CHAPTER FIVE

SUMMARY AND CONCLUSIONS

5.0.0.0 PROLOGUE

In present research study an attempt was made to study the 'Effects of Different Methods of Teaching Science on the Achievement. Basic Science Process Skills and Scientific Attitude of Standard Six Pupils with Different Achievement Levels'. This chapter presents a brief summary of the study under the captions, Introduction, Need for the Study, Statement of the Problem, Objectives of the study, Operational Definitions, Assumptions of the Study, Scope and Limitations of the Study, Methodology and Procedure of the Study, Design of the Study, Field Study, Experimental Study, Analysis of the Data, Findings and Conclusions, Implications of the Study and Suggestions for Further Research.

5.1.0.0 INTRODUCTION

Teaching is an intentional activity, which assumes its distinctive character and meaning not in isolated behaviours but in sequences of interrelated acts. Therefore no single factor can entirely explain or describe the quality of a 'good' or effective teacher as well as teaching. It is an interactive process aimed at desirable products called learning. As an interactive process, teaching includes both verbal and non-verbal activities of the teacher and the pupils.

Research on teaching usually involves the measurement of two or more variables of different types and the study of the relationships between them. Research on teaching is as complex as the subject it investigates. Thus, the researcher should find in it only a wide variety of different conceptual schemes for expressing the behaviours of teachers and pupils but also many different types
of variables that are presumed to bear relationships to the teaching process. Earlier researches on ‘Teaching’ have usually employed outcome measures at the end of the instruction to quantify learning while ignoring changes that occur during learning. But it is the process of change from ignorance to competence, which needs to be the major focus of instructional psychology.

Teaching process is a set of activities related to teaching behaviour. These behavioral patterns are expected to occur in a particular sequence. These sequences can be classified into various meaningful categories such as Methods, Strategies and Patterns.

Method is a wider term. It includes strategies and techniques of teaching. Different strategies may be adopted in following a method. The teacher has to modify or adopt these strategies to suit the particular situation. Then these strategies are converted into methods of teaching. Different strategies may be adopted in following a method. The methods of teaching deal with a sequence of presentation of content in the classroom. Different patterns may be used within the same strategy and method or method is implemented in an actual classroom by interaction with different types of pupils, it is translated into different teaching patterns. Therefore, teaching patterns are observable forms of a particular teaching strategy or a method.

The school curriculum through the teaching of different subjects, viz., Languages, Mathematics, Science, Social Sciences and Art and Craft, aims at the fulfillment of national objectives of education. Science is included in the school curriculum for the same reasons as any other subject, but in addition science inculcates special values peculiar to it and which no other subject can provide. But besides satisfying the visual needs for its inclusion as a subject in the curriculum such as intellectual, cultural, moral, aesthetic, utilitarian and vocational values science learning provides training in Scientific Attitude of mind in the learner, gives opportunities for Creative Thinking and Constructive Imagination. The qualities imbibed by the learner through learning science are of great value to a citizen living in the society. Hence, science is now made a
compulsory subject in every system of school education right from the elementary stage.

If one reviews research studies on teaching one finds very little attempt is being made to study the efficiency of teaching strategies at primary level. It has been also observed that research studies on teaching science at the primary level were very meager. Therefore, the present study was designed and completed by the investigator. The title of the study was as below.

"A study of the Effects of Different Methods of Teaching Science on the Achievement, Basic Science Process Skills and Scientific Attitude of Pupils with Different Achievement Levels".

5.2.0.0 NEED FOR THE STUDY

A peep into the status of science education in India shows that the status of science education at the primary and secondary stage is not encouraging. The many attempts made to develop science curriculum as well as try out different Methods of Teaching Science have been meager and have not disseminated on a large scale. It has also been observed that the research studies on teaching strategies have by and large, been of the presage-product type that is simply measuring the outcome of an instructional process. And most of the studies have been conducted on secondary level learners and teacher trainees. Very few attempts were made to study the effectiveness of instructional strategies at the primary level. Thus, there is scope for studying the efficiency of teaching strategies at primary level for the learners with special educational needs, such as under achievers and gifted. Research studies indicate that individual students do not have a similar type of educational standard, they no longer need one textbook, one method or one curricular programme. They need different types of quality instruction. They also need to be taught through different methods and need to be exposed to various instructional materials. Hence there is a need for the present study.
5.3.0.0 STATEMENT OF THE PROBLEM

A study of the effects of different Methods of Teaching Science on the Achievement in terms of Knowledge, Understanding and Application Objectives and its retention, Basic Science Process Skills and Scientific Attitude of Standard Six pupils with different Achievement Levels.

5.4.0.0 OBJECTIVES OF THE STUDY

As discussed under Section 1.6.1.0. the present study can be viewed from four dimensions of the variables involved in the teaching-learning process. The investigator has also classified the objectives of the study under the same four dimensions as given below:

5.4.1.0 Objectives Related to Presage-Context-Product

i. To study the effect of Methods, Levels of Pre-Achievement and their interaction on Achievement of Knowledge, Understanding and Application Objectives separately by taking Intelligence as covariate.

ii. To study the effect of Methods, Levels of Pre-Achievement and their interaction on Total Achievement, Scientific Attitude and Basic Science Process Skills separately by taking Intelligence as covariate.

iii. To study the effect of Methods, Levels of Pre-Achievement and their interaction on retention of Knowledge, Understanding and Application objectives and Total Achievement separately by taking Intelligence as covariate.

5.4.2.0 Objective Related to Presage-Process

To study and compare the teaching processes in terms of interaction patterns associated with the Teacher Demonstration, Guided Discovery and Cooperative Learning Methods of Teaching Science.
5.4.3.0 **Objective Related to Context-Process**

To study and compare variation in interaction patterns due to change in prior achievement levels of pupils with respect to Teacher Demonstration Method, Guided Discovery and Cooperative Learning Methods of Teaching Science.

5.4.4.0 **Objective Related to Process-Product**

To explain the relationships between significant differences in Achievement, improvement of Scientific Attitude and Basic Science Process Skills in terms of differences in teaching process.

5.5.0.0 **OPERATIONAL DEFINITIONS**

**Co-operative Learning Method**

Cooperative Learning refers to a family of small group instructional practices in which, the group work is carefully prepared, planned and monitored by the teacher so that students work together to maximize their own and each other’s learning. In the present investigation the Cooperative Learning Method was referred to as the method of teaching in which the teacher provided the various tasks based on the content selected for the study, which were planned and designed in a definite sequence to attain the objective of the lesson to groups of four pupils of the same age and achievement level. Communication of the group goal and task structure, monitoring of group work and testing of individual learning were done by the teacher.

The sequence of moves followed were Communication of the Group Goal (CGG) → Communication of the Task Structure (CTS) → Pupil-Pupil Interaction (PPI) → Monitoring and Intervention by the Teacher (MIT) → Testing of Individual Learning (TIL)

**Guided Discovery Method**

Guided Discovery Method is a method of teaching in which the pupils will be provided with guidance/directions in the form or series of examples or cue questions step by step by the teacher so as to help the pupils to discover the
concepts/principles to be learnt. In the present investigation the Guided Discovery Method referred to the method of teaching in which, the teacher provided the basic elements of the lesson in the form of carefully sequenced examples following the inductive approach, highlighting the features of special relevance, leading question and hints and made each student to draw the generalization and discover the concepts/principles.

The sequence of moves followed were. Clarification of the Concept (CC) \(\rightarrow\) Generalization of Concept (GC) \(\rightarrow\) Examples from the Pupil (EP) \(\rightarrow\) Application of the Concept (AC)

**Teacher Demonstration Method**

Teacher Demonstration Method is a method of teaching in which the teacher gives an oral presentation of the subject matter while demonstrating with certain devices. In the present study the Teacher Demonstration Method was referred to as the method of teaching in which the teacher stated the concepts/principles and clarified them through oral presentation of the subject matter while demonstrating with certain devices such as experiments/models/charts specimens.

The sequence of moves followed were the Statement of the Concept by the Teacher (SCT) \(\rightarrow\) Clarification of the Concept through Demonstration (CCD) \(\rightarrow\) Summary of the Demonstration by the Pupil (SDP) \(\rightarrow\) Application of the Concept (AC).

**Achievement in Science**

Learning attained in the form of Knowledge, Understanding and Application by the sample related to the units of content in science of Standard Six which was used for treatment in the present study was considered as Achievement. It was measured through a specially prepared Post-Achievement Test by the Investigator.

**Scientific Attitude**

Scientific Attitude is the mental attitude characterized by willingness to search for truth, without prejudices, to change one's opinion on the basis of new
evidence, to seek the cause and effect relationship and to discriminate between fact and theory Good (1945, p.37).

In the present study Scientific Attitude was defined as the mental attitude characterized by commitment of the value of rationality, to seek cause effect relationship, acceptance of criticalness, desire for completeness of knowledge, seeking to find out ‘how’ and ‘why’ of observed phenomena, willingness to search for truth, aversion to superstition, objectivity of intellectual beliefs, and to discriminate between fact and theory. It was measured using the Scientific Attitude Scale (SAS) constructed by the Investigator.

**Basic Science Process Skills**

Science Process Skills are a set of broadly transferable abilities, appropriate to many science disciples and reflective of the true behaviour of scientists. [Science – A Process Approach (SAPA)]. SAPA divided the process skills into two types, basic and integrated. The Basic Science Process Skills are the basic ways of thinking by the scientist in discovering and ordering knowledge. These skills provide a foundation for learning the more complex integrated skills. The Basic Science Processes are observing, classifying, communicating, measuring using space/time relations, using numbers, inferring and predicting. The Integrated science process skills are controlling variables, interpreting data, formulating hypothesis, defining operationally and experimenting. The Basic Science Process Skills considered for the present study were.

- a. Observation
- b. Inference
- c. Classification
- d. Measurement
- e. Communication
- f. Prediction

**Observation**

In the present study the Process Skill of Observation was considered as the pupils imperical experiences realized thorough their senses and expressed in the form of statement of facts and propositions which was measured through the Test on Basic Process Skills.
Inferences

The Process Skill of Inferences was an ability to make judgement about non-observable properties of an object or an event based on the observable properties of the object or event based on the assumption of continuity, which was measured through a Test on Basic Process Skills.

Classification

The Process Skill of Classification was referred to as the ability of the pupils to classify and seriate the objects according to the given criteria based on the observations made on the given data, which was measured through the Test on Basic Process Skills.

Measurement

The Process Skill of Measurement was an ability to measure the given objects using the unit of measure prescribed, with accuracy, which was measured through the Test on Basic Process Skills.

Communication

The Process Skill of Communication was an ability to report and explain the observed phenomena with accuracy, completeness and conciseness, which were measured through the Test on Basic Process Skills.

Skill of Prediction

The Process Skill of Prediction was an ability to forecast future observations based on extensive and careful observation of the given data, which was measured through the Test on Basic Process Skills.

Achievement Levels

The Achievement Levels were referred to as the Pre-Achievement Levels of the sample of the study. Pre-Achievement was considered as the status attained by the sample with respect to learning attained in the form of Knowledge, Understanding and Application related to the content in science which was an essential pre-requisite to learn the units of content in science of Standard Six which was used for treatment in the present study. It was measured through the specially prepared Pre-achievement Test by the Investigator.
The two levels of Pre-achievement considered in the present study were low Pre-achievement level and high Pre-achievement level and were termed as ‘high achievers’ and ‘low achievers’ respectively.

**High Achievers**

The pupils whose scores on the Pre-Achievement Test were at Q₃ and above.

**Low Achievers**

The pupils whose scores on the Pre-Achievement Test were at Q₁ and below.

**Pupils of Standard Six**

Pupils of Standard Six were the ones studying in the selected three Government Higher Primary Schools situated in rural areas of Dakshina Kannada District.

**Knowledge Objective**

The Knowledge Objectives emphasizes most the psychological processes of remembering. In the present study the Knowledge Objective was referred to those behaviours or test situations which emphasize remembering either by recognition or recall of concepts, principles, methods and phenomena. It was measured through a specially prepared Post-Achievement Test.

**Understanding Objective**

The Understanding Objective was referred to those behaviours or responses which represent an understanding of the literal message contained in communication and make use of the material or idea being communicated without necessarily relating it to other material or seeing its fullest implications. It was measured through the specially constructed Post-achievement Test.

**Application objective**

The Application Objective was the behaviours or responses which represent the use of concepts / principles / procedures / methods correctly in a given appropriate situation in which no mode of solution is specified, which was measured through a specially prepared Post-achievement Test.
5.6.0.0 SCOPE AND LIMITATIONS OF THE STUDY

i. This study was limited to only students selected from three Government Higher Primary Schools of a rural area from Dakshina Kannada District of Karnataka State.

ii. Most of the students were from middle and lower middle classes of the society.

iii. There were sixteen students in each sub-group. Thus the total sample was limited to ninety-six.

iv. The teaching units were selected from the Science textbook of Standard Six of Karnataka State.

v. In the present study only the low achievers and high achievers of Standard Six were taught through Teacher Demonstration, Guided Discovery and Cooperative Learning Methods of teaching science. Thus the study was limited to low achievers and high achievers of Standard Six.

vi. Sixteen lessons on two selected units that is, ‘The Changes Around Us’ and ‘Motion, Force and Simple Machines’ were taught for sixteen school periods to each of the six subgroups. Thus the total treatment period was limited to ninety-six school periods.

vii. The study was limited to find the comparative effectiveness of the Teacher Demonstration, Guided Discovery and Cooperative Learning Methods of Teaching Science on pupils’ Achievement in Science, Basic Science Process Skills and Scientific Attitude.

viii. In the present study the effects of Teacher Demonstration, Guided Discovery and Cooperative Learning Methods of Teaching Science was limited to the six Basic Science Process Skills as defined operationally in the Section 1.9.0.0.

ix. The study was limited to only pupils Achievement in Knowledge, Understanding and application objectives under cognitive domain.

x. In the present study teaching – learning process of group and not of individuals was studied.
5.7.0.0 METHODOLOGY AND PROCEDURE OF THE STUDY

The study comprised of two major aspects

i. Field study, and

ii. Experiment.

The details about the methodology and procedure followed with respect to field study and experiment are given in subsequent sections.

5.7.1.0 Design of the Study

The research design followed the study is given in Table 5.1

TABLE 5.1
Research Design of the Study

<table>
<thead>
<tr>
<th>Stage one</th>
<th>Phase One</th>
<th>Phase Two</th>
<th>Phase Three</th>
<th>Phase Four</th>
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</thead>
<tbody>
<tr>
<td>Pre-Experimental Survey</td>
<td>Selection of Sample for field study</td>
<td>Preparation of ‘Questionnaire to Science Teachers on Science Teaching</td>
<td>Administration of ‘Questionnaire to Science Teachers on Science Teaching</td>
<td>Analysis of Data using Descriptive Analysis</td>
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<td>Stage Two</td>
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<td>Selection of the Sample</td>
<td>Preparation and Selection of Tests</td>
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<tr>
<td></td>
<td>i. Selection of the Content for experimental teaching based on the findings of the field study</td>
<td>Preparation of the following tests</td>
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<td></td>
<td>ii. Selection of the schools for experimental study</td>
<td>i. Pre-achievement Test related to the units selected for experimental teaching</td>
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<td>ii. Post-achievement Test on the units ‘The Changes Around Us’ and ‘Motion, Force and Machines’</td>
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<td>iii. Scientific Attitude Scale</td>
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<td>Selection of the following Standardized Tests</td>
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<td>i. Standard Progressive Matrices by J.C. Ravens to measure Intelligence</td>
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<td>ii. Test on Basic Process Skills by Padilla, Cronin and Twiest (1985)</td>
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</tbody>
</table>
| Phase Three | Administration of Pre-achievement Test prepared by the Investigator in three selected schools for both the sections of Standard Six  
| Phase Four | Administration of the following tests on student sample  
| Phase Five | Preparation of lesson plans on two selected units of Standard Six using Teacher Demonstration, Guided Discovery and Cooperative Learning Methods of Teaching  

### Phase Three
Administration of Pre-achievement Test and Selection of sample for experiment

#### i. Administration of Pre-achievement Test
- Prepared by the Investigator in three selected schools for both the sections of Standard Six

#### ii. Scoring of Pre-achievement Test
- Answer scripts and selection of low achievers and high achievers groups in each school

### Phase Four
Pre-treatment Measurement of variables

#### i. Scientific Attitude Scale
- Pretest by the Investigator

#### ii. Test on Basic Process Skills
- By Padilla, Cronin and Twiest (pretest)

#### iii. Standard Progressive Matrices
- By J.C. Ravens

### Phase Five
Preparation of Instructional Materials

#### i. Preparation of lesson plans
- On two selected units of Standard Six using Teacher Demonstration, Guided Discovery and Cooperative Learning Methods of Teaching

#### ii. Preparation of Teaching Aids
| Phase Six  |
|Treatment  |
| Procedure of Treatment |
| i. Sixteen teaching sessions each of Cooperative Learning Method of Teaching Science for high achievers and low achievers |
| ii. Sixteen teaching sessions each of Teacher Demonstration Method of Teaching Science for high achievers and low achievers |
| iii. Sixteen teaching sessions each of Guided Discovery Method of Teaching Science for high achievers and low achievers |
| iv. Audio recording of each lesson for Process Analysis |

| Phase Seven  |
|Administration of Post-treatment Tests  |
| Administration of the following Post-treatment Test |
| i. Post-achievement Test |
| ii. Test on Basic Process Skills (posttest) |
| iii. Scientific Attitude Scale (posttest) |

| Phase Eight  |
|Scoring and Consolidation of the Data  |
| i. Scoring of Pre-treatment Tests answer scripts |
| ii. Scoring of Post-treatment Tests answers scripts |
| iii. Consolidation of the Data |
Phase Nine
Analysis of Data

i. Analysis of presage-context-product part of the experimental study through:
   a) Analysis of Co-variance
   b) Analysis of Variance
   c) ‘t’ test

ii. Analysis of teaching process through
    a) Verbal Interaction Category (VICS) by Amidon and Hunter
    b) Descriptive Analysis
    c) ‘t’ test

iii. Findings of the Study

5.7.2.0 Field Study

Field studies are useful for bridging the gap between theory and practice. Field studies in teaching can be as simple as describing the teaching phenomena to as complex as establishing the relationship between observed teacher behaviours and their effect on pupils’ achievement.

The nature of the field study depends upon the purpose of the field study. In the present investigation, field study was undertaken for a specific but with a limited purpose. The objectives of the field study are given below:

i. To select the units of teaching for the experiment;
ii. To determine the number of periods normally required for the teaching of selected units;
iii. To study the methods of teaching science adopted by the teachers, and
iv. To study the facilities available in the school for teaching science.
5.7.2.1 Sample for the Field Study

The sample comprised of forty science teachers teaching science to Standard Six belongs to thirty-two schools. Selection of the schools was made on the basis of purposive sampling method. The selected schools were in the neighbourhood of experimental schools where the investigator had planned to undertake the experiment.

5.7.2.2 Tool Used for the Field Study

A questionnaire consisting of open end as well as, closed end questions developed by the Investigator.

5.7.2.3 Procedure of Data Collection

The “Questionnaire to Teachers on Science Teaching” prepared by the Investigator was administered to forty teachers teaching science to Standard Six belong to twenty-five schools of Mangalore District. The analysis of the responses based on those given by forty teachers was done through descriptive statistics such as mean, mode, percentage, range and weighted mean.

5.7.3.0 Experimental Study

5.7.3.1 The Design of the Experimental Study

A 3 x 2 factorial design was used. Three levels of teaching and two levels of Pre-achievement levels were decided upon by the investigator. The three levels of methods of teaching were the, Teacher Demonstration, Guided Discovery and Cooperative Learning Methods of teaching science. Low achievers and high achievers were two achievement levels of pupils. The design is schematically represented in Table 5.2
<table>
<thead>
<tr>
<th>Levels of Pre-achievement (B)</th>
<th>Teacher Demonstration (A₁)</th>
<th>Guided Discovery (A₂)</th>
<th>Cooperative Learning (A₃)</th>
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</table>
5.7.3.2 Variables in the Study

The four types of variables used in the present study are listed below

I. Independent Variables

i. Methods of Teaching Science having three levels:
   a. Teacher Demonstration;
   b. Guided Discovery;
   c. Cooperative Learning.

ii. Pre-Achievement levels having two levels:
   a. High Achievers;
   b. Low Achievers.

II. Dependent Variables

i. Total achievement in Science;

ii. Achievement in Knowledge Objective;

iii. Achievement in Understanding Objective;

iv. Achievement in Application Objective;

v. Basic Science Process Skills;

vi. Scientific Attitude.

III. Control Variable - Covariate

Intelligence

5.7.3.3 Sample for the Experimental Study

a. Selection of the Schools

The investigator selected at random three Government Higher Primary Schools, situated in a rural area and more or less having homogeneity with respect to age, social and economical background of pupils and medium of instruction. In all the three schools there were two sections each in Standard Six with more than forty students in each of the sections.

These schools were:

i. Dakshina Kannada Jilla Panchayath Model Higher Primary School, Kavoor;
ii. Dakshina Kannada Jilla Panchayath Model Higher Primary School, Marakada, and

iii. Dakshina Kannada Jilla Panchayath Model Higher Primary School, Panjimogaru.

b. Selection of the Subjects

Pre-Achievement Test was administered to all the students belonging to Standard Six of the three schools selected. Based on the scores on Pre-Achievement test percentile ranks of each student was found out. On the basis of percentile ranks, the students were categorized into two groups. Pupils with percentile ranks $\geq 75$ as high achievers and pupils with percentile ranks $\leq 25$ as low achievers. The number of students belong to each level of Pre-achievement was found out with respect to both the divisions from each of the three schools selected for the experiment. Accordingly sixteen pupils from each section were selected; hence, the total sample was ninety-six pupils.

The Investigator selected by casting lots, the Model Higher Primary School, Kavoor for Co-operative Learning Method; Model Higher Primary School, Marakada for Teacher Demonstration Method and Model Higher Primary School, Panjimogaru for Guided Discovery Method.

5.7.3.4 Tools Used

i. Pre-Achievement Test in Science;

ii. Raven’s Standard Progressive Matrices;

iii. Scientific Attitude Scale to measure the Scientific Attitude of pupils;

iv. Test on Basic Process Skills by Padilla Cronin and Twiest;

v. Post-achievement Test in Science.

5.7.3.5 Instructional Material

a. Lesson Plans

Sixteen each lesson plans based on the Teacher Demonstration Method, Guided Discovery Method and Cooperative Learning Methods were prepared by
the investigator on the units, ‘Changes Around Us’ and ‘Motion, Force and Machines’ from the science textbooks of Standard Six of Karnataka State.

b. Work Sheet

Worksheets were designed by the Investigator for the learners to be followed while teaching through Guided Discovery Method and Cooperative Learning Method.

5.7.3.6 Procedure for Data Collection

The procedure in which the present study has been conducted comprised of four levels viz. pretest level, treatment, collection of the teaching process data, posttest level.

a. Pre-Treatment Phase

Before starting the treatment sample was tested on a number of variables using appropriate tools. The Pre-treatment phase of the study is shown below with the help of Table 5.3

**TABLE 5.3**

**Variables Measured and Tools Used at the Pre-Treatment Phase**

<table>
<thead>
<tr>
<th>Variables Measured</th>
<th>Tools Used</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Pre-achievement in science</td>
<td>Pre-achievement Test in Science (Prepared by the Investigator)</td>
</tr>
<tr>
<td>b. Intelligence</td>
<td>Raven’s Standard Progressive Matrices</td>
</tr>
<tr>
<td>c. Scientific Attitude</td>
<td>Scientific Attitude Scale (Prepared by the investigator)</td>
</tr>
<tr>
<td>d. Basic Science Process Skills</td>
<td>Test on Basic Process Skills by Padilla, Cronin and Twiest</td>
</tr>
</tbody>
</table>

b. Treatment

A 3 x 2 factorial design was followed for the present research study. Based on the Pre-achievement Test scores, sixteen low achievers selected from one
section and sixteen high achievers were selected from another section from each school for treatment.

According to the design of the study the investigator taught thirty-two lessons each on the two units selected from Textbook on Science of Standard Six, through Teacher Demonstration, Guided Discovery and Cooperative Learning methods. The sixteen lessons were taught using the three different methods in each school to low achievers and high achievers separately. Thus a total of ninety six lessons of the duration of forty minutes each were taught by the Investigator to the six groups, viz., the total sample of ninety-six students.

c. Collection of the Teaching Process Data

Audio recording of all the ninety-six lessons was done by the investigator in order to analyze the teaching processes associated with the Teacher Demonstration, Guided Discovery and Cooperative Learning Methods of teaching with respect to verbal interactions during the lesson.

d. Post-Treatment Phase

At the end of the treatment phase the sample were Post-tested on three dependent variables using the appropriate tools. The details of Post-treatment phase are presented through the Table 5.4

<table>
<thead>
<tr>
<th>Variable</th>
<th>Tools Used</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Achievement in Science</td>
<td>Post-Achievement Test in Science</td>
</tr>
<tr>
<td>b. Scientific Attitude</td>
<td>Scientific Attitude Scale</td>
</tr>
<tr>
<td>c. Basic Science Process Skill</td>
<td>Test on Basic Process Skills by Padilla, Cronin and Twiest</td>
</tr>
</tbody>
</table>
5.8.0.0. Analysis of the Data

i. Analysis of the Post-test Data

For the detailed analysis of presage-context-product part of present experimental study, where the relative effectiveness of the Teacher Demonstration, Guided Discovery and Cooperative Learning Methods of Teaching was done, the Analysis of Covariance techniques was used. The posttest scores on six dependant variables such as total Achievement in Science, Achievement in terms of Knowledge, Understanding, Application Objectives Scientific Attitude and Basic Science Process Skills were used for this analysis. The Intelligence score of the sample on above mentioned six dependent variables, which was considered as the covariate, was controlled using Analysis of Covariance Technique.

The 't' test was also used to test the significance of the difference between the means of scores.

The comparative effectiveness of Teacher Demonstration, Guided Discovery and Cooperative Learning Methods of Teaching Science on the retention of low achievers and high achievers on the criterion of Knowledge, Understanding and Application Objective was done, the Analysis of Variance technique was used.

ii. Analysis of the Process Data

In order to study the interaction patterns associated with the Teacher Demonstration, Guided Discovery and Cooperative Learning Methods of Teaching, and variation in interaction patterns due to change in the Pre-Achievement levels of pupils, and to study the relationship between teaching process and learning outcome related to six dependent variable of the study, the investigator transcribed only sixty lessons among the ninety six lessons which were audio taped. Selection of the lessons was done based on the clarity of the audio-tape. Three seconds interval was marked on all the transcripts of the teaching process.
Since it was impossible to analyze all there sixty lessons because of the lengthy process involved in the task the investigator chose only the lessons four, eight, twelve and sixteen from each of the four groups to do the further analysis. Accordingly twenty-four lessons in all were chosen for studying the teaching process.

The data was coded using Verbal Interaction Category System (VICS), based on Flander’s System of Interaction Analysis modified version developed by Amidon and Hunter (1966). It has seventeen categories for analyzing classroom verbal behaviour. Prior to coding the lessons, both inter-observer and intra-observer reliabilities were established. Interaction patterns associated with the Teacher Demonstration, Guided Discovery, Cooperative Learning Methods of Teaching and variation in interaction patterns due to difference were studied by using different methods such as:

i. By finding out percentage of time spent on different categories;
ii. By studying percentage of time spent on various area of the matrix;
iii. By finding between two interactions patterns was tested by using ‘t’ test, and
iv. The relationship between teaching processes associated with the Teacher Demonstration, Guided Discovery and Cooperative Learning Methods of Teaching and learning outcome with respect to product variables was studied through qualitative analysis.

5.9.0.0 FINDINGS AND CONCLUSIONS OF THE STUDY

5.9.1.0 Conclusions of the Field Study

Keeping in view the objectives of the field study, the following findings were arrived at by the investigator on the basis of analysis of the data.

i. With the exception of three, all the teachers involved in the study had undergone either secondary teachers’ training (B.Ed.) or primary teachers’ training (TCH). A majority of the teachers had studied science upto
S.S.L.C. level, forty two percent of the teachers had studied science upto the graduation level (B.Sc.) and ten percent of the teachers had studied science upto higher secondary level (P.U.C.). Most of the teachers had offered methodology of teaching science for their training qualification.

ii. Thirty percent of the teachers had attended seminar / workshop / refresher courses of short duration related to the teaching of science.

iii. The teaching experience of the teachers varied from one to thirty years.

iv. The teacher pupil ratio was 1:52 and the classes were over crowded as far as the area per pupil was concerned.

v. All the classes had sufficient daylight and electricity.

vi. Most of the schools had necessary equipment and chemicals to teach Standard Six science content. Most of the schools did not have a science laboratory, only 10% of the schools had the science laboratory.

vii. The seating arrangement was generally the same and that was constant throughout the academic year.

viii. All the teachers were encouraging the students’ questions and were allowing them to discuss with each other, although 80% of them were not doing so always and 20%, only sometimes.

ix. In most of the classes students’ achievement in science was average.

x. About 90% of the teachers had taken their students outside the classroom for curricular activities casually. The remaining 10% did not take their students outside the classroom for any curricular activities.

xi. The teachers were using different types of written materials to supplement teaching. Textbooks on different branches of science, experiments in Science and Science Journals / Magazines / periodicals were maximally used by the teachers.

xii. Most of the teachers were giving homework regularly. All the teachers were giving question and answer type of homework. The other type of homework, such as undertaking investigatory projects, preparation of improvised apparatus and reading specific articles in science journals or
periodicals and collection of specimens and objects were also given to students by some of the teachers.

xiii. With respect to instructional activities related to teaching science most of the teachers were giving importance to Teacher Demonstration and some were giving importance to pupils' individual work and group work.

xiv. All the teachers were using different types of teaching aids in their teaching. They were either prepared by the teachers or students or readymade. Chalkboard, Charts, Models, experiments, objects / specimens were some of the commonly used teaching aids by the teachers. Very few teachers used films, slides, filmstrips and simulation games.

xv. With respect to Methods of teaching most of the teachers preferred the Demonstration Method. Some of the teachers preferred the Laboratory Method and the lecture method. Guided Discovery Method and deductive method were least preferred by the teachers.

xvi. With respect to Basic Science Process Skills in science, most of the teachers were giving importance to the skills of observation and communication. The skills of inference, measurement and classification were given importance by some of the teachers. The least importance was given to the skills of using space-time relationship, prediction and using numbers.

xvii. All the teachers have been making special efforts to improve the achievement level of their students in science specially by creating opportunities for student participation in curricular activities and periodical revision.

xviii. Enrichment activities were provided by 55% of the teachers to increase the achievement of high achievers. Assignments on investigatory projects, preparation of working model and reading specific articles published in science journals and periodicals were some of the enrichment activities provided by the teachers.
According to most of the teachers, important factors that contributed to effective teaching of science were, the resourcefulness of the teacher, pupils' interest in learning science, pupils' participation in curricular activities, Methods of teaching and suitable learning environment.

The units selected for the experimental teaching were 'Changes Around Us' and 'Motion, Force and Machines'.

It was realized that the duration of the experimental study including pretests and posttest should be sixteen periods in each class.

5.9.2.0 Conclusions of the Presage-Context-Product Study

Teacher Demonstration, Guided Discovery and Cooperative Learning Methods of Teaching Science were taken as presage variables and its comparative effectiveness was tested on the various product variables, such as, scores on Knowledge, Understanding, and Application Objectives, Total Achievement, Scientific Attitude and Basic Science Process Skills in science. Their effectiveness was also tested on the criterion of retention of Knowledge, Understanding, Application and Total Achievement scores. The ANCOVA and ANOVA techniques were used for analysis respectively. The major findings of these analyses are given below:

5.9.2.1 Conclusions Based on Analysis of the Post-test Scores

When the Intelligence of students was controlled statistically, treating the scores on the Intelligence Test RPM as the covariate and assuming the linear correlation between the covariate and the criterion score then the conclusion are as follows:

1. Teacher Demonstration Guided Discovery and Cooperative Learning Methods of Teaching Science differed in their effect on the Achievement of Knowledge Objective.

2. The Teacher Demonstration Method of Teaching Science was significantly more effective than the Guided Discovery Method of
Teaching Science with respect to the criterion of Achievement scores on Knowledge Objective.

3. The Cooperative Learning Method of Teaching Science was as effective as Guided Discovery and Teacher Demonstration Method of Teaching Science on the criterion of Achievement scores with respect to Knowledge Objective.

4. The Teacher Demonstration Method of Teaching Science and Cooperative Learning Methods of Teaching Science were equally effective on the criterion of achievement scores with respect to Knowledge Objective.

5. Teacher Demonstration, Guided Discovery and Cooperative Learning Methods of Teaching Science had differential effect on Achievement on the Understanding Objective.

6. The Teacher Demonstration Method of Teaching Science was significantly more effective than Guided Discovery Methods of Teaching Science with respect to the criterion of Achievement scores on the Understanding Objective.

7. Cooperative Learning, Guided Discovery and Teacher Demonstration Methods of Teaching Science were equally effective on the Achievement of low achievers and high achievers with respect to Achievement on the Application Objective.

8. Guided Discovery, Cooperative Learning and Teacher Demonstration Methods of Teaching Science differed in their effect on the Total Achievement in Science.

9. The Teacher Demonstration Method of Teaching Science was significantly more effective than both Guided Discovery and Cooperative Learning Methods of Teaching Science with respect to criterion of Total Achievement scores in Science.

10. The Cooperative Learning Method of Teaching Science was as effective as Guided Discovery Methods of Teaching Science on the criterion of Total Achievement scores in Science.
11. Guided Discovery, Cooperative Learning and Teacher Demonstration Methods of Teaching Science had differential effect on high achievers and low achievers with respect to improvement of scores on Scientific Attitude.

12. The Cooperative Learning Method of teaching science was significantly more effective than Guided Discovery and Teacher Demonstration Method of Teaching Science with respect to improvement of scores on Scientific Attitude of high achievers.

13. The Guided Discovery Method of Teaching Science was significantly more effective than Teacher Demonstration and Cooperative Learning Methods of Teaching Science with respect to improvement of Scientific Attitude of low achievers.

14. Guided Discovery Method of Teaching Science was significantly more effective with respect to improvement of scores on Scientific Attitude of low achievers than high achievers.

15. Cooperative Learning Method of Teaching Science was significantly more effective with respect to improvement of scores on Scientific Attitude of high achievers than low achievers.

16. The effect of Guided Discovery Method of Teaching Science on low achievers was statistically highly effective than the effect of Teacher Demonstration Methods of Teaching Science on high achievers with respect to the improvement of scores on Scientific Attitude.

17. The effect of Cooperative Learning Method of Teaching Science on high achievers was statistically more significant than the effect of Guided Discovery Method of Teaching Science on low achievers with respect to the improvement of scores on Scientific Attitude.

18. Teacher Demonstration, Guided Discovery and Cooperative Learning Methods of Teaching Science differed in their effect with respect to improvement of Basic Science Process Skills.
19. The Guided Discovery Method of Teaching Science was significantly more effective than Teacher Demonstration and Cooperative Learning Methods of Teaching Science with respect to improvement of Basic Science Process Skills.

5.9.2.2 Conclusions Based on Analysis of Percentage of Retention Scores

1. The Teacher Demonstration, Guided Discovery and Cooperative Learning Methods of Teaching Science were equally effective on the retention of pupil with respect to Achievement on the Knowledge Objective.

2. The Guided Discovery, Cooperative Learning and Teacher Demonstration Methods of Teaching Science were equally effective on the retention of pupils with respect to Achievement on the Understanding Objective.

3. The Teacher Demonstration, Guided Discovery and Cooperative Learning Methods of Teaching Science had differential effect on the retention of high achievers and low achievers with respect to Achievement on the Application Objective.

4. The Guided Discovery method of Teaching Science was significantly more effective than the Cooperative Learning and Teacher Demonstration Methods of Teaching Science on the retention of low achievers with respect to Achievement on the Application Objective.

5. The Cooperative Learning Method of Teaching Science was significantly more effective than the Guided Discovery and Teacher Demonstration Methods of Teaching on the retention of high achievers with respect to Achievement on the Application Objective.

6. Cooperative Learning Method of Teaching Science was significantly more effective on the retention of high achieves than low achievers with respect to Achievement on the Application Objective.
7. Guided Discovery Method of Teaching Science was significantly more effective on the retention of low achievers than high achievers with respect to Achievement on the Application Objective.

8. The effect of Guided Discovery Method of Teaching Science on low achievers was statistically more effective than the effect of Teacher Demonstration on high achievers with respect retention of Achievement scores on the Application Objective.

9. The effect of Cooperative Learning Method of Teaching Science on high achievers was statistically more effective than the effect of Teacher Demonstration Methods of Teaching Science on low achievers with respect of Achievement scores on the Application Objective.

a) The Guided Discovery, Cooperative Learning and Teacher Demonstration Methods of Teaching Science were equally effective on the retention of pupils with respect to high achievers and low achievers on Total Achievement.

5.9.3.0 Conclusions of the Teaching Process Study

The various conclusions drawn with respect to presage-process, context-process and process-product study are summarized below:

5.9.3.1 Conclusions with Respect to Presage-Process Study

1. The interaction pattern associated with Teacher Demonstration Method of Teaching Science was as follows:
2. The interaction pattern associated with Guided Discovery Method of Teaching Science was as follows:
3. The interaction pattern associated with the Cooperative Learning Method of Teaching Science was as follows:

4. The Teacher Demonstration Method of Teaching was associated with direct patterns, the Guided Discovery Method of Teaching was associated with indirect patterns and the Cooperative Learning Method of Teaching was associated with indirect patterns to the minimum whereas the students' direct interactions were to the maximum.

5. In the Teacher Demonstration Method of Teaching Science the teacher explained and demonstrated for a longer period and criticized the students' behaviour and rejected students initiated ideas more than both Guided Discovery and Cooperative Learning Methods of Teaching Science, whereas the teacher responded to the pupils and presented information more than in the Cooperative Learning Method of Teaching Science.

6. In the Guided Discovery method of Teaching Science, the teacher accepted the pupils' response and pupil-initiated talk more than in both the Teacher Demonstration and Cooperative Learning Methods of Teaching Science, whereas, the teacher initiated talk, student talk which was followed by teacher initiated talk and teacher-response followed by teacher initiated talk, were more than for the Cooperative Learning Method of Teaching Science and silence was more at the Teacher Demonstration Method of Teaching Science.

7. In the Cooperative Learning Method of Teaching Science the student-response followed by teacher-initiated talk, extended student response to another pupil, student-response followed by student initiated statements,
student-initiated statements followed by student-response and extended student initiated talk to another pupil were more than in both Teacher Demonstration and Guided Discovery Method of Teaching Science, whereas the student-response followed by teacher initiated talk and silence were more at the Teacher Demonstration Method of Teaching Science.

8. In the Guided Discovery Method of Teaching Science the teacher used oral questions while guiding the content oriented part of the discussion than in both Cooperative Learning and Teacher Demonstration Methods of Teaching Science. In the Cooperative Learning Method of Teaching, the teacher asked more new questions instead of lecturing than in both Teacher Demonstration and Guided Discovery Methods of Teaching Science.

9. In the Cooperative Learning Method, the pupils were provided with more opportunities to initiate their ideas, feelings and questions either to the teacher or to another pupil than in Teacher Demonstration and Guided Discovery Methods of Teaching Science.

10. In the Teacher Demonstration Method of Teaching the content oriented extended lectures and demonstrations were more than in both Guided Discovery and Cooperative Learning Methods of Teaching Science.

11. In the Cooperative Learning Method of Teaching the teacher praised and integrated the pupils’ ideas and feelings into the class discussion more than for Teacher Demonstration and Cooperative Learning Methods of Teaching.

12. The teacher reacted to the pupils’ ideas and feelings more at both Guided Discovery and Cooperative Learning Methods of Teaching than at the Teacher Demonstration Method of Teaching.
5.9.3.2 Conclusions with Respect to Context-Process Study

a. Conclusion with Respect to Teacher Demonstration Method of Teaching

1. There was a significant difference between high achievers and low achievers taught through the Teacher Demonstration Method of Teaching Science with respect to the percentage of time spent on different categories.

2. The teacher’s rejection of pupil behaviour, pupil-initiated talk to another-pupil, pupil response to another pupil and student disruption was significantly higher in the low achievers’ class than at the of high achievers’ class.

3. The teacher rejections of the pupils’ ideas and unpredictable pupil response to the teacher were significantly greater in the high achievers’ class than in the low achievers’ class.

4. There was a significant difference between the high achievers and low achievers taught through the Teacher Demonstration Method of Teaching Science with respect to the percentage of time spent on the various regions of matrix and variation in different interaction ratios.

5. The student-response followed by teacher initiated behaviour and confusion among the students were significantly higher in low achievers’ class than at the of high achievers’ class.

6. Prolonged teacher initiated talk with respect to explanation of content, demonstrations and giving directions and student-initiated talk followed by teacher acceptance were significantly higher in high achievers’ class than at the of low achievers’ class.

7. During the Teacher Demonstration Method of Teaching at the low achievers’ class the students were distracted and confused and the student responses were substantiated with the teacher’s explanation more than in high achievers’ class, whereas in the high achievers’ class the teacher explained and demonstrated for a longer period and the student initiated talk was accepted by the teacher more than at the of low achievers’ class.
8. In the Teacher Demonstration Method of Teaching, the content cross ratio and student steady state ratio were higher in high achievers' than at the of low achievers class, whereas, pupil initiation ratio and instantaneous teacher questions ratio were much higher in low achievers’ class than at the high achievers’ class.

b. Conclusion with Respect to Guided Discovery Method of Teaching

1. There was no significant difference between the high achievers and low achievers taught through the Guided Discovery Method of Teaching Science with respect to the percentage of time spent on different categories except, category number 6a, i.e., teacher's rejection of pupil ideas.

2. The scores of the high achievers’ class whereby the teacher criticized, rejected and discouraged the pupils’ ideas and waited for a longer period of time to elicit answers from the pupils were significantly more than those of the low achievers’ class.

3. In the low achievers’ class the predictable pupil response to the teacher and acceptance of pupils’ ideas was significantly more than that of the high achievers’ class.

4. There was no significant difference between the low achievers’ and high achievers’ group with respect to the percentage of tallies in the different areas of matrix.

5. The teacher praised and integrated pupil ideas and feelings into class discussion was significantly more in the low achievers’ class than in the of high achievers’ class.

6. The teacher asked new and thought provoking questions instead of lecturing was significantly more in the high achievers’ class than in the of low achievers’ class.
c. Conclusion with Respect Cooperative Learning Method of Teaching

1. There was significant difference between the high achievers and low achievers, taught through Cooperative Learning Method of Teaching Science with respect to the percentage of time spent on different categories.

2. The teacher initiated explanation, demonstration directions, questions and pupil initiated talk to teacher and silence were significantly more for the low achievers’ class than of high achievers class.

3. Pupil-initiated talk to another pupil and pupil response to another pupil were significantly more in the high achievers’ class than those of low achievers’ class.

4. There was significant difference between the high achievers and low achievers taught through the Cooperative Learning Method of Teaching with respect to the percentage of time spent on the various regions of the matrix and variation in different interaction ratios.

5. Prolonged teacher initiated explanations, demonstrations and directions and periods of silence, were significantly greater in the low achievers’ class than in the of high achievers’ class. Whereas, the pupil-pupil interactions were significantly more in the high achievers’ class than in the low achievers’ class

6. The teacher was very responsive towards the pupils’ ideas and praised and integrated their ideas, significantly more in the high achievers’ class than in the low achievers’ class. Whereas the teacher responded to pupils’ responses and asked content oriented questions, significantly at a higher rate in the low achievers’ class than in the of high achievers’ class.

5.9.3.3 Conclusions with Respect to Process-Product Study

The Cooperative Learning Method of Teaching Science was significantly more effective than both Guided Discovery and Teacher Demonstration Methods of Teaching Science on the Achievement of high achievers, with respect to the
criterion on improvement in Scientific Attitude and retention of achievement on the Application Objective due to the following process variables:

i. Pupil response to the question or ideas of another pupil;
ii. Pupil initiated talk to another pupil;
iii. Student-response behaviour followed by teacher-initiated behaviour;
iv. Student-response statement followed by student initiated statements;

v. Extended student-initiated talk to either the teacher or another pupil, and

vi. Teacher response ratio, pupil initiation ratio, instantaneous teacher response ratio and pupil steady ratio.

The Guided Discovery Method of Teaching Science was significantly more effective than both Cooperative Learning and Teacher Demonstration Methods of Teaching Science on the achievement of low achievers with respect to the criterion on improvement in Scientific Attitude and retention of achievement on the Application Objective because of the following process variables:

i. Teacher initiated directions;
ii. Narrow questions by the teacher;
iii. Predictable and unpredictable pupil response to teacher;
iv. Silence;

v. Teacher-initiated talk followed by teacher acceptance;

vi. Teacher –response ratio, pupil interaction ratio, instantaneous teacher response ratio, and

vii. Pupil steady ratio.

The Guided Discovery Method of Teaching Science was significantly more effective than Cooperative Learning and Teacher Demonstration Methods of Teaching Science on the retention of low achievers with respect to achievement on the Application Objective because of the following process variables:

i. Teacher initiated directions;
ii. Narrow questions by the teacher;

iii. Predictable and unpredictable pupil response to teacher;
iv. Silence;
v. Teacher-initiated talk-followed by teacher acceptance, and
vi. Teacher response ratio, pupil interaction ratio, instantaneous teacher
response ratio and pupil steady ratio

The Cooperative Learning Method by Teaching Science was significantly
more effective than Guided Discovery and Teacher Demonstration Methods of
Teaching on the retention of high achievers with respect to achievement on the
Application Objective due to the following process variables:
i. Pupil response to the questions or ideas of another pupil;
ii. Pupil initiated talk to another pupil;
iii. Student-response behaviour followed by teacher-initiated behaviour;
iv. Student-response statements followed by student initiated
statements;
v. Extended student-initiated talk to either the teacher or another pupil,
and
8. Teacher-response ratio, pupil initiation ratio and pupil steady state ratio.

5.10.0.0 IMPLICATIONS OF THE STUDY

Based on the outcomes of the experiment, the following recommendations
are made by the Investigator, which may assist in improving the existing practice
of Teaching Science in the Higher Primary Classes as well as the Content-cum-
Methodology of Teaching Science in Colleges of Teacher Education and Teacher
Training Institutions.

The results of the experiment have indicated that the Teacher
Demonstration Method, Guided Discovery Method and Cooperative Learning
Method of Teaching Science adopted by the Investigator had an influence on the
outcome of science learning of high achievers and low achievers of Standard Six.
The results of the experiment will help to formulate some theoretical guidelines so
as to modify the present practice of Teaching Science especially in Higher
Primary Classes and the Methodology of Teaching Science in Teacher Training Institutions and Colleges of Teacher Education.

5.10.1.0 Implications to Primary Education

1. The study has revealed that with respect to Standard Six pupils Achievement in Science taught through Teacher Demonstration Method has been more effective than,
   i. The Guided Discovery Method on the criterion of the Knowledge Objective, Understanding Objective and Total Achievement;
   ii. The Cooperative Learning Method on the criterion of Total Achievement.

   These results imply that teachers could make use of the Teacher Demonstration Method of Teaching Science to pupils of higher primary classes to attain the Knowledge Objectives, Understanding Objective and to promote Achievement in Science. The above findings also imply that the Teacher Demonstration Method of Teaching needs to become an integral part of the Methodology of Teaching Science at the Higher Primary Stage of school education. In the present experiment the lesson plans were prepared according to the lesson format developed by the investigator with a sound theoretical base. The fidelity of the lessons was also established. Therefore, teachers could prepare detailed lesson plans following the format developed by the investigator or any other format with a sound theoretical base and taking the utmost care to execute the plan.

2. It was found out that the Guided Discovery Method of Teaching Science was significantly more effective than the Teacher Demonstration Method and the Cooperative Learning Method in improving the Basic Science Process Skills pupils of low achievers of Standard Six.

   The findings imply that in order to improve the Basic Science Process Skills, teachers could use the Guided Discovery Method in the higher primary classes with positive effectiveness.
In the present study the investigator had taught the lessons from the prescribed syllabus, but the lessons were prepared by emphasizing the process aspect of science in the learning activities planned and provided to the pupils. Therefore, the findings imply that the teachers could capitalize on opportunities to practice the Basic Science Process Skills in the activities normally done in the classroom through the Guided Discovery Method of Teaching to improve the Basic Science Process Skills among the pupils of higher primary classes.

3. The study revealed that the Cooperating Learning Method of Teaching Science was significantly more effective,
   i. than both Guided Discovery and the Teacher Demonstrational Method of Teaching Science in improving the Scientific Attitude among high achievers, and
   ii. in improving the Scientific Attitude of high achievers than low achievers.

   These findings indicate that the teachers could make use of Cooperative Learning Method of Teaching Science to improve the Scientific Attitude of the high achievers of Higher Primary Classes and derive maximum benefits.

4. It was found out that the achievers taught through the Guided Discovery Method of Teaching Science retained the learning outcomes of Applications Objectives significantly more than,
   i. the low achievers taught through the Teacher Demonstration and the Cooperative Learning Method of Teaching, and
   ii. the high achievers taught through Guided Discovery Method of Teaching.

   The findings imply that the teacher should make use of the Guided Discovery Method of Teaching Science to low achievers of Higher Primary Classes to increase the retention of learning outcomes with respect to Application Objective.

5. It was also revealed from the study that the Cooperative Learning Method of Teaching was significantly more effective,
than the Teacher Demonstration and the Guided Discovery Method of Teaching on the retention of the learning outcomes of the Application Objectives among high achievers.

ii. On the retention of high achievers than low achievers with respect to Achievement on the Application Objective

These findings imply that the teachers should make use of the Cooperative Learning Method of Teaching Science to high achievers of Higher Primary Classes to increase the retention of the learning outcome with respect to Application Objectives. Therefore, wherever the curricular materials are amenable this method can be practiced in our schools successfully, especially for the mastery of higher orders learning outcomes in science.

5.10.2.0 Implications to Teacher Education

1. The results of the experiment have revealed that the effects of the Teacher Demonstration Method, Guided Discovery Method and the Cooperative Learning Method of Teaching Science depend upon the criterion to be measured as well as the Pre-Achievement Levels of students. Therefore, Pre-service teachers should be trained in all the three Methods of Teaching and avail of their use in different context.

2. It was found out from the teaching process analysis of the Teacher Demonstration Method, Guided Discovery Method and Cooperative Learning Method of Teaching Science to Standard Six pupils that the Teacher Demonstration Method of Teaching Science was associated with direct patterns, the Guided Discovery Method of Teaching was associated with indirect patterns and the Cooperative Learning Method of Teaching was associated with the indirect patterns to the minimum and the students’ direct interaction to the maximum. These findings imply that while guiding and training student teachers for methods, training in the respective patterns of teaching should be given.
3. In the present study the effectiveness of the Teacher Demonstration Method, the Guided Discovery Method and the Cooperative Learning Method on pupils' Achievement, Scientific Attitude and Basic Science Process Skills was found out by establishing the fidelity of each method. This implies that the theory on fidelity and training in establishing fidelity of the treatment has the strong base be included in under Content-cum - Methodology of Teaching Science in Teacher Education Courses.

4. The theory and practice of Cooperative Learning would be an effective methodology or technique to be included in Teacher Education Courses.

5. Workshops and Seminars conducted to In-service teachers on the theory and practical experience of Cooperative Learning will provide an exposure to fresher approaches to be practiced in the classroom.

6. If Pre-service teachers are exposed to the knowledge and practice of the Basic Science Process Skills using creative techniques of teaching, their ability of using every activity related to the teaching of science to develop the Science Process Skills and consequently the Scientific Attitude will be enhanced.

5.11.0.0 SUGGESTIONS FOR FURTHER RESEARCH

The findings of the present study may serve as a basis for further research. Based on the findings of the study, the following suggestions are offered:

i. The present investigation was limited only to two teaching units i.e., 'Changes Around Us' and 'Motion, Force and Machines', and they were taught by only one teacher in three different schools. Similar studies can be under taken for more units in Science and could be tried out by a number of teachers for a bigger number of schools from different locations.

ii. The 'Total Teaching Time' was kept constant in all the six groups irrespective of the Method of Teaching or Level of Pre-Achievement of the students. Effects of these methods could be studied by keeping the
‘Content’ constant and varying the amount of teaching time on the achievement of the students of different levels of Pre-Achievement.

iii. Other context variables such as the levels of Intelligence, Thinking Skills and Problem Solving Ability of the students could be considered for studying the context-process relationship with respect to Teacher Demonstration, Guided Discovery and Cooperative Learning Methods of Teaching Science.

iv. Similar studies can be undertaken by controlling the Intelligence experimentally and prior achievement statistically.

v. This study can be extended to other subject areas as well as other stages of education especially the Lower Primary, Secondary and Higher Secondary sections of school education.

vi. The relative effectiveness of the Teacher Demonstration Method, Guided Discovery Method and Cooperative Learning Method of Teaching on other criterion measures such as Critical Thinking, Problem Solving and Integrated Science Process Skills, could be tried by researchers.

vii. This study can be extended further by providing the students with explicit instructions on the nature, benefits, roles and responsibility associated with Cooperative Learning, and giving the experience of learning one unit through Cooperative Learning prior to the treatment.

viii. In the present study the Expository Approach was followed in the Teacher Demonstration Method. Similar studies can be undertaken by following the Discovery Approach in the Teacher Demonstration Method of Teaching Science.

ix. The Individual Guided Discovery Method was used in the present study. Similar studies can be undertaken by using the Group Guided Discovery Method of Teaching Science.

x. The Cooperative Learning Method used in the present study was developed by the investigator by adopting the ‘Learning Together’ approach of
Cooperative Learning. Studies can be undertaken by changing the Method of Cooperative Learning and trying out other alternatives.

xi. Effects of different Methods of Cooperative Learning can be undertaken by considering the same context and the product variables in the same subject area or different subject areas.