CHAPTER-IV
RESEARCH METHODOLOGY

4.1. INTRODUCTION
4.2. RATIONALE FOR THE STUDY
4.3. STATEMENT OF THE PROBLEM
4.4. BACKGROUND OF THE RESEARCH DESIGN
4.5. OBJECTIVES
4.6. ASSUMPTIONS
4.7. HYPOTHESES
4.8. DELIMITATIONS
4.9. PROCEDURE FOR THE EXECUTION OF RESEARCH
  4.9.1. EXPERIMENTAL DESIGN
  4.9.2. RESEARCH DESIGN SELECTED
  4.9.3. ADVANTAGES
4.10. EXPERIMENTAL THREATS
  4.10.1. INTERNAL VALIDITY
  4.10.2. HISTORY
  4.10.3. SELECTION
  4.10.4. STATISTICAL REGRESSION
  4.10.5. TESTING
4.11. MEASURING INSTRUMENTS
  4.11.1. MATURATION
  4.11.2. SELECTION MATURATION INTERACTION
  4.11.3. EXPERIMENTAL MORTALITY
  4.11.4. EXTERNAL VALIDITY
4.12. VARIABLES
4.13. DEFINITIONS OF KEY TERMS
   4.13.1. OPERATIONAL DEFINITIONS

4.14. EXPERIMENTATION IN PHASES

4.15. DURATION OF EXPERIMENTATION
   4.15.1. PHASE-I SAMPLE FOR THE STUDY
   4.15.2. PHASE-II SELECTION OF THE COMPETENCIES
   4.15.3. PHASE-III CONDUCTING PRE TEST
   4.15.4. PHASE-IV TRAINING ON METACOGNITION AND
            MOTIVATION STRATEGIES
   4.15.5. PHASE-V
   4.15.6. PHASE-VI PROGRESSIVE TEST
   4.15.7. PHASE-VII
   4.15.8. PHASE-VIII PROGRESSIVE TEST II
   4.15.9. PHASE-IX TRAINING
   4.15.10. PHASE-X PROGRESSIVE TEST III

4.16. SCHEME OF DATA ANALYSIS
CHAPTER-IV
RESEARCH METHODOLOGY

4.1. INTRODUCTION

This chapter describes the procedure adopted to conduct the investigation. The investigation is described under the following sections: Objectives of the research study, Research questions, Hypothesis, Assumptions, Experimental design, sample for the study, Delimitations, and Construction & validation of tools.

4.2. RATIONALE FOR THE STUDY

There are so many innovative strategies in science teaching, but teachers are not able to bring desired changes among the students. The reasons for this may be many but the investigator thinks that the lack of competency in teaching science is one of the reason. Competency in teaching science is influenced by a number of variables. The most important variables the investigator considered are the lack of metacognition and proper motivation in teaching of science. A science teacher must know the motivation strategies and metacognitive strategies for effective teaching. No study has been made on the combined effect of motivational strategies and competency in teaching science. This made the investigator to undertake the present study.
4.3. STATEMENT OF THE PROBLEM

The progress and prosperity of a country depends upon the quality of the citizens. The quality of its citizen is the quality of education provided to them. The quality of education depends on the quality of teachers. The teachers have a major role in educational development whether they approach their work actively or passively. The teacher has to play an active role for congenial interaction between the teacher and the taught. A competent teacher should have not only mastery over his or her subject matter, but also his or her competency which should be measured by students learning. Effective learning is the result of successful teaching. Teaching competency is one or more abilities of a teacher to produce agreed upon educational effects. The title of the problem is,

"Effect of Metacognition and Motivational Intervention Strategies to Enhance Competencies in Teaching Science among DIET Trainees."

4.4. BACKGROUND OF THE RESEARCH DESIGN

Research Questions
1. What is meant by competency in teaching science?
2. What is meant by Metacognition?
3. Do metacognition improve competency in teaching science?
4. Do motivation improve competency in teaching science?
5. Do motivational strategies improve competency in teaching science?
6. Do metacognition strategies improve competency in teaching science?

7. Do metacognition and motivation together enhance competency in teaching science?

4.5. OBJECTIVES OF THE STUDY

- To assess the level of competency in teaching science among the student teachers.
- To assess the level of metacognition among the student trainees.
- To assess the level of motivation among the student trainees.
- To identify the metacognitive strategies that enhances the competencies in teaching science among the student trainees.
- To identify the motivational strategies that enhances the competencies in teaching science among student trainees.
- To develop a model that metacognitive and motivational strategies and principles to enhance the competencies in teaching science among student trainees.
- To implement the model to the student teacher to enhance the competency in teaching science.
- To test the level of metacognition and motivation among the student teachers.
- To test the effect of metacognition and motivation strategies on enhancing the competencies in teaching science.
• To identify the effect of motivational intervention strategies on competency in teaching science among the student teachers.

• To identify the effect of metacognition intervention strategies on competency in teaching science among the student teachers.

4.6. ASSUMPTIONS OF THE STUDY

• Student teachers could be given training towards developing the competency in teaching of science.

• Student teachers in DIET use metacognition and motivation strategies while teaching Science.

• Motivation level of students teachers is low

• The level of motivation could be developed.

• There is significant correlation between motivation and competency in teaching science.

• The student teachers can design and develop strategies to motivate the students towards teaching of science.

• The student teachers can enhance the competency in teaching science by motivating them through activating motivational strategies.

• A model based on the metacognition and motivation principles enhance the competency in teaching science.

• An intervention with the help of the model should enhance the competency in teaching science.
• The progress of the learners would be assessed with the help of the tools, formulated by the researcher.
• After the intervention programme the final assessment of the competency in teaching science would be done.
• Effective use of competencies /skills increased after the treatment.

4.7. HYPOTHESES

The following are the hypotheses framed for this study

1. There will be significant difference between the pretest and progressive test scores on competency in teaching science among the student teachers.
2. There will be significant difference between the progressive test and Post-test scores on competency in teaching science among the student teachers.
3. There will be significant difference between the pre and post-test scores on competency in teaching science among the student teachers.
4. There will be significant difference between pretest and progressive test on level of metacognition among the student teachers.
5. There will be significant difference between progressive test and post-test of the level of the metacognition among the student teachers.
6. There will be significant difference between the pre test and post-test of the level of the metacognition among the student teachers.

7. There will be a significant difference between the pre test and the post test of motivation.

4.8. DELIMITATIONS OF THE STUDY

1. This investigation is confined only to District Institute of Education and Training of Pondicherry.

2. Only 20 female students were selected for investigation.

3. 12 Competencies in teaching science were selected.

4.9. PROCEDURE FOR THE EXECUTION OF RESEARCH

4.9.1. EXPERIMENTAL DESIGN

Experimentation has been put to various uses in solving educational problems. The experiment is the only means for settling disputes regarding educational practice, the only way of verifying educational improvement, and the only way of establishing a cumulative tradition in which improvements can be introduced without the danger of a faddish discard of old wisdom in favor of inferior novelties (Campbell and Stanley, 1963).

This method is scientifically sophisticated. It is defined as observation under controlled conditions. Experimental research can be effectively applied within the classroom, where significant factors or
variables can be controlled to some degree. Experimental method involves interventions to manipulate the independent or explanatory variable and observe whether hypothesized dependent variable is affected by the intervention and how they affect the subjects being studied. It is the best way to establish cause and effect relationship between the variables. This method is considered to be the best because it provides a high degree of control over the extraneous variables and the manipulation of variables. The experimentation consists of the deliberate and controlled modification of the conditions determining the event and in the observation and interpretation of the changes occurring in the event. The purpose of experimentation is to generalize the variable relationships so that they may be applied outside the classroom to a wider population. Though the experimentation is used in the physical sciences its application is limited to education and social sciences. Based on the above advantages of experimental research the investigator has adopted an experimental design for the present investigation.

4.9.2. RESEARCH DESIGN SELECTED

The investigator has employed experimental design single group pretest-treatment- post-test design.

The researcher selected this design due to the following reasons.

1. Being a science teacher for this group of students, this group is readily available.
2. The researcher liked to continue the research work without affecting regular academic work.

3. The students have undergone observation study and teaching practice in the schools which can only be used for the experimentation.

The procedure in this design is as below

\[
\begin{array}{ccc}
O1 & X & O2 \\
Pretest & treatment & post-test
\end{array}
\]

In this study competency in teaching science is dependent variable. Metacognition and motivation are independent variables. All the three variables are assessed before treatment. During the treatment progressive assessment in competency in teaching science and metacognition are assessed. After the treatment is over post assessments in all the above three variables were also competed.

4.9.3. ADVANTAGES OF THIS DESIGN

This type of design permits an experiment to be conducted by a teacher in his own classroom without assistance. Since the same group and same teacher are involved, it seems to make a fair attempt at equating the factors of the ability and background of the subjects and the general characteristics of the experimental situation. No part of the difference in the results can be attributed to the validity of the subjects or the teachers.
4.10. EXPERIMENTAL THREATS

4.10.1. INTERNAL VALIDITY

An experiment has internal validity to the extent that the factors that have been manipulated (independent variables) actually have a genuine effect on the observed consequences (dependent variables). Campbell and Staneley (1963), identified eight extraneous variables that threaten the internal validity. These variables must be controlled or else they might lead to alternative interpretations of the results.

4.10.2. HISTORY

Unplanned events may occur during the research and affect the results. Such events are referred to in educational research as "History threat". During the experimentation unexpected events did not occur, hence this threat was eliminated.

4.10.3. SELECTION

Differences between the subjects in the groups may result in outcomes. The random assignment of subjects to experimental group ensures, according to the law of probability that the groups compared do not significantly differ from one another in their composition. The subjects should be equal in all respects. In this study all the students were assigned to the same group, so this threat was nullified.
4.10.4. STATISTICAL REGRESSION

Statistical regression which is also known as regression to the mean, is a phenomenon due to subjects are selected on the basis of extreme high or low pretest scores. The subject should be selected in equal numbers from all levels of scoring. In this study all the students were assigned to the same group, so this threat is eliminated.

4.10.5. TESTING

The process of pre testing at the beginning of an experiment can produce a change in subjects, pre testing may produce a practice effect. The effect of pre test upon the scores of a subsequent post-test is called testing threat. In experimental studies it is common to test subjects at the beginning and end of the study. If considerable improvement is found in the post-test scores the researcher may conclude that this improvement is due to the experimentation and alternative explanation is that it may be due to the use of pretest. In this investigation pre test, progressive tests and post-test were conducted, hence this threat was eliminated.

4.11. MEASURING INSTRUMENTS

Differences in results due to changes in the measuring instruments between the pre test and post-test may constitute a threat to the internal validity. The same tools to measure level of motivation and competency in teaching Science were used throughout this study. Hence this threat was nullified.
4.11.1. MATURATION

The time period that elapses during the experimentation may produce certain changes in the subjects. The subjects may perform differently on the dependent variable on different occasions as a result of biological or psychological processes like fatigue, age, interest or motivation. Therefore the effects on the dependent variable as a result of the change in subjects due to passage of time could mistakenly be attributed to the experimental variable. The total duration of this sturdy was 12 weeks so this threat was eliminated.

4.11.2. SELECTION MATURATION INTERACTION

The effect of maturation not being consistent across the groups because of some selection factor like intelligence, motivation, age etc. rather than experimental variable constitutes this threat. The subject selected was similar in all respects (e.g. age, academic achievement in their undergraduate level etc.) Hence this threat was eliminated.

4.11.3. EXPERIMENTAL MORTALITY

The differential loss of subjects particularly in a long-term experiment from the comparison groups may affect the findings of the study. Some subjects in the experimental group who receive lowest scores on the pre-test dropout after taking the test, this group will show higher mean on the post test than the control group, not because of experiment
but because of low scoring subjects are not present. In this study there is no loss of subjects. So this threat is eliminated.

4.11.4. EXTERNAL VALIDITY

External validity refers to difficulties in generalizing the findings of experimental research to other settings, persons, variables, measuring instruments. External validity is the extent to which the findings of the study in one situation can be generalized or applied to another situation.

a. Threats to external validity

External validity is the extent to which the findings of the study in one situation can be generalized or applied to another situation. Bracht and Glass described another type of external validity called Ecological validity that concerns the extent to which the results of an experiment can be generalized from the set of environment conditions created by the researcher to other environmental conditions.

b. Interaction effect of testing

Pre testing interacts with the experimental treatment and causes some effect such that the results will not be generalized to an un pre tested population. All the students teachers were subjected to this type of programme. If at all any interaction effect occur it would be common to all students.
c. Interaction effects of selection Biases and the experimental treatment

This refers to the effect of some selection factor of intact groups interacting with the experimental treatment that would not be the case if the groups had been randomly formed. All the available subjects were selected. So this threat was eliminated.

d. Multiple treatment interference

When the same subjects receive two or more treatments there may be a carry over effect between treatments such that the results cannot be generalized to single treatment. Only one treatment was given to all the student teachers at a time, a time gap was given before another treatment; moreover the carryover effect of the first treatment was taken into account by partialling out the contribution by the independent variables on dependent variable.

e. Articiality of the experimental setting

In an effort to control extraneous variable the researcher imposes careful controls which may introduce a sterile or artificial atmosphere that is not at all like the real life situation about which generalizations are desired, the reactive effects of the experimental process is constant threat. By conducting the experiment in the actual school classroom this type of threat is eliminated.
**f. Hawthorne effect**

Knowledge of participation in an experiment may introduce the extraneous variable of bias in favor of experimental group. As this study is concerned with enhancement of competency and it is part and parcel of a pre-service training programme the student teachers did not have this type of threat.

**g. Contamination**

Contamination is a type of bias introduced when the researcher has some previous knowledge about the subjects involved in an experiment. By comparing the assessment by the investigator with guide teacher this threat is eliminated.

The good experimental design is determined on the basis of attaining, maximum internal validity and external validity. The selection of a particular experimental design is based on the purpose of the experiment, the type of variables involved in this study and the conditions or limiting factors under which it is conducted. The design deals with how the subjects are selected, the way variables are to be manipulated and controlled, the method of data collection and the type of statistical analysis to be employed in interpreting data relationships.
4.12. VARIABLES

The present investigation is an attempt to determine the “Effect of metacognition and motivation intervention strategies on enhancing competency in science teaching among DIET trainees”, and to estimate the extent of relationship between selected variables.

a. Metacognition and motivation are independent variables.

b. Competency in teaching science is the dependent variable.

c. Control of extraneous variables.

   i. Gender – study is conducted with female student teachers.

   ii. Maturation- Investigation is carried out within the duration of 3 months.

   iii. Age – student teachers of the same age group have been chosen (17-20).

   iv. Qualification – Study is conducted with student teachers who have completed +2 higher secondary level.

   v. Parental motivation – student teachers selected for this study are day scholars.

   vi. Peer group interaction- Only one group of D.TEd., students available in the college.

4.13. DEFINITIONS OF KEY TERMS

Effect: According to Webster’s Dictionary ‘Effect’ means the power to bring about a result.
**Metacognition:** thinking about one's own cognitive processes.

**Motivation:** Motivation leads an individual towards a goal.

Motivation is an internal force or energy or need which initiates sustains, directs and regulates the behaviour of the learner.

**Intervention:** According to Oxford Dictionary intervention means "interference".

**Strategy:** a plan to achieve a goal.

**Developing:** improve.

**Competency:** having necessary skills to do something successfully.

**Teaching:** show how to do things. give information to learn.

**Science:** body of knowledge of natural phenomena.

### 4.13.1 OPERATIONAL DEFINITIONS

**Effect:**

The effect refers to cause and effect of variables. The response created by the independent variable.

**Metacognition:**

Metacognition is the knowledge and awareness of one's own cognitive processes (Flavell 1976).
The ability to monitor, regulate and evaluate one's thinking (Brown 1978). "Metacognitive processes enable individuals to better control their thinking and thereby become more efficient and flexible learners".

The subjects are asked to monitor, regulate and evaluate their thinking; Learners are given training on the dimensions of metacognition to improve their learning skills.

**Motivation:**

Something which prompts, compels and energies an individual to act or behave in a particular manner at a particular time for attaining some specific goal or purpose.

The subjects are given motivation to do a task, motivation is a process in which the learner’s internal energies or needs are directed towards a goal.

**Intervention**

According to Oxford Dictionary intervention means “interference”.

The independent variables intervene a process of learning causing changes in the dependent variable. Metacognition and motivation strategies intervene the learning.
Strategy

The art of planning a skill in managing any affair. Metacognition and motivation strategies are used.

Developing

Improving the teaching competency in science.

Competency

A set of elements which lead not only to develop a skill but a good combination of knowledge, understanding, problem solving abilities and values (attitudes).

Competency is equipping the teacher with adequate knowledge and ideas to begin with profession career.

Competency is the demonstration of knowledge, skills and attitudes required to perform a given task or act.

Competency is transformation of inborn/ innate qualities and concealed / hidden strength of the individual into application (utility).

Teaching

Teaching process is determined by knowledge a set of abilities, attitudes, and skills which in turn determine pupil outcomes.

Teaching can be defined as a set of observable teacher behaviours that facilitate or bring about pupil learning.
Science

Science encyclopedia has emphasized, “Science is an accumulated and systematized learning in general usage restricted to natural phenomenon.

Science is a cumulative and endless series of empirical observations which result in the formation of concepts and theories with both concepts and theories being subject to modification in the light of further, empirical observations (Frederic, 1960).

Science is both a body of knowledge and the process of acquiring it.
Baskar Strategy to Enhance Competencies in Teaching Science

Pre-instruction session
- Planning session
  1. Lesson preparation
  2. Selecting resources
  3. Strategies selection
- Interaction with students' self views, perceptions, ideas.
- Reflection session
  Reflect ideas, restate, translate, compare ideas.

Strategy Training in Science
- Classroom Instruction
  - Motivation throughout instruction
    1. Rewards
    2. Reinforcements
    3. Teaching aids
    4. AV aids
    5. Competitions
    6. Encouragements
  - Types of instructional methods
    1. Lecture Method
    2. Group, individual activities
    3. AV presentation
    4. Field trip
    5. Experiment method
  - Metacognitive knowledge
    Components use of strategy, task demand, use of prior knowledge, self-regulation, peer assistance are used by the trainees throughout instructions.

Pre-experimental session
- Planning

Experimental Session

Post-experimental session
- Reciprocal Teaching in small groups to develop science process skills

Observation of student activities in areas like
1. Field work
2. Learning strategies
3. Science process skills
4. Assignment
5. Follow up activities
6. Project work

Evaluation
- Supervising students' activities in science classroom/laboratory.
- Teachers performance in competencies/skills Science classroom.
- Students' behavior during trainees' classroom instruction.
- Evaluation of students' personalities
  1. Rational
  2. Openminded
  3. Honest
  4. Social responsibility.
4.14. EXPERIMENTATION IN PHASES

PHASE-I

1. Understanding the need for a Training Model for trainees of DIET.

2. Developing a suitable training Model to enhance motivation, metacognition, and competency in teaching Science.

PHASE-II

3. Administering pretests in metacognition, motivation, and competency in teaching science.

PHASE III

4. Training given to trainees using training model developed by the investigator, for three months.

5. Assessing the trainees performance progressively.

PHASE-IV

6. Administering post tests in motivation, metacognition, and competency in teaching science using the same tools.

PHASE-V

7. Entering, categorizing and analyzing the pretest and post test scores.

8. Interpreting the result of the experiment after analyzing the data.
## 4.15. DURATION OF EXPERIMENTATION

<table>
<thead>
<tr>
<th>Week (Phase)</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>I week (Phase-I)</td>
<td>Selection of the sample.</td>
</tr>
<tr>
<td>II week (Phase-II)</td>
<td>Selection of competencies in teaching science.</td>
</tr>
<tr>
<td>III week (Phase-III)</td>
<td>Pre-assessment of variables, Metacognition, Motivation, and Competencies in Teaching Science.</td>
</tr>
<tr>
<td>IV week (Phase-IV)</td>
<td>Orientation on training model of Metacognition, Motivation, and Competency in Teaching Science.</td>
</tr>
<tr>
<td>V week (Phase-V)</td>
<td>Training in four Competencies in Teaching Science i.e. knowledge, facilitation, instruction, and information processing.</td>
</tr>
<tr>
<td>VI week (Phase-VI)</td>
<td>Progressive Test I assessment of three Teaching Competencies.</td>
</tr>
<tr>
<td>VII week (Phase-VII)</td>
<td>Training in three Teaching Competencies i.e. decision making, Science processing, and integration.</td>
</tr>
<tr>
<td>VIII week (Phase-VIII)</td>
<td>Progressive Test II assessment of second three Teaching Competency</td>
</tr>
<tr>
<td>IX week (Phase-IX)</td>
<td>Training in general teaching competencies i.e. individual difference, communication, planning, evaluation, and human relationships.</td>
</tr>
<tr>
<td>XI week (Phase-XI)</td>
<td>Post Test assessment of Teaching Competency, Metacognition and Motivation.</td>
</tr>
</tbody>
</table>
4.15.1. PHASE-I

Sample for the Study

Location and Selection of the Sample

District Institute of Education and Training institutes were visualized as vibrant Institutions at the district level to provide “Academic and resource support at the grass root levels for the success of various strategies and programmes being undertaken in the areas of elementary and adult education.” DIET’s were also visualized as part of larger design and strategy to achieve national goals in the areas of elementary and adult education.

In the present scenario of educational development, quality of education has emerged as an important priority. The DIET’s have a critical role in this direction. Thus besides UEE pursuit of excellence has to be the other guiding principles in the area of elementary education and the DIET’s therefore have a role in the teacher training, in order to enhance their quality, competency and commitment.

Teacher training is a continuous process. Pre-service and In-service training of teachers therefore forms an important component of this process. The main role of DIET’s is to provide both pre-service and In-service training to teachers specially elementary education. The role of DIET’s can be broadly classified as transactional and transformational.
Pre-Service Teacher Education Branch

This branch is to organize a regular full time two years teachers training Programme for students with a minimum academic qualification of +2 or Senior Secondary School certificate. The curriculum to be followed in DIET generally includes.

a. Subject content enrichment
b. Postulates of Pedagogy
c. Foundations of Education
d. Problems of education
e. Practical work including practice teaching, work experience, preparation of instructional aids, etc.

The present investigation was carried out in District Institute of Education and Training, Pondicherry. The course offer a two year Diploma in teacher Education. The eligibility for the course is +2 higher secondary school passed students. The age group of students is from 19-20 Years. There are Tamil medium and English medium classes with a capacity of 50 students each. In Second year English medium 80% of the students are females. The investigator selected only volunteered students who showed interest and sincerity in teaching. 20 female students are selected for the study.
Duration of the Treatment

The students of the experimental group were made to familiarize with the model on metacognition and motivation strategies orientation on competencies/skills on teaching science. They were also given training to teach science in classroom through this model. Duration of the experiment is of Eleven weeks.

4.15.2. PHASE-II
SELECTION OF THE COMPETENCIES

There are a number of competencies essential for the teaching of science. The investigator selected 12 competencies from UN-L Science Education General Competencies. “Open competence” put forward by the study group meeting on science curriculum and instructional materials development (UNESCO, BANKOK, in NOV 1981,) recommended skills/competencies considered essential for the science teachers at lower secondary stage. It is essential for the science teachers to practise Competencies / skills. (Harlen, W New Trends in Primary School Science Education, Vol I, Paris UNESCO, 1983)

Validation of Tools

The investigator on the basis of review of related studies and correlates on competency in teaching science, identified that metacognition and motivation influences competency in teaching science. Hence the investigator decided to measure the effect of metacognition and motivation with their respective tools.
Besides the investigator administered the scale to measure the competency in teaching science. The validated tools used are the following:

1. Metacognition assessment scale developed and validated by the Investigator.
2. Achievement motivation Scale (Beena Shah, 1986).
3. Competency in Teaching science developed by the Investigator.

To construct a tool, there are several factors to be kept in mind. The factors include the area, the age group, and the grade for which the test to be developed. The following are the important factors.

**Planning**

When constructing a tool the limitations under which it is to be developed should be considered. This includes the purpose of the tool, time, nature of the sample, cost and resources at the disposal of the researcher etc.

The preliminary draft should be prepared, it contains double the items needed and it should be edited. A small group try-out helps the researcher to get the indices of the difficulty and discrimination quickly for selecting good items for the final test.
Item analysis

The item analysis is important for the improvement of the total score reliability or total score validity or both. The final draft should be prepared and the selected items are included which will be administered to sample.

While constructing the tools the purpose of the tool, the language and the length of the tool should also be taken care of, considering the above facts the tools were constructed.

Content validity

Refers to the degree to which the test actually measures, or is specially related to, the traits for which it was designed. Content validity is based on the careful examination of course text book, syllabi, objectives, and subject matter specialists, often assessed by panel of experts in the field who judge its adequacy.

Reliability

A test is reliable to the extent that it measures whatever it is measuring consistently. Reliable tests are stable in whatever they measure and yield comparable scores upon repeated administration. The reliability or stability of a test is usually expressed as a correlation coefficient. The reliability of the tools was established by KR 20 method. The reliability
of the questionnaire of metacognition is 0.72 the motivation is 0.33 and the competency of teaching science is 0.65.

4.15.3. PHASE-III

CONDUCTING PRE TEST

Pre-Assessment Tool of Metacognition

The pre assessment level of metacognition of student teachers is assessed through a questionnaire which contains 50 items under three major headings Planning, Monitoring, and Evaluation.

Scoring

The presence and absence of behaviour are marked in the form of yes or no. The score for the presence is ‘1’ and the absence is ‘0’. This questionnaire helps to identify the presence of the metacognitive behaviour among the subjects.

Achievement Motivation Scale

To measure the level of Achievement Motivation, the investigator used the Achievement Motivation Scale (AMS) constructed and validated by Beena Shah (1986). This scale included 4 dimensions, need for academic success, need for vocational achievement, need for social achievement, and need for skill achievement. Each dimension has 10 items. Each item has three alternatives (A,B,C) to choose.
**Scoring**

The achievement Motivation Scale is a three point scale, consisted of 40 items. Each statement is followed by three alternative responses. Weightage of 1, 2, 3 are respectively awarded for alternatives (a), (b), and (c) irrespective of any statement. Thus the scale value lies between 40 and 120 (33-100 in percentage). The co-efficient of reliability are varying with time intervals between 0.77 to 0.87. The validity of the scale was ascertained in a three fold fashion: content validity, item validity and congruent validity. The investigator also established reliability by KR 20 method and it was found to be 0.33.

**Construction of Scale to Assess Competencies in Teaching Science**

Competencies/Skills in teaching science profile was developed by the investigator to measure the skills used in the classroom. The rating scale of competency in teaching science indicates the adequacy and appropriateness of the occurrence of the skills. The investigator identified 12 competencies that have 45 skills which are essential to promote competency in teaching science.

**Scoring**

The rating scale was prepared with five points as below.

- To the maximum extent - 5
- To greater extent - 4
- To some extent - 3
Motivation Intervention Strategies to enhance Competencies in Teaching Science
Baskar Model

Input Components of Motivational Strategies
- Competence Motivation
  - Positive self views
  - Internal Locus of control
- Self Perception
- Strategic awareness
- Self Evaluation
  1. Self efficacy
  2. Self Competency
  3. Locus of Control
  4. Self responsibility
- Direct Instruction of intervention strategies
- Self Management skills
  1. Planning
  2. Monitoring
  3. Regulating
  4. Evaluating
- Self Managed learning
- Self Control in Learning

Processes Interventions
- Attention, interest, arousing, intrinsic motivation
- Creativity, Novelty,
- Self views, self Perceptions,
- Self standards,
- Self reinforcement
- Self efficacity, self esteem, self criticism, self correction
- Self -worth, self reward
- Self evaluations of Understanding
- Self evaluation of competence
- Awareness of process of learning

Enhanced performance in competencies /skills
- Science Process Skills
- Instructional skills
- Information process skills
- Decision making skills
- Knowledge skills
- Facilitator
- Attend to Individual differences
- Communication skills
- Planning skills
- Evaluation Skills
- Human relation
• To the minimum extent - 2
• Not at all - 1

There were 45 items in the questionnaire. Thus the scale lies between 45 and 125 (more than 7 percentage). The validity of the scale was established by content validity. The content validity was established by consulting teacher educators in various DIETs. The investigator established the reliability by KR 20 method and it was .65 which was found to be significant.

4.15.4. PHASE-IV
TRAINING ON METACOGNITION AND MOTIVATION STRATEGIES

Studies show that metacognitive strategies increase learning. Direct teaching of thinking strategies may be useful, and that independent use develops gradually. Recognizing, and applying in practice, metacognitive strategies, will help students solve problems successfully. The investigator gave instruction on the following topics:

• Basic metacognitive strategies
• Strategies for developing metacognitive behaviours
• Strategies for enhancing memory
• Strategies for science teaching
• Metacognitive training strategies
• Motivational strategies
Five characteristics of a good strategy user are (1) a broad repertoire of strategies, (2) metacognitive knowledge about why, when, and where to use strategies, (3) a broad knowledge base, (4) the ability to ignore distractions, and (5) automaticity.

**Baskar Model of Metacognition and Motivation Interventions**

**Strategies to enhance Competency in Teaching Science.**

Interventions included various combinations of metacognitive knowledge, self-regulation, and/or motivation. Some contained one component; others included several components.

The investigator developed a model to Science Teachers that describes how to sequence strategy instruction involving metacognition and motivation strategies, and use peers and tutors whenever possible. The Investigator used Nine-step sequence of strategy instruction for science teaching.

**Step-I**

**Teaching Strategy Explicit Instruction**

It involves the discussion and explaining the value of Science Teaching strategies. Students should understand why they are being asked to learn strategies, what instruction will be like, and how they will use them.
Introduce only a few Science Teaching strategies step by step. Students can be overwhelmed easily. The best chance of teaching students general strategies that are useful to them is to limit the number taught to two or three over an eight- to ten-week period of instruction. This time affords students a chance to acquire the strategy, practice it, and become somewhat automatic.

Explicit instruction occurred in the majority of the interventions designed to increase metacognition directly or to induce metacognition indirectly. Direct interventions taught metacognitive components (e.g., the usefulness of a strategy, task demands) explicitly, whereas indirect interventions taught cognitive strategies (e.g., summarize, predict) explicitly with the assumption that the strategies would, in turn, enhance metacognition. The metacognition strategies taught are goal setting, meta attention, memory strategies, encoding, summarizing, predicting, and planning, etc.

Developing a Strategy Teaching Plan comprises the following steps:

- Teaching each strategy first in familiar contexts.
- Introduce only one new strategy at a time.
- Allow the new strategy to be consolidated before introducing the next one.
- Giving time for students to see the value of the strategy.
• Revising the earlier strategies regularly.

• Integrate the new strategy with existing strategies, to decide when and how to use.

• Allowing students to practice and remembering them.

Step-II
Model strategy by Teacher

Even when students understand why they are learning a strategy and how to use it, they need to see the strategy modeled by a teacher or other expert. Modeling should include at least two components how the strategy is used in a variety of settings to accomplish different learning objectives, and why the teacher uses the strategy.

Modeling refers to the process of intentionally demonstrating and describing the component parts of a skill to a novice student. Modeling works because it provides a great deal of explicit information about a skill and raises the novice's expectations that a new skill can be mastered. Teacher models are important as well. Often, the teacher is the only person in the classroom who adequately model a complex procedure.

There are a number of ways to model a new skill other than teacher-directed instruction. One method is reciprocal teaching, in which two to four students work in cooperative learning groups. Teachers modeled by explicitly and overtly 'thinking aloud' the steps for
performing a strategy. Modeling-plus-explicit instruction or specific feedback to be more effective than modeling alone for diverse learners. Motivational strategies used in the modeling are novelty, and creativity.

**Step-III**

**Interaction between trainees and teacher**

A common assumption of metacognitive instruction is that interaction induces the social construction of metacognition. For example, teacher dialogue that includes how to do a task and providing feedback to students' responses facilitates understanding of the purpose of a task and execution of a strategy. Additionally, discussions between students provide opportunities for metacognitive exchanges. Metacognitive strategies used are reviewing and reflection by students and teacher. Motivational strategies like self views, self perception are more appropriately used.

**Step-IV**

**Peer Modeling**

Peer models are usually the most effective because they are most similar to the individual observing the model. Metacognitive strategies used are the reciprocal teaching, seeking peer assistance, and comparing. Motivational strategies are self standards of the trainees.
Step-V

**Guided practice**

Continued practice over an extended period. Plan on six to ten weeks for instruction, modeling, and practice of a new strategies. Periodic follow-ups are helpful to ensure that the strategy is being maintained. Students require adequate time and practice to increase metacognition. Guided practice provides students repeated opportunities to practice procedures of a strategy under teacher supervision. Monitoring and regulation of strategies are followed. Motivational strategy used in guided practice is self reinforcement. Reinforcement of learning is stressed for the trainees.

Step-VI

**Automaticity**

Students are most likely to think metacognitively when the lower cognitive skill became automated. The strategies became associative mechanisms which operate without conscious effort. It involves processes such as review, reflection, and deliberation.

**Review**: to look over, examine, or study past experiences.

**Reflection**: to reflect personal skills and past experience to a current task.

**Deliberation**: to consider the thoughtfulness of current actions and decisions.
Automaticity was acquired through strategies like rehearsal, more exercise, repetitions etc. Motivational strategies used are self-management skills like Planning, Monitoring, Regulating, and Evaluating. Trainees gain Self-confidence when strategies become automatic and Self-control over learning is achieved. Self-control of learning is the motivation to learn. We need to understand what makes up the skills and will to maintain motivation and use appropriate strategies. The self controlled and self-motivated learner is one who can plan, regulate, and evaluate his or her own skills and strategies. Strategic behaviour involves intentionality and self-control. They combine skill and will to accomplish a goal.

Step-VII
Providing Systematic feedback

Provide feedback to students about strategies. One way for teachers to share their expertise with students is to provide feedback about how, why, and when to use strategies. This information helps students evaluate strategy effectiveness, that is, whether it has made a noticeable improvement on performance or has increased efficiency.

Feedback is an essential part of the modeling process. Feedback refers to explicit information provided to students about the process and products of their work. Feedback provided to students directly from the teacher improves both performance and self-efficacy. Students providing
feedback to other students appears to be equally effective in many situations. Self-generated feedback also plays an important role in learning; it enables students to self-regulate their performance without teacher or peer-model assistance.

Diverse learners require considerable practice with feedback to increase metacognition. In addition, feedback should be specific, carefully planned, and timed.

Feedback specifically linked success in answering questions to strategy use (i.e., strategy-value feedback) and included re-explanations and re-instruction as needed. In addition to teachers, peers provided feedback that included encouragement and corrections.

Another common feature was the timing and distribution of feedback. Across interventions, teachers provided feedback at different intervals. Interventions included a range of one to several metacognitive components in various combinations making it difficult to determine which components or combinations of components are benefited. Interventions included: self-regulation only, a combination of metacognitive knowledge components (e.g., usefulness of strategy, task demands, usefulness of prior knowledge, when to use a strategy) or a combination of metacognitive knowledge and self-regulation strategies like error detection, self correction, practice may be used. Ultimate
motivational components like self efficacy, self esteem, self criticism, and self correction are developed.

**Step-VIII**

**Full fill Objectives**

Student teachers has to check for the fulfillment of Objectives by checking and rechecking. Self management skills are developed through above model. The motivational strategies like self-reward, self-worth were helpful in achieving the objectives.

**Step-IX**

**Evaluation**

Self-evaluation is the final step of the model. Testing and self-assessment are the metacognitive strategies used to evaluate the trainees. The motivational strategies like self-appraisal increases the self evaluation of the trainees.

**4.15.5. PHASE – V**

Training was given in first three competencies in Science using the training model. They are knowledge, facilitator, and Instructional competencies.

**Knowledge:** The science teacher understands the central concepts of science, tools of inquiry, and structures of discipline and create
learning experiences that make science personally, vocationally, and academically meaningful and relevant to students.

**Facilitator:** The Science teacher understands that children construct meaning and can provide learning opportunities that support, their intellectual, social, and personal development.

The teacher should know how learning occurs and is facilitated. All students come with diverse ideas, and skills. Students misconceptions or naïve conceptions and experiences which shape learning.

**Training in Instructional Competencies**

**Lesson Preparation**

The training was given to the trainees based on the training model on instructional competencies as below

A major task of the science teacher is lesson preparation. A successful performance of this task demands the use of skill which the teacher is expected to learn. Already the trainees are aware of the preparation of the lesson plan they were suggested to follow the strategies given below

a) Selecting a topic from a real life situation

b) Stating objectives of the lesson.

c) Selecting strategies and resources to use in teaching the lesson.
d) Writing a plan for a science lesson.

e) From the list of teacher competencies/skills, which of them the teacher uses to pursue the lesson.

f) From the list of teacher role which role the teacher is going to perform

g) Topic for teaching.

The objectives of each lesson must be stated explicitly in terms of learning outcomes. Lesson objectives can be stated in terms of competencies /skills (e.g., Science Process skills like observe, predict, hypothesise, infer etc). Lesson objectives can be stated so as to include the teaching strategies (e.g., to design an experiment, project, etc). The objectives may be cognitive, affective, or psychomotor.

**Cognitive Objectives:** development of refinement of knowledge, and acquire of knowledge.

**Affective Objectives:** which concern with feelings, interests, appreciations, attitudes, and values.

**Psychomotor Objectives:** those intended to develop and refine action, motion and behaviours.

To include metacognitive activities, the investigator asked the Trainees to Self-question the students needs during the preparation of a lesson. The sample questions are,
a) How did I make my strategies more suitable to students?
b) How did I provide for the development of skills in students?

c) How did I provide for the development of thinking skills to students?

d) How did I provide for attitude and value development of students?

e) What skills do I need to do all the above?

f) What role do I perform in taking into consideration numbers a-d?

Discussions on the following headings were conducted by the investigator and the trainees, for the selection and usage of strategies:

- What strategies and resources you will use in teaching lesson for chosen topic?
- What strategies fit the objectives and resources?
- Focus on strategies that develop science process skills, decision making skills, information processing skills, attitudes, values, whenever possible.
- Are the strategies you have chosen for your lesson suitable? How can you tell?
- Are the resources to be used with the strategies are appropriate?
- Focus on resources available within the community
- Resources include teaching aids, equipments, and references etc.
• What skills are needed to choose the appropriate strategies and resources for your lesson?

• What role is performed while selecting a particular strategy and a resource?

The trainees write the objectives, strategies, and resources identified and write a lesson plan and arrange them as follows with all their details.

| Topic | Objectives | Concepts/subconcepts | Procedure/strategy | Methodology | Resources |

The trainees consider the following strategies while selecting the resources to teach in the science classroom, which refers to all the materials to be used in teaching the lesson. It includes charts, maps, instruments, equipments, chemicals and other consumable materials, films, videos, tapes, transparencies, and reference.

• The age level of the students, for which the resources will be used.

• The sufficiency of the resources to motivate and maintain the interests of the students.
• Whether the use of the resources will help in developing the science ideas and objectives aimed for.
• Whether resources will be easy enough to use under the classroom conditions available in the school.
• Weather it is possible to allow students to handle and operate/manipulate/use these resources.

Lesson Presentation

The following strategies are used during the training model.

Use of Motivation: During presentation, engage the student’s interest from the beginning to the end of the class, continuous motivation should be given throughout activities, rewards, reinforcement, encouragements, use of equipment, teaching aids, stimulating verbal interaction in class. Trainees used motivational Strategies in motivating students to perform activities and tasks relevant to learning.

Supervising Students Activities: The science class room should always be with lots of activities either by teacher or students or both. Science teacher should know how to supervise students activities in the science classroom.

• Provide activities for learning.
• Safety and well being of the students are provided.
• Materials and equipments are correctly used to prevent breakage and wastage.
The following activities are suggested by the investigator.

- Briefly describe the activities that students will perform during the lesson.
- State the reasons for choosing the activities.
- Identify the competencies/skills needed to supervise student performance on the activities.
- The roles performed by the teacher when supervising the student activities.

**Conduct Interactive Session**

Conducted interactive session in the classroom with the students by the trainees, using the motivational strategies such as self-views, self-perceptions, reward, self-reinforcement. The Trainees conducted Interactive sessions with students which are largely verbal. Both students and teacher talk, exchange ideas, views, refine, modify, reinforce, and restate each other idea. Science ideas are interacted by teacher and students. Teacher tactfully and affectionately encourages the shy and reticent students to share their ideas. No single person monopolies the session. A summary of main points discussed can reinforce students learning. A resource person can be invited to share his/her expertise opinion on the subject.
**Metacognitive activity**

The trainees involved in self-reflection as follows

- What science ideas are expected to be brought out of the interactive session?
- What procedural matters concerning the strategy used would need further discussion?
- What kind of learning outcome is to be expected from the interactive session?
- What skills are to be developed in conducting the interactive session on the chosen topic?
- What roles are performed by the teacher in carrying out the interactive sessions on the chosen topic?

**4.15.6. PHASE – VI PROGRESSIVE TEST**

Progressive test I was conducted after the training the above three competencies.

**4.15.7. PHASE – VII**

During this phase training was given on the next three competencies i.e. science process skills, information processing skills, and decision making skills. The science teacher has to develop skills in conducting experiments in the laboratory, projects and arrive at
conclusions to submit reports, following strategies were used during the experiment sessions.

**a. Conducting Peer Discussion**

Discussion to be conducted before the experiment among trainees guidance of investigator. Questions prepared in advance to start discussion. A discussion is meant to stimulate thinking on the experiment to be conducted.

**b. Experimental Session:** The trainees need to develop rational thinking, scientific methods of analysis and arriving results they need to apply these in their real life situations with full awareness of short and long term consequences.

**c. Strategies suggested:** Observation, inquiry, predicting, hypothesis forming, inferring, gathering data, skill in handling apparatus, reporting are strategies suggested to the trainees.

Competencies and skills most needed during the experimental session are,

**Science processing skills:** communicating, interpreting data and making conclusion.

**Information processing skills:** identifying, locating and utilizing information, classifying, analyzing, and utilizing relevant information
searching for ways to understand scientific information from primary sources. Always update oneself on scientific and technological information, as well as information in other areas.

**Decision making skills:** Selecting reliable information and classifying values, ethics, Identifying alternatives, Predicting the consequences of each alternative, Weighing the pros and cons of each alternative ordering the alternative, Taking actions consistent with the stated values, and Accepting possible consequences of the actions taken.

d. Reflective Thinking Session

Upon completion of the experimental session, reflective thinking session is required as a follow up activity. It is assumed that the teacher trainee now has acquired competencies and skills required for development of scientific attitudes, values and ethics. The trainees are asked to do some reflective thinking on the following metacognitive activities:

- What competencies are required, from the beginning to the end of experimental session?

- To what extent does the experimental session, help you develop scientific attitudes, values, and ethics?

- At this point the investigator may need to provide explanations and examples concerning such competencies and skills. Moreover, the
trainees may need to be given more exercise to practice such competencies and skills.

- The teacher trainees should discuss among themselves with guidance of teacher educator about strategies/activities to be used in real classrooms in order to bring about the development of scientific attitudes, values, and ethics.

- Present after discussion and reflection, a view of the interplay of competencies and skills needed to develop the scientific attitudes, values.

- Planning and development of strategies/activities for children.

- Relate the competencies and skills to strategies and activities with scientific attitudes.

- Acquire skills in developing feelings of concern and social responsibility in children.

4.15.8. PHASE-VIII PROGRESSIVE TEST II

The progressive test II was conducted on the above three competencies on teaching science, and progressive assessment of metacognition was conducted.

Progressive Assessment Tool of Metacognition

Out of many dimensions of Metacognition 50 items are selected. Based on these dimensions a questionnaire was framed which could be assessed using three point scale. The presence and the degree of presence
are analyzed in terms of greater extent, some extent, and not at all, the weight age given are 2, 1, 0.

4.15.9. PHASE –IX TRAINING

Training was given in the next five competencies they are integrated skills general competencies (individual differences, communication, human relationship, and evaluation)

**Individual differences**

The training was given to student teachers as to how students differ in their approaches to learning and creates instructional opportunities that are adapted to diverse student needs, including, gender, cultural, disabilities, aspirations, interests in science.

**Human relationships**

Awareness in human relationship are given by the investigator. Science teachers should be aware of understanding of values, and lifestyles. Science teachers should have the ability to recognize and deal with sexism, racism, prejudice, and discrimination, and impact of such biases on interpersonal relations. The respect for human dignity and individual rights. The ability to translate knowledge of human relations into attitudes, skills, and techniques which result in favorable experience for students.
Evaluation

Evaluation of Class Room Students on their personalities

Training on various types of evaluation was given to student teachers.

The trainees were asked to evaluate students through observations like what to observe (event), whom to observe (individuals), when to observe (short period), and how to observe (check list notes). The following scientific attitudes of the students were observed:

Rationale

Always provide reasons or evidence to support ideas.

Judgment is usually based on information.

Open-mindedness

Accept other people's ideas that are different from one's own.

Willing to change one's idea if more information is provided.

Willing to listen to others.

Honesty

Sincerity of observation, accuracy, commitment all combine together to indicate the honesty of effort or activity.

Social responsibility

Think collectively (always take into consideration the factors concerning community or group).

Take action (if needed) for the benefit of community/society/group.

Concern for others.
Belief and apply process of science

Recognize the value and importance of the process of science (scientific method).

Apply process of science in daily living (tackle problems systematically).

The trainees were asked to do Observation of student activities in the areas of Field work, Science process skills, Teaching strategies, Experimentation, Group discussion, Assignment, Project, and Follow up activities. Based on the above observations a check list was prepared in terms of students participation.

Evaluation of Instructional methods and behaviours in science Classroom

The goal of pre-service teacher training is to have the trainee teachers gain competencies in teaching. An evaluation of the classroom practices is a way to investigate the teachers competency and skills as applied in teaching. This could be done by peer-group teaching, teaching practices and teaching demonstrations. Responses could be obtained from the teacher trainers, peers, classroom students and even from the trainee through self-evaluation.

Evaluation of the trainees classroom practices can be made by using a checklist on types of instructional methods applied by the trainee
together with observation questionnaires on teachers and students behaviours in the science classroom. The types of instructional methods used are Question – answer methods, lecture method to the whole class followed by questions from individual students, all students do the assignment. The class is divided in to small groups who work together on same assignments or different assignments including practical/laboratory work, presentation of audio-visual materials to the class, and the whole class goes on a field trip or excursions in connection with the science programme visiting industries, botanical gardens, zoological parks, or scientific important places.

**Evaluation of Teacher behaviors in Science Classroom**

The investigator has noted the following behaviors of the trainees in the science classroom.

- At the start of each science lesson, the teacher reminds the students about the work they covered and concepts and ideas learned during the previous lessons.
- At the end of science lesson the teacher gives a summary of what was learned in the lesson.
- The students are allowed to make their own choice of science topics to study.
- The teacher uses students ideas and suggestions when planning science lessons
• The teacher does demonstrations to help explain scientific ideas.
• The teacher makes science lessons interesting for students.
• The science teacher helps students who have difficulties in learning science.
• The teacher explains the science that the student is learning and relates to their own life.
• The teacher discusses possible careers in science with the students.
• When students do experiments, the teacher provides them with problems to solve and then leaves students to work out their own methods and solutions.

Students behavior in the Science Class room

The trainees were asked to note the behavior of the students as below.

• During science lessons the students copy teachers notes from the blackboard.
• For science home work students prepare reports of their laboratory and practical work.
• Students have tests on what they have learned in science.
• Students do field work outside the classroom as part of their science lessons.
• Students do practical work as part of their science lessons.
• The science class is divided into small groups of students to do practical work.
• When students perform experiments, the teacher gives instructions about what to do.

• When students perform an experiment, they use a practical book or other written instructions on how to perform it.

• In their practical work, students identify their own problems and then the teacher helps them to plan experiments to solve problems.

• In their practical work, students identify their own problems and work out their own methods to investigate the problems.

4.15.10. PHASE-X PROGRESSIVE TEST III

The progressive test III was conducted on the last four competencies in science.

CONDUCTING POST TEST

Post Assessment Tool of Metacognition

To assess the level of the metacognition of the subjects after the treatment the self report of the subjects is used as the tool. The subjects were requested to give a self report about how they learn and to what extent they made use of the metacognitive principles while learning. The subjects were asked to write freely how they were useful. Out of fifty items of metacognition from their self report the presence and the degree of use of the metacognition behaviour and absence of the behaviour were...
measured using the two point scale, yes or no all with scores of 1, 0.

**Post assessment tool for the Achievement Motivation**

After the experimentation was over the same tool used for the pretest was used to conduct post-test for Motivation.

**Post assessment tool of Competency in teaching science**

The same tool used for the pre test to measure Competency in teaching science was used for the post-test also. Competencies/Skills in teaching science profile was developed by the investigator to measure the skills used in the classroom. The rating scale of competency in teaching science indicates the adequacy and appropriateness of the occurrence of the skills. The investigator identified 12 competencies that have 45 skills which are essential to promote competency in teaching science.

**Scoring**

The rating scale was prepared with five points as below.

- To the maximum extent - 5
- To greater extent - 4
- To some extent - 3
- To the minimum extent - 2
- Not at all - 1
There were 45 items in the questionnaire. Thus the scale lies between 45 and 125 (more than 7 percentage). The validity of the scale was established by content validity. The content validity was established by consulting teacher educators in various DIETs. The investigator established the reliability by KR 20 method and it was .65 which was found to be significant.

4.16. SCHEME OF DATA ANALYSIS

The relevant data obtained from the pre assessments, progressive assessments and post assessments of all the three variables metacognition, motivation, Competencies in teaching science, were analysed using the following statistical techniques.

a. Descriptive Analysis

Descriptive statistical analysis limits generalization to the particular group of individuals observed. No conclusions are extended beyond this group, and any similarity to those outside the group cannot be assumed. The data describes one group and that group only. Descriptive analysis provides valuable information about the characteristics of a particular group of individuals on the variables. In descriptive analysis mean and standard deviation were calculated for all the pretest, progressive test and post-test scores to determine the central tendencies and dispersion of variables.
In the present investigation, the number of students by the components in the entire pretest, progressive test and post-test were tabulated. The mean and the standard deviation were calculated and described.

b. Correlation Analysis

Correlation is the relationship between two or more paired variables or two or more sets of data. The degree of relationship is measured and represented by coefficient of correlation. In this study the relationship between metacognition and motivation, motivation and competency in teaching science, metacognition and competency in teaching science were correlated.

Partial and multiple correlation analysis are used to analyse the interrelationships among the correlated variables like metacognition, motivation, and competency in teaching science. Partial correlation between competency in teaching science and metacognition, competency in teaching science and motivation were calculated to find out the influence of third variable. Multiple correlations between competency and metacognition, motivation at various phases were calculated to find out the combined effect of metacognition and motivation on competency in teaching science.
c. Differential analysis

This analysis involves determination of statistical significance of difference between the pretest and post-test scores with reference to selected variables. It involves Correlated ‘t’ test. In the differential analysis the researcher makes inferences involving determination of the statistically significance of difference between the pre test, progressive test and post test scores with reference to the selected variables. ’F’ Test, ‘t’ test, Wilcoxon signed rank test were used to analyze the significant difference between the pretest, progressive test and post test scores.