science</td>
</tr>
</tbody>
</table>
The table 3.12 shows that most of the students were interested in science, more specifically physical science as well as mathematics.

3.5 DESCRIPTION OF THE TOOLS

Tools were classified according to the usage of tool in different stage of programme. The following assessing instruments were adopted for identification of scientifically talented students.

1. Peer nomination form
2. Teacher nomination form
3. Raven’s Progressive Matrices test
4. Scientific aptitude test (Indian edition)

The details of each assessing instruments were given below.

3.5.1 Peer nomination

**Description:** The original Peer Nomination Form was prepared by Eisenberg and Epstein in 1982. Peers are very good at naming gifted /talented classmates which account’s for the use of peer nomination by one fourth of gifted programmes. Children have special relationship with their peers. The peer nomination depends on the answer for the question” who is who?” There are fifteen items in the peer nomination form. The peers have to nominate their classmates as per their perception. Peer nomination consists of self nomination also. If the student wants to nominate himself he/she can write that also. A copy of peer nomination is given on Appendix I.

**Administration:** All the students (1232) were given the peer nomination form. Before writing peer nomination form the students were asked to mask their nomination form so that his /her friend should not see the nomination what they are
writing. After the collection of the nomination forms the researcher assured the confidentiality of the form. Each student writes the name of the classmate for each item. The students were given an instruction that he/she should write the name of classmate whom they are thinking as gifted with reference to different fields and not the friends who are sitting near by.

**Scoring:** Researcher has made a matrix of the students who are nominated at least two different students. From there he made a list of students in which the peers are nominated.

### 3.5.2 Teacher Nomination Form

**Description:** Teacher Nomination is developed by Joseph. Renzulli for school wide enrichment model programme. Researcher has modified the teacher nomination form which was developed by Renzulli by deleting two item of SBRCSS total and parent nomination question. Teacher Nomination form consists of 7 items. It is the most common identification method. A copy of the teacher nomination form is given in Appendix II. Teacher nomination consists of all record of the student like, Date of birth, Average grade/mark in the current year, and special recommendation for teacher and Specific interest in the areas, Special interest in curricular areas, etc.

**Administration** The researcher has discussed with headmaster/mistress to meet the class teachers and concerned teacher in Physics and mathematics for IX standard of the classes where he taken as the sample. Researcher has given the teacher nomination form to all teachers who were taking classes for IX standard. In all fifteen school the researcher given the teacher nomination form In each class the teacher
were asked to nominate at least two students to four students depending upon the size of the class.

**Scoring:** The names which are identified by teacher were matched with peer nomination form, which researcher has used in the first stage. The details of the teacher nomination are given in Chapter IV.

3.5.3 Standard Raven’s Progressive Matrices (1998)

**Description:** This test was developed by Raven (1965). It is designed to provide a reliable estimate of person’s capacity to think clearly when left undisturbed. It is made up of five sets of Series of diagrammatic Puzzles exhibiting serial change simultaneously. Each puzzle has a part missing, which the person taking the test has to find among the six option provided. Only one option is perfectly correct. Even though some others will be partially correct, select the perfectly correct option. This test was meant to asses the intellectual “g” factor with the seaming technique. It consists of 60 problems, divided in to 5 sets A, B, C, D, E. Each includes 12 problems. In each set the first problem is as nearly as possible self evident. The problems which follow build an argument of those that have gone before and become progressively difficult. Thus it is evident that this test is meant to assess chief cognitive process. The test calls for the recognition of abstract relationship, but the amount which the person has to hold in the mind at once is strictly limited. He must recognize the relationship as he/she scans the pattern horizontally and vertically but noted not scan them both at once.

**Administration:** The test was administered individually for 40 minutes. After establishing a rapport with students instruction were given reading the test booklets
were distributed for recoding the responses. Care taken to mention that try each one
turns from the beginning to the end of the booklet and does not miss any item. If you
pay attention to initial ones the later ones will be less difficult, students were allowed
to work quietly at their own speed. It was mad sure that those who attended the test
under stood that what they have to do. Hence the clarification related to the test was
made in between.

In case of SPM score is the number of items answered correctly. Maximum
score of each set is 12 and there are 12 problems. Therefore the maximum total score
is 60, as there are 5 sets.

The test gives the following classification of Person based on the performance
on this test.

**Scoring:** As per the Raven’s score the students can be classified in to three

**Intellectually superior:** if the subjects’ score is at or above 95\(^{th}\) Percentile for his age
group.

**Above average Intellectual capacity:** If the core lies between 25\(^{th}\) and 75\(^{th}\)
percentile.

**Below average intellectual capacity:** If the score lies below 25\(^{th}\) percentile.

The said classification was followed by table SPM18 smoothed norms for
Pune and Mumbai with whose score lies 95\(^{th}\) percentile with in the age group
13-14 years were taken in to study.

3.5.4 Scientific Aptitude Test Battery (SATB) Dr.K.K Agarwal and Saroj Arora

**Description of the test:** In Order to find out the aptitude of science of those identified
gifted students, these students were given Scientific aptitude test.
Scientific aptitude test of consists four subsets. 1) Reasoning test 2) Numerical ability test 3) Scientific information test 4) Science vocabulary test. Each test were described in detail. The total time allowed for all these test were 90 minutes. all test were comprised in one test (SATB). The details of the test were given below.

**Reasoning test**

Its purpose is to gauge the capacity of students to discover analytic, synthetic, and reasoning powers. It is a verbal group test and point scale in omnibus form. It consists of 52 items divided in two sections. Section A comprising of general reasoning and Section B comprises of science reasoning. The items were classified analogies, number series and grouping, multiple choice, classification etc. The time given for reasoning test was 25 minutes.

**Numerical ability test**

The test consists of 52 items divided in to two sections, section A consists of problems on the arithmetical computation and section B consists on arithmetic reasoning. Items in section A are of multiple choice type and Section B consists of simple problems, total number of items are 52 and allowed 30 minutes.

**Science information test**

This test consists of 50 items in Physics and chemistry of secondary school. It attempts to know whether students keep them read with recent discoveries in the scientific field and whether they have ability to apply principles in making simple predications. The time of the test was for 20 minutes.
Science Vocabulary Test

It consists of item based on the definition of important terms, acquaintance with important science concepts and understanding theories and principles. The number of item comprising the test are 56 and time fixed is 15 minutes (Reliability).

<table>
<thead>
<tr>
<th>Type of test</th>
<th>Test-retest</th>
<th>Split-half</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reasoning test</td>
<td>0.90</td>
<td>0.91</td>
</tr>
<tr>
<td>Numerical ability</td>
<td>0.91</td>
<td>0.91</td>
</tr>
<tr>
<td>Science information test</td>
<td>0.84</td>
<td>0.84</td>
</tr>
<tr>
<td>Science vocabulary Test</td>
<td>0.93</td>
<td>0.84</td>
</tr>
<tr>
<td><strong>Entire battery</strong></td>
<td><strong>0.94</strong></td>
<td><strong>0.93</strong></td>
</tr>
</tbody>
</table>

Validity: The battery of the test has been validated against high school examination is science, mathematics and total. The validity coefficients being 0.59, 0.57, 0.58 respectively which are quite satisfactory.

Administration: The test were conducted the students who were already screened by Raven’s progressive matrices test. Researcher has visited the schools where he has selected the students in leisure time. Instructions were given before conducting the test. They were asked to mark the answer only on pen. The total duration of test was 90 minutes. Students were given option for writing part by part for the test in order to adjust their timing in the school.

Scoring: Each answer there is +1 mark is given and each wrong answer no mark is given. Each test was totaled separately and weighted score were found out by the following formula. $1.33X_1 + 1X_2 + 2X_3 + 3X_4$ Where $X_1, X_2, X_3, X_4$ are the raw scores on test shown in the above table.
3.6 CONSTRUCTION OF AN ACHIEVEMENT TEST IN PHYSICAL SCIENCE

It is not possible to include all the topics of Physical Science which are included in the grade IX syllabus as, it has to be followed by an enrichment programme. So the investigator decided to restrict the number of topic and sub-topics to be included in the achievement test. In order to identify the topics to be included in the achievement test and the enrichment programme the researcher applied following criteria:

Criteria 1: Topic and sub-topics of physical science should have been already studied by the students in grade IX.

Criteria 2: Topic and sub-topics should have adequate number of concepts, principles, problems to be solved, graphical and experimental skills.

Criteria 3: Topic and sub-topics should be interesting in nature and should have relevance for the daily life.

Criteria 4: Topic and sub-topics should have adequate scope for conducting experiments independently by the students using minimum infrastructure available of the Institute.

Based on the above criteria the researcher selected the topic on “Mechanics” which includes Subtopics – Motion, and Work and Energy, Specifically the sub topics covered were different characteristics of motion, Variables of motion, Graphical representation of motion, different concepts related to motion, circular motion, work, power, and energy.
3.6.1 Content Analysis

In order to construct the achievement test the researcher did the Content analysis of the topic mechanics to identify the major concepts, principles, graphical skills and experimentation skills. They are listed below.

1. Whenever a position of a body changes with respect to another body is said to be in motion. (Principle)

2. In order to describe the motion of an object one reference point is required. (Principle)

3. The shortest distance traveled by a body in a particular direction is called displacement. (Concept)

4. If a body travel equal distance in equal interval to time it is said to be in uniform motion. (Concept)

5. Scalars (concept) are the quantity which is having magnitude and vectors are quantity which is having both magnitude and direction.

6. Speed (concept) is equal to \( \frac{\text{distance travelled}}{\text{time}} \) and Velocity is defined as \( \frac{\text{displacement}}{\text{time}} \)

7. Average velocity (concept) = \( \frac{\text{Initial velocity} + \text{final velocity}}{\text{Time}} \)

8. Rate of change of velocity is called acceleration or acceleration (concept)

\[ = \frac{\text{change in velocity}}{\text{Time taken}} \]

9. If a graph represented by distance along y-axis and time along x-axis it is called distance-time graph. (Skill)
10. The slope of a graph (concept) can be represented by \( \frac{\text{Change in y-axis}}{\text{Change in x-axis}} \)

11. If a graph represented by velocity along y-axis and time along x-axis it is called velocity-time graph.(skill)

12. Area under velocity time graph gives the displacement (Skill).

13. The slope of distance-time graph is velocity (skill)

14. The equation of motion are \( V=U+at \)
\[
V^2=U^2+2aS \\
S = Ut+\frac{1}{2}at^2
\] (Principle)

15. When a body moves along the circumference of a circle it is called circular motion (Principle)

16. The angular velocity (concept) of a body moving along a circumference of a circle is given by \( \nu = \frac{2\pi r}{T} \).

17. Work done (concept) on an object is defined as the magnitude of the force multiplied by the distance moved by the object in the direction of the applied force. The unit of work is joule.

18. Work done (concept) on an object by a force would be zero if the displacement of the object is zero. \( W=F.d\cos \alpha \) where \( \alpha \) is the angle between Force and Displacement.

19. Work done in a Circular motion is zero (Principle)

20. An object having capability to do work is said to possess energy. Energy has the same unit as that of work.(Principle)

21. Energy possessed by a body always positive quantity. (Principle)
22. In a conservative system the sum of Potential energy and kinetic energy is a constant. (Principle)

23. According to the law of conservation of energy, Energy can only be transformed from one form to another. It can neither be created nor destroyed. The total energy before and after the transformation always remains constant. (Principle)

24. Energy exists in nature in several forms such as kinetic energy, potential energy, heat energy, chemical energy etc. The sum of the kinetic and potential energies of an object is called its mechanical energy (Concept).

25. Power (concept) is defined as the rate of doing work. Power = Work done/time

The SI unit of power is watt 1W = 1J/sec

26. The energy used in one hour at the rate of 1 kw is called 1 kwH (Concept).

27. Air-bubble experiment: To understand the concept of Uniform motion

28. Galileo’s experiment: To understand the equation of motion.

29. Newton’s second law: To understand the law of conservation of momentum and energy.

30. Spring Constant experiment: To find out the relation between load-extension and Potential energy.

31. Simple Pendulum experiment: To measure the acceleration due to gravity and to understand equation l-T^2.

Thus the topic on “Mechanics” included 13 concepts, 8 Principles, and 4 Graphical Skills and 5 experimental skills. Except the experimentation skills all the other concepts, principles and graphical skills were part of the syllabus for Grade IX
of both CBSE and STATE patterns. The experimentation part was not included in the achievement test

3.6.2 Writing the Items

As the target population is scientifically talented students, include the items with higher difficulty level which tap higher order thinking processes like problem solving and critical thinking. For this purpose the investigator referred to many sources, like Books and Websites. The Books referred by the investigator were: University Physics (Roger A. Freedman), Fundamentals of Physics (David Reznick and Haliday), PSSIVE Physics (NCERT).

From the above sources, the investigator identified and selected nearly 50 items related to the topics mechanics.

3.6.3 Validation of the Items

Initially there were 50 questions which were in the form of objective and short answer type identified by the above sources. The questions were given to the panel of experts including three physical science teacher and three from three educationists. The items which were considered to be extremely difficult for the grade IX students were eliminated. The remaining 35 items given to a group of 40 students in a CBSE school and the time given was 60 minutes. The items which were not answered by any students were rejected question. There were 10 questions were not correctly answered by any students. They were eliminated. The remaining 25 items were retained and included in the final test. The whole test was divided into two sub tests. Sub test 1 includes the sub-topics related to “Motion”.

3.6.4 Description of the Test Items

The test items which measures different aspects of the topic “Mechanics” are given in the Table 3.13. A copy of the tool is given in the Appendix III. Each test item consists of two parts. First one to identify the correct response from the multiple choices, Second one justification for the selected option in a few sentences. (Very short answer/Short answer).

Table 3.13: Test items and the Aspects Tested

<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>Aspects tested</th>
<th>Serial Number of the items</th>
<th>Total number of items</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Understanding the concepts</td>
<td>1,2,7,14,17,21,24</td>
<td>7</td>
</tr>
<tr>
<td>2</td>
<td>Understanding the Principles</td>
<td>5,6,9,13,15,22,23</td>
<td>7</td>
</tr>
<tr>
<td>3</td>
<td>Solving the Problem</td>
<td>3,8,11,16,18,19,</td>
<td>6</td>
</tr>
<tr>
<td>4</td>
<td>Attainment of Graphical Skills</td>
<td>4,10,12,20,25</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td></td>
<td>25</td>
</tr>
</tbody>
</table>

3.7 ADMINISTRATION PROCEDURE

The test was planned to administer in two settings of 30 and 35 minutes, giving one sub test at a time. Sub test-1 (12 items) included the sub topics related to “Motion” and Sub test-2 (13 items) included the sub topics related to “Work and Energy”.

3.7.1 Scoring Procedure

The scoring will be done by using the scoring key, which is given in the Appendix III. Each correct item in the test will be given +1 mark and wrong items will not given any mark. Even if the answer is correct, if the justification is not correct student will get zero mark. The maximum marks for both the tests will be 12 and 13 respectively and the total marks for the test will be 25.
3.8 VALIDATION OF THE EFFECTIVENESS OF THE ENRICHMENT PROGRAMME

The validation of the effectiveness of the Enrichment programme for Scientifically Talented Students was done in two phases.

Phase I: Planning out an enrichment programme for improving the learning of the topic “Mechanics” with sub topics “Motion and Work and Energy”. More specifically the purpose of the enrichment programme was to improve the
(a) Understanding of the concepts related to mechanics
(b) Understanding of the Principles related to mechanics
(c) Solving the problem related to mechanics
(d) Attainment of Graphical skill related to mechanics

Phase II: Empirically validating the effectiveness of the enrichment program planned in the previous phase.

3.8.1 Planning of Enrichment Programme

The objectives of the Enrichment programme are:

I. Maximum achievement in basic skills
   a. Advanced pace/placement of content or skills; extension of depth and breadth
   b. Oral communication skills sharing ideas verbally and in depth
   c. Study skills.

II. Content in depth
   a. Extends the traditional curriculum.
   b. Resources beyond the designated grade level – materials equipment, information
III. High content complexity

a) Working with abstract ideas and theories that require reflective, evaluative, critical thinking

b) Working with concepts and generalizations

c) Applying learning not just parroting it

d) Developing products that challenge existing ideas and produce new ideas.

IV. Experience in problems solving

a) Learning to seek problems

b) Learning to define problems

c) Reconceptualizing existing knowledge, generating new knowledge.

V. Developing thinking skills

a) Independent, self-directed study skills.

b) Critical thinking.

c) Decision making planning and organizing.

In order to meet the above objectives of Enrichment programme the following principles were considered.

Enrichment for the gifted may be built on the premise that high-level intelligence makes certain demands upon gifted children and that behaviours of gifted children result from these demands. Furthermore, there are curriculum implications inherent in these demands. A list of these demands of giftedness as compiled by Jeanne Delp (1962), former director of gifted programs in Garden Grove, California, follows:
1. to crave knowledge—to satisfy the need to feel progress in what they are learning
2. to feel the need to focus on or devour a subject
3. to make observations and to see relationships
4. to place high standards on themselves
5. to be creative or inventive; to seek an unusual or unique approach to an assignment
6. to question generalizations
7. to be serious minded; to be intolerant (usually) of foolishness or silliness
8. to concentrate—to become totally absorbed in a task; to have a longer attention span
9. to explore wide interests at a maturity beyond their chronological age
10. to be sensitive to honor and truth
11. to express ideas and reactions (sometimes viewed as argumentative)
12. to resist routine and drill; to require unique ways of pursuing a drill
13. to work alone
14. to be intolerant of stupidity
15. to seek order, structure, and consistency
16. to do critical, evaluative thinking (may lead to critical attitude toward self and others)
17. to be rarely satisfied with the simple and obvious
18. to be impatient with sloppy or disorganized thinking
19. to be sensitive and empathetic
20. to have their intelligence responded to
21. to seek out their mental peers
22. to be friendly and outgoing
23. to use their power of abstraction; to see and point out cause-and-effect relationships
24. to have time for thinking-solitude
25. to pursue a learning pace of their own (may be fast or slow)
26. to be outstanding in several areas but average in some

Each of these characteristics can be used to guide the development of enrichment activities for the gifted.

In the study it can be noticed that the percentage of students who are scientifically talented is same in both the streams. i.e. CBSE and State and there is no significant difference between the performance of students studying in CBSE and State syllabus in Physical science. Therefore, a common enrichment programme was planned for all the STS of the study.

In the study the Enrichment programme was mainly based on Multiple Menu model of Renzulli (1988). The reason for selecting the multiple menu model is as follows.

1. Multiple Menu Model contain all the areas of learning by elaborating each menu.
2. Multiple Menu model gives blue print within which the content and process can be applied in class room settings.
3. A broad dimension of knowledge and instructional objectives are arranged in a series of menu. Curriculum authors can make choices based on the particular types of emphasis they would like to place an instructional sequence.
4. Multiple Menu Model is helpful for enrichment programme based on an established curriculum.

The Multiple Menu Model consists of four menu a) knowledge menu b) instructional objectives/Student Activities menu c) Instructional sequence menu d) Artistic modification menu. The details about these menus are given in the section 1.10 of Chapter I. The first two menus are related to student learning process and third menu related to sequence of activities which makes the first two menus become successful. The artistic modification menu deals with the original contribution of the teacher in classroom. The details of the Menu and items in the Menu are described in the Chapter I.

Since the Multiple Menu Model consists of a number of Instructional objectives, students activities, it is not possible to adopt all the Instructional objectives/strategies which advocated in the Model. Hence only some of the aspects of each menu in the Multiple Menu Model were only adopted for the enrichment programme. Each menu described as follows.

I. Knowledge Menu

Knowledge menu consists of (i) Location, definition, organization, (ii) Basic Principles Concepts, (iii) Knowledge about methodology, (iv) Knowledge about specific.

(i) Knowledge about Location, definition, Organization

The first task in analyzing a given field of knowledge is to provide learners with information about where a field is “located” within the broad spectrum of knowledge, the general nature of a field, the various subdivisions of knowledge
within that field, and the specific mission and characteristics of any given subdivision.

In order to introduce the topic “Motion” and “Work and Energy” as the topics of knowledge with in the broad spectrum like Mechanics, which is in Physics a knowledge tree was used as follows.

```
Science
  ↓
Physics
  ↓
Mechanics
  ↓
Motion, work power, energy
  ↓
Different concept and principles of motion
```

After locating the topic “ Motion” and “Work and Energy”, content analysis were done for the topics “Mechanics” and subtopics” Motion” and “Work Energy”.

**(ii) Basic principles, concepts and knowledge about specific**

Every field of knowledge is built upon a set of basic principles and key concepts that help to facilitate comprehension, information processing, and communication of information that is representative of the essence of the field. The following concepts and principles were selected as apart of the enrichment programme. The concepts are listed below.

1. Concept of Distance travelled
2. Concept of scalars and vectors
3. Concept of speed and velocity
4. Concept of uniform motion
5. Concept of Average velocity
6. Concept of acceleration
7. Concept of slope.
8. Concept of circular motion
9. Concept of work.
10. Concept of energy
11. Different forms of energy. (Kinetic energy, Potential energy)
12. Concept of Power
13. Concept of the unit of energy

The concepts will be covered by experimentation, Discussion and computer aided simulation. For example, In order to learn the concept of uniform motion investigator will give an experiment called “Air bubble experiment” to STS. From discussion the STS will learn the concept of Uniform motion thoroughly. The details were given in the lesson plan which is attached to this chapter. From these concepts the generalization can also be prompted so as to form the Principles. Some of the concepts can be taught by the method of computer simulation, where the students are the active participator of the learning process. There were seven Principles. The principles are listed the section 3.5.1 of this Chapter.

In order to improve the third sub objective, i.e. to improve in solving the problems, Drill and practice can be used as Instructional Strategy. In the first step of Drill, these students will be given problems which are at the basic level of solving. In the Second step the students can be given problems of higher order which requires good critical thinking. The solutions of these problems will be discussed with each other and with the tutor. The tutor will guide the students and the tutor will never give
the answer directly. After solving the problem in the drill section, they have to write
the explanation of doing the problem. Various concepts of mathematics, is also
required to solve the problems.

In order to improve attainment of graphical skills of the STS, the following
steps will be adopted.

1. Basic idea of selecting variables (Independent, Dependent)
2. Scaling of the variable appropriate to the data.
3. Drawing the graph.
4. Finding the slope in the graph.
5. Finding the area under the graph.

The attainment of these skills will be done by actual practice, and computer
aided simulation. The derivation of equation of motion can be done by graphical
representation of velocity-time graph. The following graphs will be discussed.

1. Distance-time graph
2. Velocity-time graph
3. Acceleration-time graph

(iii) Knowledge about methodology

The subcategories dealing with methodology represent a generally standard
listing of investigative procedures that are followed in most fields of inquiry. A useful
source consists of the laboratory manuals that frequently accompany college level
textbooks. This section of the Knowledge Menu is especially important for
curriculum development because it has important implications for more active kinds
of instructional techniques. By providing students with the know-how of investigative
methodology there is an increase in the probability of more inductive or “hands on” kinds of learning experiences. Once students have learned basic information a field or topic and the procedures for doing some kind of research related to that topic, it can be proceed to the application level, which is considered by many to be the highest level of involvement in a field of study.

The experimentation is the unique feature of the Enrichment programme for the STS. In the Secondary schools usually students will not be given the opportunity to conduct the experiments. In the present study students were given the opportunity to conduct the experiments both with guidance and independently.

1. Air-bubble experiment: To understand the concept of Uniform motion.
2. Galileo’s experiment: To understand the equation of motion.
3. Newton’s II Law: To understand the law of conservation of momentum and energy.
4. Spring Constant experiment: To relate the potential energy and find the relative density of the given body.
5. Simple Pendulum experiment: To measure the acceleration due to gravity and to understand equation $1-T^2$.

Experiments like any other psychomotor skills involve three phases – Cognitive Phase, Organization Phase and Automation Phase. During the cognitive phase the rational for each experiment, the specific objectives, the way the experiments have to be carried out were made known to the students through discussion and demonstration. The students actively participated in clarifying their doubts. During the organization phase, the students were allowed to carry out the
experiments with constant guidance. The students were made into different groups on the basis of the following.

Six groups of students were made. Five groups include two students and one group had only one student. In every group one boy and one girl was there; The group members were from different schools and different streams of syllabus; Each of the student had to work singly on rotation. Students were free to take experiments after completing the one conducted among the above experiments.

In the automation phase the students had to do the experiments independently on their own way. The students utilized the apparatus which they already used. They had to frame the objective of the experiment, methods of doing, tabulating the data and finally conclude the experiments with the result. The results were not pre-determined by the investigator.

(iv) Instructional objectives/student activities menu

This combined menu of instructional objectives and student activities is designed to provide the curriculum developer with a wide range of both general statements and specific behaviors that are associated with various aspects of learning. The first section of the menu (Assimilation and Retention) deals with information input or pickup processes. The second section (Information Analysis) focuses on a broad range of thinking skills that describe the ways in which information can be processed in order to achieve greater levels of understanding. The third section (Information Synthesis and Application) deals with the output or products of the thinking process. The final section (Evaluation) is also an output process, but in this
case the focus is on the review and judgment of information in terms of aesthetic, ethical, and functional qualities.

In this study the following subcomponents of Instructional objectives menu will be using. In Assimilation and retention the following sub components can be used 1) Listening, 2) Observing, 3) Manipulating, 4) Identifying informative type.

In the information analysis menu components like classifying, interpreting, inferring, experimenting, graphing and charting, tabulating, interrelating, problem solving, problem focusing generalizing, practising, demonstrating and presenting.

In the information synthesis and application menu components like writing, speaking and presenting can also be used

3.8.2 Instructional Strategies Menu

This menu provides a broad range of strategies that represent the ways in which teachers organize learning situations. The strategies range from highly structured situations to those in which greater degrees of self directedness are placed upon the learner. Many of the strategies are, of course, used in combination with one another. It contains the following instructional strategies.

I. Recitation and Drill
II. Peer Tutoring
III. Programmed Instruction
IV. Lecture
V. Lecture and Discussion
VI. Discussion
VII. Guided Independent Study or Exploration (With or Without a Teacher or Mentor)

VIII. Learning or Interest Center Activity

IX. Simulation, Role Dramatization. Guided Fantasy

X. Learning Games

XI. Replicative Reports or Projects

XII. Investigative Reports or Projects

XIII. Unguided Independent Study or Exploration

XIV. Internship or Apprenticeship

The major instructional Strategies used by the investigator is given below

1. Discussion

2. Independent study

3. Computer Aided simulation

4. Peer tutoring

Each instructional strategy was explained as below

**Discussion:** The contents were to be taught has separated in to different concepts, principles, these content were presented to the student by different discussion. The students were prompted to think about a concept and principles. Students were given time for imagination of a concept by linking different.

**Independent study:** In the Instructional Strategies menu, investigator has used the method for instruction. The objectives of the independent study is given below.

1. To be familiar with results of scientific work situated in time and space
2. To gain insight into the way in which the results are established

3. To be able to interpret the information independently

4. To be able to actively contribute to knowledge development process

The guided independent study was based on the topic which the students were brought for Enrichment programme. While doing the experiments in order to learn the concepts, principles, etc, the students were asked about the exploration of ideas which can be proved by the experiments, Apart from the experiments which they were doing. In the last session of the enrichment programme, the students were asked to find out a problem related to the topic in Physical science and think about how they can prove or solve the problem by using the limited apparatus, which they were familiar. The experiments are open ended in nature.

**Computer Aided simulation**: Computer aided simulation is used as an instructional strategy for teaching concepts in which is having complexity of nature. Investigator has used computer simulation based on the topics which has written in java language. These applets are extremely interactive. The following concepts were taught based on computer simulation also. The java Applets were freely available,. The java applets were prepared from Walter Fendt were used for learning these concepts for STS

1. Concept of vector and scalar

2. Concept of velocity

3. Concept of acceleration

4. Concept of velocity time graph

5. Concept of Centripetal acceleration
The advantage of computer aided simulation is that the students have freedom to change the variables like velocity, acceleration, etc, and find the difference in various graphs concerned with it. As a result, students will get a concrete idea about the different concepts, principles.

**Peer tutoring**

Peer tutoring is another method which employed in the enrichment programme as an instructional strategy. One student should be asked to draw the graph and derive the equation of motion. The other students will interactively participate in the discussion. The teacher role is a facilitator who facilitates the discussion.

**Experimental Validation of Enrichment Programme**

Experiment conducted to evaluate the Enrichment Programme

In order to meet the objective “to study the effectiveness of enrichment programme in improving (a) Understanding of Concepts, (b) Understanding of Principles, (c) Solving the Problems, (d) Attainment of Graphical skills Enrichment programme was conducted. The details of the experiment were given below.

**Sample**

Out of 17 students identified as scientifically talented, only 11 students fulfilled the following criteria.

(i) Willingness to come to the venue on their own from the residence or school irrespective of the students level of scientific aptitude.

(ii) To come to the venue on the specified dates.

(iii) Willingness to take the tests administered.

(iv) Parental willingness and cooperation.
Though all the students were interested in participating in the enrichment programme, 6 students experienced difficulty in meeting the above conditions. Thus they were excluded. The experimentation was done only on 11 students who fulfilled all the above conditions.

3.8.2.1 Design of the experiment

Because of the heterogeneity among the subjects of the study, and non-availability of more number of STS, a single case pre-test, post-test design was thought to be appropriate in the context of present experimental study. The design of the experiment can be represented as follows.

<table>
<thead>
<tr>
<th></th>
<th>Administration of the achievement test in Physical science constructed by the investigator</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pre-test</strong></td>
<td>Administration of the achievement test in Physical science constructed by the investigator</td>
</tr>
<tr>
<td><strong>Experimental Treatment</strong></td>
<td>Administration of the Enrichment programme Planned in the study</td>
</tr>
<tr>
<td><strong>Post-test</strong></td>
<td>Administration of the achievement test in Physical science constructed by Investigator</td>
</tr>
</tbody>
</table>

**Pre-test**

Pre-testing was done by administering Achievement Test constructed by the investigator. It contains two subtests, sub test I and sub test II. The sub test I relates to the topic “Motion” and sub test II relates to topic “Work and Energy”. Each test contains questions related to understanding of concepts, principles, problems, skills of the topic. The subtests were administered in two settings of 30 and 35 minutes respectively.

**Controlling the intervening the variables**

In order to make enrichment programme uniform and to avoid influence of intervening variables like, changing tutor/facilitator, special efforts were made.
Investigator himself acts as tutor/facilitator for the programme. The expert team is also same. All the students were given enrichment programme in the same venue at the same time.

3.8.2.2 Experimental Treatment

The programme started at 9.00 am. The investigator explained the objectives of the programme. The location of the programme was arranged in such a way that both the classroom and lab are nearby, so that the students have hands own experience on the different concepts. The enrichment programme was given by the investigator and a mentor who is an expert in physics and a faculty member in the Institute.

**Duration and venue of the programme:** The content which were taken for Enrichment Programme was normally covers 4 classes in a school for a period of 45 minutes. In the study same content was taught for 36 hours. It is not possible to interact with the students in their respective schools as they lack the facilities. Group interaction and discussion would not have been possible for the students if they were given enrichment programme in their schools. Before conducting the enrichment programme, investigator had informed the STS student about the content part and asked to prepare and come for the pre-test. Enrichment programme conducted in four days consecutively in order to avoid the other extraneous variables, like getting help from other experts/sources. It was also helping in seeking cooperation from all the students in participating the programme compulsorily.
The time table for the programme and details of each session were given below.

**Table 3.14: Schedule for Enrichment Programme**

<table>
<thead>
<tr>
<th>Day 1</th>
<th>Session 1</th>
<th>Session 2</th>
<th>Session 3</th>
<th>Lunch break</th>
<th>Session 4</th>
<th>Session 5</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Topic Motion</td>
<td>Topic Motion</td>
<td>Topic motion</td>
<td>10.30-12.00</td>
<td>12.00-1.30</td>
<td>1.30-2.00</td>
</tr>
<tr>
<td></td>
<td>9-10.30</td>
<td>10.30-12.00</td>
<td>12.00-1.30</td>
<td>1.30-2.00</td>
<td>2.00-3.30</td>
<td>3.30-5.00</td>
</tr>
<tr>
<td>Day 2</td>
<td>Session 6</td>
<td>Session 7</td>
<td>Session 8</td>
<td>Lunch break</td>
<td>Session 9</td>
<td>Session 10</td>
</tr>
<tr>
<td></td>
<td>Topic Motion</td>
<td>Topic Motion</td>
<td>Topic motion</td>
<td>10.30-12.00</td>
<td>12.00-1.30</td>
<td>1.30-2.00</td>
</tr>
<tr>
<td></td>
<td>9-10.30</td>
<td>10.30-12.00</td>
<td>12.00-1.30</td>
<td>1.30-2.00</td>
<td>2.00-3.30</td>
<td>3.30-5.00</td>
</tr>
<tr>
<td>Day 3</td>
<td>Session 11</td>
<td>Session 12</td>
<td>Session 13</td>
<td>Lunch break</td>
<td>Session 14</td>
<td>Session 15</td>
</tr>
<tr>
<td></td>
<td>Topic: Work and Energy</td>
<td>Topic: Work and Energy</td>
<td>Topic: Work and Energy</td>
<td>10.30-12.00</td>
<td>12.00-1.30</td>
<td>1.30-2.00</td>
</tr>
<tr>
<td></td>
<td>9-10.30</td>
<td>10.30-12.00</td>
<td>12.00-1.30</td>
<td>1.30-2.00</td>
<td>2.00-3.30</td>
<td>3.30-5.00</td>
</tr>
<tr>
<td>Day 4</td>
<td>Session 16</td>
<td>Session 17</td>
<td>Session 18</td>
<td>Lunch break</td>
<td>Session 19</td>
<td>Session 20</td>
</tr>
<tr>
<td></td>
<td>Topic: Work and Energy</td>
<td>Topic: Work and Energy</td>
<td>Topic: Work and Energy</td>
<td>10.30-12.00</td>
<td>12.00-1.30</td>
<td>1.30-2.00</td>
</tr>
<tr>
<td></td>
<td>9-10.30</td>
<td>10.30-12.00</td>
<td>12.00-1.30</td>
<td>1.30-2.00</td>
<td>2.00-3.30</td>
<td>3.30-5.00</td>
</tr>
</tbody>
</table>

The investigator had introduced the topic of Motion by discussion. A sample lesson were prepared in order to teach one concept. The investigator has brought different materials for the explanation of each concept.

The first concept was about the reference point. Table 3.15 shows the transaction of the enrichment programme.
Table 3.15: Transaction of Enrichment programme for session 1

<table>
<thead>
<tr>
<th>Knowledge about specific</th>
<th>Instructional strategies menu</th>
<th>Instructional objectives/Student activities</th>
<th>Knowledge menu</th>
<th>Knowledge about methodology</th>
<th>Duration In minutes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reference point (Concept)</td>
<td>Providing Life situation 3</td>
<td>Information analysis (explaining)</td>
<td></td>
<td></td>
<td>20</td>
</tr>
<tr>
<td>Motion along a straight line – (Principle)</td>
<td>Providing Life situation 3</td>
<td>Information synthesis (Drawing a rough diagram)</td>
<td></td>
<td></td>
<td>40</td>
</tr>
<tr>
<td>Distance traveled (Concept)</td>
<td>Discussion</td>
<td>Assimilation and Retention</td>
<td></td>
<td></td>
<td>30</td>
</tr>
</tbody>
</table>

For the above session two lesson plans were written. A copy of the sample lesson plan is given below.

**SAMPLE LESSON PLAN**

**Topic: Motion**

**Grade: IX**

Specific facts: In order to perceive and represent a motion a reference point is required.

**Concept: Reference point**

Organization of learning situation (Instructional strategies menu)

Situation provided/created

1) When we are sitting in a train and it moves from station, How you will perceive the motion?
2) When we are sitting in an moving train and another train moves along with the first one. On what basis we can tell that we are in motion?

3) In a sea shore what is the role of the light house?

**Instructional strategy:** These situations were presented one after the other. The students were asked to think and answer.

**Instructional objectives/student activities:** The above situation were critically analysed, comparison were made and inference were drawn with reference to each situation

Situation 1: In situation I the motion of train can easily be perceived with respect to station, railway station is the reference point. (information analysis and explaining)

Situation 2: In the second situation, when we are in motion with respect to ground.

The motion can be perceived by looking to the ground.

Situation 3: The light houses are the reference point in sea, where to find out the sea shore.

**Learning experience 2**

1. When will the object is said to be in motion (from the above examples)?

2. How the motion can be described?

Students respond that when an object changes the position with respect other, and with respect to time. It is said to be in motion. In order to describe the motion some reference point is required. An object is said to be in motion if its position changes with respect to time.
Information synthesis

Topic: Motion

Grade IX

**Specific fact:** The simplest motion is motion along a straight line

**Organization of learning situation**

An ant is moving 1) Rope 2) Plank 3) Ball. How the motion of the ant can on these things can be represented?

Prompt: imagine and try out the situation and represented pictorially

Situation 1: An ant is moving on a rope

Material supplied: A rope, An ant inside a glass jar.

**Instructional objectives/Student Activities**

Pictorial representation of situation by the students (Information synthesis )

Prompt: how many axis is required to represent the motion in this situation

Response: only one axis

Situation 2: An ant is moving along a thin plank

Materials: A thin plank, An ant inside the glass jar

Pictorial representation of students

Student observes the movement of ant on the plank and trace and represented pictorially

Prompt: How many axis are required to represent the motion, in this situation ?

Response: Two axes are required
**Situation 3:** An Ant is moving around a ball

Material supplied: An ant inside a glass jar, Ball

Pictorial representation of students

Student observes the movement of an ant around a ball and traces the motion

Prompt: How many axis required to represent the motion

Response: Three axis (X-Y-Z) are required

Learning experience 2:

Task: Comparison of the above three situation

Prompt: Among three situation which one indicates the simplest type of motion

Process: Student compares each situation and analyses the co-ordinates required.

Inference:

1. Motion can be different types depends upon the restriction of number of coordinates required simultaneously to represent the motion.

2. Simplest motion is the motion along a straight line.

**Generalization**

The student generalized the fact that simplest type of motion is along straight line or along an axis.
Table 3.16: Transaction of Enrichment programme for session 2

<table>
<thead>
<tr>
<th>Knowledge about specific</th>
<th>Instructional strategies menu</th>
<th>Instructional objectives/Student activities</th>
<th>Knowledge menu Knowledge about methodology</th>
<th>Duration In minutes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Displacement (concept)</td>
<td>Providing Life situation 3</td>
<td>Information analysis (explaining)</td>
<td></td>
<td>20</td>
</tr>
<tr>
<td>Scalars and Vectors</td>
<td>Computer Aided Simulation</td>
<td>Information synthesis (Drawing a rough diagram)</td>
<td></td>
<td>20</td>
</tr>
<tr>
<td>Speed and velocity-time graph</td>
<td>Computer Aided Simulation Peer tutoring</td>
<td>Assimilation and Retention</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The following concepts were discussed with the help of computer simulation.

The students were expected to do the following tasks.

1. Observing the distance traveled by car by computer simulation

2. Changing the velocity of the car and acceleration of the car based on simulation

3. Understanding and interpreting the graph, etc.

4. Solving the numerical problem related to graph.

Table 3.17: Transaction of Enrichment programme for session 3

<table>
<thead>
<tr>
<th>Knowledge about specific</th>
<th>Instructional strategies menu</th>
<th>Instructional objectives/Student activities</th>
<th>Knowledge menu Knowledge about methodology</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uniform motion – (concept)</td>
<td>Experimentation</td>
<td>Information analysis</td>
<td>Experimentation Air bubble experiment</td>
<td>90</td>
</tr>
</tbody>
</table>
Topic: Motion

Teaching point: concept of uniform motion.

Concept: A body is said to be in uniform motion if it travels equal distances in equal intervals of time

SAMPLE LESSON PLAN

Learning experience 1:

Task : To find the velocity of air bubbles locked in a burette for a distance of 30 cm in an interval of 10 cm and represent graphically in velocity-time graph;

Material supplied: Sealed burette trapped air bubble, stand, stop-watch, Potractor.

Sub task 1: Familiarization of apparatus and use of apparatus, Keeps apparatus at low inclination of 5°

Sub task 2: Representation of data in tabular form

Subtask 3 Representing the data in graphical form

Sub task 4: Finding the conclusion in a systematic way

Task 2: doing the experiment

Prompt: Observe the motion of air bubble, Note the time taken, when the air bubble is at 10 cm, 20 cm, 30 cm and 40 cm

Response: Student does the experiment and represents the data of time and distance covered in a tabular form

Prompt: find out the velocity at 10 cm, 20 cm, 30 cm.

Response: velocity is defined as Displacement/Time. Finding the velocity at each point.
Student: Analyse the data and manipulates the velocity for each readings

Prompt: whether the velocity remains constant or not

Response: Constant.

Task: Draw the Distance –time graph

Student: Represent distance –time data which he/she already collected. Selecting the appropriate scale to represent in graph

Prompt: What is the shape of the graph

Response: A straight line

Prompt: find the slope of the graph at particular point

\[ \text{Slope} = \frac{\text{Change in Y-axis}}{\text{change in x-axis}} \]

Prompt: what do you infer ?

Response: The value of the slope is equal to velocity which have found form tabular form.

Inference: Student infers that velocity remains constant throughout the displacement lie.

Information analysis

Inference 2: The slope under the distance time graph represents the velocity.

**Generalization 1:** if body travels equal distance in equal intervals of time it is said to be in uniform motion.

**Generalization 2:** slope under distance –time graph represents a velocity.
Table 3.18: Transaction of Enrichment programme for session 4

<table>
<thead>
<tr>
<th>Knowledge about specific</th>
<th>Instructional strategies menu</th>
<th>Instructional objectives/Student activities</th>
<th>Knowledge menu Knowledge about methodology</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average velocity (Concept)</td>
<td>Providing Life situation 2</td>
<td>Information analysis (Speaking and Presenting)</td>
<td></td>
<td>30</td>
</tr>
<tr>
<td>Acceleration (Concept)</td>
<td>Computer Aided Simulation</td>
<td>Assimilation and Retention</td>
<td></td>
<td>30</td>
</tr>
<tr>
<td>Concept of slope</td>
<td>Discussion about the slope</td>
<td>Information analysis (explaining)</td>
<td></td>
<td>30</td>
</tr>
</tbody>
</table>

In order to understand the concept of average velocity, investigator had provided three life situations.

- Discussed two life situation
- Used computer aided simulation where students can change velocity and acceleration
- Graphs were drawn on the board and teacher explained about graph

Table 3.19: Transaction of Enrichment programme for session 5

<table>
<thead>
<tr>
<th>Knowledge about specific</th>
<th>Instructional strategies menu</th>
<th>Instructional objectives/Student activities</th>
<th>Knowledge menu Knowledge about methodology</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acceleration due to gravity (concept) Oscillatory motion</td>
<td>Experimentation</td>
<td>Information analysis experimenting</td>
<td>Simple pendulum experiment</td>
<td>90</td>
</tr>
</tbody>
</table>
Tasks included

- Discussion about the concept of acceleration due to gravity and oscillatory motion.

- Students were asked to find out the acceleration due to gravity with the help of simple pendulum experiment. Students conducted the experiment and plotted the graph between l-t2 graph and they were given the formula \( g = 4\pi^2/lT^2 \)

Table 3.20: Transaction of Enrichment programme for session 6

<table>
<thead>
<tr>
<th>Knowledge about specific</th>
<th>Instructional strategies menu</th>
<th>Instructional objectives/Student activities</th>
<th>Knowledge menu</th>
<th>Knowledge about methodology</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equation of motion by graphical method</td>
<td>Peer tutoring</td>
<td>Information synthesis and application. Graphing and charting</td>
<td></td>
<td></td>
<td>90</td>
</tr>
<tr>
<td>( v=u+at ) Principle</td>
<td>Peer tutoring</td>
<td>Information synthesis and application. Derivation of the principle</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( v^2 = u^2 + 2as ) Principle</td>
<td>Peer tutoring</td>
<td>Information synthesis and application. Derivation of the principle</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( S = ut + 1/2at^2 ) Principle</td>
<td>Peer tutoring</td>
<td>Information synthesis and application. Derivation of the principle</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Tasks included

Task 1: Drawing a velocity-time graph by the students.

Task 2: Mark the points in the graph with initial velocity ‘u’ and final velocity ‘v’

Task 3: Finding the acceleration.

Task 4: Finding the velocity by graph.
### Table 3.21: Transaction of Enrichment programme for session 7

<table>
<thead>
<tr>
<th>Knowledge about specific</th>
<th>Instructional strategies menu</th>
<th>Instructional objectives/Student activities</th>
<th>Knowledge menu Knowledge about methodology</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solving the problem related to equation of motion, v-time graph, distance-time graph</td>
<td>Providing higher order problem -3</td>
<td>Information analysis Critiquing (critical evaluation)</td>
<td>Application of the knowledge about the equations of motion</td>
<td>90</td>
</tr>
<tr>
<td>Providing data related to graph -2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Table 3.22: Transaction of Enrichment programme for session 8

<table>
<thead>
<tr>
<th>Knowledge about specific</th>
<th>Instructional strategies menu</th>
<th>Instructional objectives/Student activities</th>
<th>Knowledge menu Knowledge about methodology</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>S/t² = constant for uniform motion (Principle)</td>
<td>Experimentation</td>
<td>Information analysis experimenting</td>
<td>Experimenting Galileo experiment</td>
<td></td>
</tr>
</tbody>
</table>
Table 3.23: Transaction of Enrichment programme for session 9

<table>
<thead>
<tr>
<th>Knowledge about specific</th>
<th>Instructional strategies menu</th>
<th>Instructional objectives/Student activities</th>
<th>Knowledge menu</th>
<th>Knowledge about methodology</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Circular motion (concept)</td>
<td>Learning situation –3</td>
<td>Information analysis speculating Discussion about circular motion</td>
<td></td>
<td></td>
<td>30</td>
</tr>
<tr>
<td>Centripetal acceleration (Concept)</td>
<td>Computer aided simulation</td>
<td></td>
<td></td>
<td></td>
<td>60</td>
</tr>
</tbody>
</table>

Enrichment programme consists of 20 sessions for 36 hours. Each session consist of 90 minutes and each session has arranged the following manner. A sample schedule is given below.

Table 3.24: Transaction of Enrichment programme for session 10

<table>
<thead>
<tr>
<th>Knowledge about specific</th>
<th>Instructional strategies menu</th>
<th>Instructional objectives/Student activities</th>
<th>Knowledge menu</th>
<th>Knowledge about methodology</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Revision of concepts related to “Motion”</td>
<td>Discussion about the concepts, principles learned</td>
<td>Assimilation and Retention Recall Concept of displacement, concept of acceleration, principle of equation of motion, graphs relating to v-t, s-t, graph Circular motion</td>
<td></td>
<td></td>
<td>90</td>
</tr>
</tbody>
</table>
Table 3.25: Transaction of Enrichment programme for session 11

<table>
<thead>
<tr>
<th>Knowledge about specific</th>
<th>Instructional strategies menu Organization of learning experiences</th>
<th>Instructional objectives/Student activities</th>
<th>Knowledge menu Knowledge about methodology</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction of work-(concept)</td>
<td>Life situations (3) Life situations (2) Demonstration</td>
<td>Information analysis (Problem solving situation) Information synthesizing Assimilation and retention</td>
<td></td>
<td>30</td>
</tr>
<tr>
<td>The direction of force (concept)</td>
<td></td>
<td></td>
<td></td>
<td>30</td>
</tr>
<tr>
<td>Definition of work (concept)</td>
<td></td>
<td></td>
<td></td>
<td>30</td>
</tr>
</tbody>
</table>

Table 3.26: Transaction of Enrichment programme for session 12

<table>
<thead>
<tr>
<th>Knowledge about specific</th>
<th>Instructional strategies menu Organization of learning experiences</th>
<th>Instructional objectives/Student activities</th>
<th>Knowledge menu Knowledge about methodology</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>The direction of cosines of work and force(concept)</td>
<td>Lecture cum discussion</td>
<td>Information analysis Demonstration</td>
<td></td>
<td>60</td>
</tr>
<tr>
<td>Solving the problems related to work</td>
<td>Discussion</td>
<td>Assimilation and retention Recall</td>
<td></td>
<td>30</td>
</tr>
</tbody>
</table>
SAMPLE LESSON PLAN

Specific principles: A work is said to be believe on object if the object displaces in the direction of Force.

Situation 1:

Imagine when we are getting down from a train with huge luggage and asked to carry some luggage to porter. He has kept the luggage on overhead and moves. We have told that he has not done work scientifically. From the above situation can you find the components of work is required.

Situation 2
Task: Move the desk which you are sitting in a linear fashion.

Task 2: Observe the motion of the desk and represent pictorically.

Prompt: find the direction of force and movement of desk and represent pictorically
Student analyse the situation and represent pictorically.
Prompt: How you measure the work done upon the desk.
Response: product of force and Displacement.

Imagine the situation 1: Represent diagrammatically the direction of force and displacement

Process: Student analyse the situation and represent pictorically.
Prompt: What is the direction of force and displacement
Response: The force and displacement re mutually perpendicular.
Prompt: What is the angle between Force and Displacement
Response: 90

Prompt: if the angle is 90, which mathematical function will be zero at 90 and 0.

Teacher explains about mathematical function of sines and cosines.

Process: Student analyzes and compares the situation. And compares the situation what is the mathematical function between force and displacement

Response: Cosine function.

Infer 1: Work is said to be done if the body displaces in the direction of work.

Infer 2: work is the product of force and displacement and the angle of the separation between force and d

**Generalization**: Work is said to be done if the body if the body moves a distance in the direction of force.

Information analysis

**Table 3.27: Transaction of Enrichment programme for session 13**

<table>
<thead>
<tr>
<th>Knowledge about specific</th>
<th>Instructional strategies menu</th>
<th>Instructional objectives/Student activities</th>
<th>Knowledge menu</th>
<th>Knowledge about methodology</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concept of energy (concept)</td>
<td>Definition, and experimentation</td>
<td>Information analysis, Experimentation</td>
<td>Newton’s cart experiment</td>
<td>10</td>
<td></td>
</tr>
</tbody>
</table>

180
### Table 3.28: Transaction of Enrichment programme for session 14

<table>
<thead>
<tr>
<th>Knowledge about specific</th>
<th>Instructional strategies menu</th>
<th>Instructional objectives/Student activities</th>
<th>Knowledge menu Knowledge about methodology</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kinetic energy (concept)</td>
<td>Learning experience –3</td>
<td>Information analysis explaining</td>
<td></td>
<td>20</td>
</tr>
<tr>
<td>Derivation of equation for K.E</td>
<td>Peer tutoring</td>
<td>Information synthesis</td>
<td></td>
<td>70</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Derivation of equation of Kinetic energy</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Table 3.29: Transaction of Enrichment programme for session 15

<table>
<thead>
<tr>
<th>Knowledge about specific</th>
<th>Instructional strategies menu</th>
<th>Instructional objectives/Student activities</th>
<th>Knowledge menu Knowledge about methodology</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Potential energy (concept)</td>
<td>Experimentation</td>
<td>Information analysis Experimentation</td>
<td>Spring constant experiment</td>
<td>90</td>
</tr>
</tbody>
</table>

### Table 3.30: Transaction of Enrichment programme for session 16

<table>
<thead>
<tr>
<th>Knowledge about specific</th>
<th>Instructional strategies menu</th>
<th>Instructional objectives/Student activities</th>
<th>Knowledge menu Knowledge about methodology</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conversion of Gravitational Potential energy to Kinetic energy -Principle</td>
<td>Experimentation</td>
<td>Information analysis Experimentation</td>
<td>Experiment to prove KE+PE=a constant</td>
<td>90</td>
</tr>
</tbody>
</table>
SAMPLE LESSON PLAN

Grade: IX

Principle: Law of conservation of energy

Concept: Potential energy + Kinetic energy is same for all points.

Total energy is conserved.

Learning experiences

Task 1: To study the transformation of potential energy to kinetic energy.

Materials required: Weight of 0.05 kg, 1 meter slide, pulley, and thread connected with plastic bowl and stop watch.

Task 2: Design an experiment based on the above apparatus to find the transformation of energy

Prompt: Find out the gravitational potential energy.

Student pictorially represents the experimental set up.

Student designs the experiment for conversion of potential energy to kinetic energy.

The experimental set up kept at height of 1 m.

Prompt 1: What is the potential energy at the starting point A.

Response: mgh; m = mass

\[ g = \text{acceleration due to gravitation} \]

\[ h = \text{height} \]

Prompt 2: What is the potential energy at point B.

Response: Zero because \( h = 0 \)

Task 2: Student starts doing the experiment.

Process: Student tabulates the data and analyse the data.
Prompt: What you are measuring at point B.

Response: Time taken to travel for 1 m.

Prompt: What is the total energy at point A.

Response: At point A

\[ KE = 0.05 \times 9.8 \times 1 \]
\[ = 0.49 \text{ J} \]

\[ KE = \frac{1}{2} \times 0.05 \times 0 \]
\[ = 0 \]

Prompt: What is the total energy at point B.

Response: At point B

\[ KE = \frac{1}{2} MV^2 \]
\[ = \frac{1}{2} \times 0.05 \times 9.6 \]
\[ = 0.49 \text{ J} \]

\[ PE = m \times gh \]
\[ = 0.05 \times 9.8 \times 0 \]
\[ = 0 \]

Prompt: What you infer.

Response: Total energy of the system remains constant.

**Generalisation:** Total energy of the system is conserved during the gravitational motion.
Table 3.31: Transaction of Enrichment programme for session 17

<table>
<thead>
<tr>
<th>Knowledge about specific strategies menu</th>
<th>Instructional objectives/Student activities</th>
<th>Knowledge menu Knowledge about methodology</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conversion of one energy to another</td>
<td>Discussion</td>
<td>Assimilation and Retention</td>
<td>90</td>
</tr>
<tr>
<td>Concept of Power, Kwh</td>
<td>Learning experience –3</td>
<td>Information analysis</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Discussion about other source of energy</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Conversion of energy from one form to another</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Explanation about horse power</td>
<td></td>
</tr>
</tbody>
</table>

Table 3.32: Transaction of Enrichment programme for session 18

<table>
<thead>
<tr>
<th>Knowledge about specific strategies menu</th>
<th>Instructional objectives/Student activities</th>
<th>Knowledge menu Knowledge about methodology</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Revision of Concepts learned in “Work “ and “Energy”</td>
<td>Discussion</td>
<td>Assimilation and retention Recall</td>
<td>90</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1. Work concept</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Energy concept</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>3. KE concept</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>4. PE concept</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>5. Power concept</td>
<td></td>
</tr>
</tbody>
</table>
Table 3.33: Transaction of Enrichment programme for session 19

<table>
<thead>
<tr>
<th>Knowledge about specific</th>
<th>Instructional strategies menu</th>
<th>Instructional objectives/Student activities</th>
<th>Knowledge menu</th>
<th>Knowledge about methodology</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Various topic related to “Motion’ and “work and energy”</td>
<td>• Finding objectives</td>
<td>Information synthesis</td>
<td>Independent study</td>
<td></td>
<td>90</td>
</tr>
<tr>
<td></td>
<td>• Arranging apparatus</td>
<td>1. Air bubble experiment in a modified form</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Design the experiment</td>
<td>2. Newton’s second law of modified form</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Conducting the experiment independently</td>
<td>3. Spring constant of modified form</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Tabulating</td>
<td>4. Simple pendulum of modified form with different types of weights</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Evaluating</td>
<td>5. Galileo’s experiment</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Writing conclusion</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 3.34: Transaction of Enrichment programme for session 20

<table>
<thead>
<tr>
<th>Knowledge about specific</th>
<th>Instructional strategies menu</th>
<th>Instructional objectives/Student activities</th>
<th>Knowledge menu</th>
<th>Knowledge about methodology</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Various topic related to “Motion’ and “work and energy”</td>
<td>Presenting the results of independent study</td>
<td>Evaluation of independent study performed</td>
<td></td>
<td></td>
<td>90</td>
</tr>
</tbody>
</table>

Last two sessions were exclusively dedicated to the open ended experiment.

Where the students have to design an experiment or modify the existing experiment.
Students had to justify the experiment. Students had done the experiment more or less independently. After the open-ended experiment they were asked to presents about the experiments in front of the subject experts.

**Post-test**

Post-testing was done by administering all the tests, that are administered during pre-test to all scientifically talented students. The two topics included 13 concepts, 8 principles, 4 Graphical skills and 20 Problem solving situations. They were taught with the help of 5 standard experiments. After 36 hours of experimentation Post-test was given.

The data was analysed and found to be effective. Since investigator did not aim at mastery of the content, the enrichment programme was stopped.