Chapter - IV

Research Procedure
Chapter IV

RESEARCH PROCEDURE

4.1 INTRODUCTION

Designing the research is planning the methods and procedures of the study. It forms a vital part of the research because it describes in detail about statement of the problem, objectives, hypotheses, sample, method, data gathering devices, selection of instructional topics etc. related to the problem. The researcher framed her research design to be suitable to the problem of her study.

According to Joyce, B. and Weil, M. teaching models are just instructional designs. They described the process of specifying and producing environmental situations, which cause the student to interact in such a way that specific change, occurs in his behavior. This teaching differs from general approaches because they aim at the specific instructional objectives while general approaches to teaching are used in all situations.

Based on review of literature it can be concluded that the ‘model’ means ‘the planning of technique with the help of which the educational objectives can be achieved’. It is a blue print or necessary guidance to the teacher to achieve the predetermined objectives such an engineer has to seek the help of a model or map to complete a project. The Inductive Thinking Model involves the concept formation, interpretation of data and application of principles through the process skills of classifying, labeling, interpreting, inferring and applying etc.

The physical geography at upper primary level comprises of physical factors such as geographical landmark, climatic conditions, factors of climate, natural vegetation, cause and effect relationship between man and environment. Geography
teaching aims at developing geographical concepts among the students to understand their principles in their life. Hence a suitable topic was framed and stated below:

4.2 STATEMENT OF THE PROBLEM

"Effects of Inductive Thinking Model on Concept formation Logical reasoning and Styles of thinking through the teaching Physical geography at Upper primary level".

In this study, the researcher has chosen Inductive Thinking Model, postulated by Hilda Taba. It is one of the modern models of teaching and its innovative approach to manipulate thinking skills and forming concepts were experimented and developed among the students of American classrooms. Though, evidences are available to prove the efficacy of this model, the effect of it in rural classrooms of India is yet to be established. Further, geography teaching at Upper primary level through this model has also to be found out through this research.

The selection of Students Standard VII at their adolescence age to improve their thinking skills and forming the geographical concepts become imperative in this study. Every teacher tries to help their students to achieve high scores in their academic subjects. For this, they use various technologies in education. Thus, the present researcher has also interested to enhance the achievement of geography through this innovative technique, ‘the model of teaching’.

4.3 OPERATIONAL DEFINITIONS OF THE KEY TERMS:

It is imperative to define operationally, the specific terms used in the study:

4.3.1 Inductive Thinking Model of Teaching

Models of teaching are prescriptive teaching strategies having specific instructional objectives. They are structural, logically consistent, and cohesive and
lucidly described alternative patterns of teaching. These are meant for creating environment and they provide specifications for constructing learning situations. The teachers can model their behavior upon these models in a coherent manner. “A model of teaching is a plan or pattern that can be used to shape curriculum to design instructional materials and to guide instructions”.

**Inductive Thinking Model**

Induction is “making general laws from knowledge of particular cases”. Hilda Taba’s Inductive Thinking Model envisages teaching through certain cognitive task. Its tasks induce students to find and organize information, to create names for concepts and to explore ways of becoming skillful at organizing information and conforming hypothesis and describing relationships among sets of data (Bruce Joyce, 1990).

Inductive Thinking Model requires the students to predict consequences, explain unfamiliar data or hypothesis and then attempts to create Inductive Thinking among children. This requires them to explain predictions, verify situations conditions that would verify them carefully squeezed content and suggested learning experience from the basis of information to precede inductively (Naresh Kumar Gupta, 1997).

In this present study, Inductive Thinking Model has been taken in a true sense as mentioned by Hilda Taba lor classroom teaching of physical geography by the researcher.

**4.3.2 Concept formation**

“Concept formation is the name given to the process by which an individual comes to develop mental categories, which will allow objects and events to be classified and grouped together” (‘Peter Stration’ and ‘Nicky Hayes’).
“Concept formation is a basic higher order thinking skill and that all other analytic and synthetic skills depend on the development of the distinctions that result in categories” (Joyce and Weil).

In the present study the researcher has taken the term ‘Concept formation’ for forming the concepts of Physical geography among Standard VII students through the concept formation strategies such as Enumeration, listing, grouping, labeling and categorizing the data, as dealt by Hilda Taba in her Inductive Thinking Model.

4.3.3 Logical Reasoning

Logic is a set of rules by which conclusions can be reliably deduced from initial statements (propositions). “Logic has been of interest in psychology, because it can be regarded as perfect reasoning and is therefore a starting point for analyzing how people reason” (Dictionary of psychology).

“Logical reasoning is coherent thought which is different from imagination. It is the problem solving process by which children associated with cognitive operations, that is rational functioning by integral mental faculty” (S. S. Mathur).

“Reasoning may be inductive or deductive. Inductive reasoning is concerned with giving simple postulates, truth, and principles, while deductive reasoning concerns testing well-framed hypothesis systematically, and arriving at solutions logically. Deductive reasoning leads to simple principles through experimentation in new situations. Unsolved problems always remain linked with reasoning ability” (Gupta, 1997).

In the present study, Logical-reasoning ability has been studied as one of the cognitive processes that related to logic and soundness of the mind, the way a person could think and act logically and objectively or rationally. The researcher finds the Logical reasoning ability of Standard VII students through the teaching of teaching of physical geography concepts.
4.3.4 Styles of Thinking

"Thinking styles are preferences in the use of abilities not abilities themselves" (J. Sternberg, 1999).

People think that about anything they do so, with preference to a specific style. Each style encompasses a set of strategies, which are employed regardless of the situation. Most people show a marked preference for a single set of strategies. A smaller percentage employs a combination of two or more. Understanding of one's own thinking style and others would promote better communication with each other. "Styles depend upon cerebral dominance of an individual in retaining and processing different models of information in his own style of learning and thinking. Styles indicate the hemispherity functions of the brain and the students learning strategy and information processing, based on the preferences of the brain area" (D. Venkataraman, 1990).

In this study, style of thinking is taken to focus the teacher's attention on students' favored thinking styles before imparting the subject matter and to find out the change in students' styles of thinking after imparting physical geography concepts through Inductive Thinking Model. Since styles are measurable and teachable, thinking styles of students are undertaken in this study. The dominants of brain hemispherity such as the Left dominance (L), Right dominance (R) and Whole dominance (W) are taken into consideration for the study of students' styles of thinking.

4.3.5 Awareness to Nature of Knowledge

"Knowledge is the awareness and understanding of facts, truths or information gained in the form of experience or learning or through introspection. It is an appreciation of the possession of interconnected details, which in isolation are of lesser value" (Jonathan Dolhenty).
By considering the age Students of Standard VII, the researcher integrates the Nature of knowledge; Bloom’s Taxonomy and Inductive Thinking Model in order to enable the students to use both Inductive and Deductive Thinking in Information processing. The ability to recall the facts, to identifying the information, restating the material in their own words, reorder ideas, ability to apply their knowledge into real situation, the ability to analyze material and to bring new ideas or theory are considered to be the awareness to nature of knowledge. The students’ ability on the above are measured in this study.

4.3.6 Sensitivity to Language

The sensitivity is ‘Response to stimulation of the senses’, ‘heightened awareness of oneself and others with in the context of personal and social relationships’ and ‘readiness and delicacy in recording changes’ (Dictionary of Psychology).

The researcher considered the sensitivity to language as the response of the students to the language while teaching physical geography through Inductive Thinking Model in her study. Students’ response to the meaning of geographical terms, items of reference, items of difference, coining new terms and applicability of terms are selected for measuring Sensitivity to Language of the students of Standard VII.

4.3.7 Physical Geography

Geography today covers vast field and comprised many branches of scholarship in its fold. The immensely interesting Physical geography is one of the branches of geography, which comprises the governing scientific laws and principles on Lithosphere, Hydrosphere and Atmosphere of Earth, and Earth as Biosphere. ‘It further divides into Climatology, Geomorphology, Biogeography and Medical geography. ‘Climatology’ is meant for the study of general conditions of a place as regards its temperature, the distribution of temperature, Atmospheric
pressure, the character and direction of winds, moisture and precipitation. The whole super structure of the discipline of geography is built upon the physical geography" (O.P. Varma and E.H. Vedanayagam).

In the present study, lithosphere, atmosphere and the concepts of temperature in climatology of physical geography are taken for teaching in this study. Concepts from the lessons of Standard VII geography textbook published by Tamil Nadu Text book Corporation are taken for teaching physical geography.

4.3.8 Upper primary level

The standard vi, vii and viii are usually called as upper primary classes. According to Piaget, formal operational stage of the children between ‘eleven to fourteen years’ of age forms Upper primary level. Piaget began to find consistent systems with in certain broad age ranges. Each the four major stages sensorimotor, pre operational, concrete operations and “formal operations, is the system of thinking that is qualitatively different from proceeding stage. Each stage is a major transformation in thought processes, comparing to the proceeding stage. Each child goes through each stage in a regular sequence. Children cannot overcome a developmental lag or speed up their movement from one stage to the next. They need to have sufficient experience in each stage and sufficient time to internalize that experience before they can move on. Our main concern as educators is to understand the major substance of each stage. Only then, what to teach and how to teach could be established” (Spring Thall (1990), Educational psychology: A developmental approach).

In this study, the Standard VII upper primary students are selected as sample because they come under formal operational stage, where the children tend to think about what it is; and have a direct connection to the process of reading development. When the potential for abstract thinking is developed, students are able to attain logical, rational and abstract strategies of symbolic meanings, metaphors and upper
primary students can now understand similes. Therefore, the upper primary students can understand abstract concepts of physical geography at this formal operational level.

4.3.9 Academic achievement

Academic achievement refers to the academic grades or scores assigned by the teachers on standardized achievement test to the students. Present study is confined to geography subject and the scores obtained by the students of Standard VII are taken as their academic achievement.

4.4 OBJECTIVES OF THE STUDY

The researcher framed the following objectives, in view of the depth and extent of the problem. The study aims to measure the effect of Inductive Thinking Model on academic achievement, concept formation, logical reasoning, and styles of thinking, Awareness to nature of knowledge and sensitivity to Language through the teaching of physical geography among Students of Standard VII of upper primary classes.

The objectives of the present study are as follows:

1. To design and develop instructional plans for teaching selected units in Physical geography from amongst the prescribed course of study for the students of Standard VII based on Inductive Thinking Model.

2. To expose a group of students of Standard VII to Inductive Thinking Model of teaching.

3. To find the effectiveness of Inductive Thinking Model among Standard VII students on:
   - Academic achievement in physical geography
   - Concept formation
   - Logical reasoning
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- Styles of thinking
- Awareness to Nature of Knowledge
- Sensitivity to language

4. To find the relative effectiveness of Inductive Thinking Model over Traditional Teaching of physical geography among Standard VII students on:
   - Academic achievement
   - Concept formation
   - Logical reasoning
   - Styles of thinking
   - Awareness to Nature of Knowledge
   - Sensitivity to language

5. To find out whether there is any significant correlation between Academic Achievement and
   - Concept formation
   - Logical reasoning
   - Styles of thinking
   - Awareness to Nature of Knowledge
   - Sensitivity to language

6. To find out whether there is any significant Correlation between Concept formation and
   - Logical reasoning
   - Styles of thinking
   - Awareness to Nature of Knowledge

7. To find out whether there is any significant correlation between Logical reasoning and
   - Styles of thinking
   - Sensitivity to language
8. To find out whether there is any significant correlation between Awareness to Nature of knowledge and Sensitivity to language.

9. To find out whether there is any significant difference between ‘boys’ and ‘girls’ when taught through Inductive Thinking Model on:
   - Academic achievement
   - Concept formation
   - Logical reasoning
   - Styles of thinking
   - Awareness to Nature of Knowledge
   - Sensitivity to language

10. To find out whether there is any significant difference between high and low achieving groups of students when taught through Inductive Thinking Model on:
    - Academic achievement
    - Concept formation
    - Logical reasoning
    - Awareness to Nature of Knowledge

11. To find out whether there is any significant interaction between the effect of treatment and gender exists on Academic achievement:
    - Concept formation
    - Logical reasoning
    - Styles of thinking
    - Awareness to nature of Knowledge
    - Sensitivity to language

4.5 HYPOTHESES OF THE STUDY

Hypotheses are tentative generalization based party on known facts and explanations and partly conceptual. Formulation of hypotheses establishes the
problem and the logic underlying the research, study, and it gives direction to the data gathering procedure. It is in the light of hypotheses that the relevance of data to be collected is judged. Hence, the researcher formulated the hypotheses by the implication of the related literature and the deductive logic of the problem under investigation.

The researcher formulated the following hypotheses only as a suggested solution to the present problem, with the objective that the ensuing study might lead either to its rejection or to its retention. Based on the researcher's experience throughout her career as teacher and teacher educator and her knowledge of behavior in a school situation, the researcher attempted to relate the behavior of students to her own, to teaching methods, to changes in the school environment and so on. From these observed relationships, the researcher inductively formulated hypotheses that attempted to explain such relationships, in empirical terms. Based on the above objectives, variables, literature, and researches in related area were formulated. The following hypotheses are framed.

1. Academic Achievement of the students of Standard VII taught through Inductive Thinking Model significantly increases.
2. Concept formation of the students of Standard VII taught through Inductive Thinking Model significantly increases.
3. Logical reasoning of the students of Standard VII taught through Inductive Thinking Model significantly increases.
4. Right dominant style of thinking of the students of Standard VII taught through Inductive Thinking Model significantly increases.
5. Left dominant style of thinking of the students of Standard VII taught through Inductive Thinking Model significantly increases.
6. Whole dominant style of thinking of the students of Standard VII thought through Inductive Thinking Model significantly.
7. Awareness to nature of knowledge of the students of Standard VII taught through Inductive Thinking Model significantly increases.

8. Sensitivity to language of students of the Standard VII taught through Inductive Thinking Model significantly increases.

9. The mean scores of the students taught through Inductive Thinking Model is significantly higher than the mean scores of the students taught through Traditional method in Academic achievement.

10. There is no significant difference between the mean scores of the students taught through Inductive Thinking Model and the mean scores of the students taught through Traditional method in concept formation.

11. There is no significant difference between the mean scores of the students taught through Inductive Thinking Model and the mean scores of the students taught through Traditional method in Logical reasoning.

12. There is no significant difference between the mean scores of the students taught through Inductive Thinking Model and the mean scores of the students taught through Traditional method in Right dominant Style of Thinking.

13. There is no significant difference between the mean scores of the students taught through Inductive Thinking Model and the mean scores of the students taught through Traditional method in Left dominant Style of Thinking.

14. There is no significant difference between the mean scores of the students taught through Inductive Thinking Model and the mean scores of the students taught through traditional method in Whole dominant Style of Thinking.

15. There is no significant difference between the mean scores of the students taught through Inductive Thinking Model and the mean scores of the students taught through Traditional method in Awareness to nature of knowledge.
16. There is no significant difference between the mean scores of the students taught through Inductive Thinking Model and the mean scores of the students taught through Traditional method in sensitivity to language.

17. There is no significant correlation between the post test mean scores of Academic achievement and Concept formation of the students taught through Inductive Thinking Model.

18. There is no significant correlation between the post test mean scores of Academic achievement and Logical reasoning of the students taught through Inductive Thinking Model.

19. There is no significant correlation between the post test mean scores of Academic achievement and Right dominant style of thinking of the students taught through Inductive Thinking Model.

20. There is no significant correlation between the post test mean scores of Academic achievement and Left dominant style of thinking of the students taught through Inductive Thinking Model.

21. There is no significant correlation between the post test mean scores of Academic achievement and Whole dominant style of thinking of the students taught through Inductive Thinking Model.

22. There is no significant correlation between the post test mean scores of Academic achievement and Awareness to nature of knowledge of the students taught through Inductive Thinking Model.

23. There is no significant correlation between the post test mean scores of Academic achievement and sensitivity to language of the students taught through Inductive Thinking Model.

24. There is no significant correlation between the posttest mean scores of concept formation and Logical reasoning of the students taught through Inductive Thinking Model.
25. There is no significant correlation between the posttest mean scores of concept formation and Whole dominant Style of Thinking of the students taught through Inductive Thinking Model.

26. There is no significant correlation between the posttest mean scores of concept formation and awareness to Nature of knowledge of the students taught through Inductive Thinking Model.

27. There is no significant correlation between the posttest mean scores of Logical reasoning and Whole dominant style of thinking of the students taught through Inductive Thinking Model.

28. There is no significant correlation between the posttest mean scores of logical reasoning and Sensitivity to language of the students taught through Inductive Thinking Model.

29. There is no significant correlation between the posttest mean scores of Awareness to Nature of knowledge and Sensitivity to language of the students taught through Inductive Thinking Model.

30. There is no significant difference between the post test mean scores of boys and girls in Academic achievement when taught through Inductive Thinking Model.

31. There is no significant difference between the post test mean scores of boys and girls in concept formation when taught through Inductive Thinking Model.

32. There is no significant difference between the post test mean scores of boys and girls in logical reasoning when taught through Inductive Thinking Model.

33. There is no significant difference between the post test mean scores of boys and girls in Left dominant style of thinking when taught through Inductive Thinking Model.
34. There is no significant difference between the post test mean scores of boys and girls in Whole dominant style of thinking when taught through Inductive Thinking Model.

35. There is no significant difference between the post test mean scores of boys and girls in Awareness to Nature of knowledge when taught through Inductive Thinking Model.

36. There is no significant difference between the post test mean scores of boys and girls in sensitivity to language when taught through Inductive Thinking Model.

37. There is no significant difference between the post test mean scores of high and low achievers in academic achievement. When taught through Inductive Thinking Model.

38. There is no significant difference between the post test mean scores of high and low achievers in Concept formation when taught through Inductive Thinking Model.

39. There is no significant difference between the post test mean scores of high and low achievers in Logical reasoning when taught through Inductive Thinking Model.

40. There is no significant difference between the post test mean scores of high and low achievers in Awareness to nature of knowledge when taught through Inductive Thinking Model.

41. There is no significant interaction effect of treatment and gender on Academic Achievement.

42. There is no significant interaction effect of treatment and gender on Concept formation.

43. There is no significant Interaction effect of treatment and gender on Logical reasoning.
44. There is no significant Interaction effect of treatment and gender on Left dominant style of thinking.

45. There is no significant Interaction effect of treatment and gender on Right dominant style of thinking.

46. There is no significant Interaction effect of treatment and gender on Whole dominant style of thinking.

47. There is no significant Interaction effect of treatment and gender on Awareness to Nature of knowledge.

48. There is no significant Interaction effect of treatment and gender on Sensitivity to language.
4.6 METHODOLOGY - EXPERIMENTAL DESIGN

The main focus of the researcher in her study is to find out the effect of Inductive Thinking Model on developing Concept formation, Logical reasoning, Styles of thinking, Awareness to nature of knowledge and sensitivity to language through the teaching of physical geography among Students of Standard VII. Joyce and others (1990) stated that Hilda Taba's Inductive Thinking Model envisages teaching through certain cognitive tasks, which induce students to find and organize information, to create names for concepts and to explore ways of becoming more skillful at discovering organizing information and at creating and confirming hypotheses describing relationships among set of data. The effect of this model could be measured only through the experimental design, as the model itself involves scientific procedure. Moreover, most of the earlier researchers like Battacharya (1984), Baveja (1988), Naresh Kumar Gupta (1997) used experimental design to find the effectiveness of Inductive Thinking Model on some correlates. On following them, the researcher selected the 'Experimental Design' for her investigation to find out the effectiveness of Inductive thinking Model on some variables. Since Experimental Design provides much control and therefore establishes a systematic and logical association between manipulated factors and observed effects, the researcher framed a 'Research Design' suitable to her research with following steps as shown in the 'Research Paradigm'.
4.7 RESEARCH PARADIGM

Flowchart 3
Research Paradigm

Phase I
Design
- Formulation of Hypotheses
- Selection of Appropriate Subject
- Analysis of topics
- Selection of concepts
- Selection of sample schools
- Selection of variables
- Selection of samples

Phase II
Organisation
- Formation of groups
- Allocation of treatments
- Securing Administrative support
- Collection of Source materials

Phase III
Development
- Lesson planning
- Preparation of TLM
- Preparation of tools

Phase IV
Implementation
- Rapport with students
- Application of preset
- Administration of tools
- Application of treatment variables
- Administration of Post test

Phase V
Design
- Calculation of 't' test
- Calculation of 'r' test
- Testing Hypotheses
- Arriving at Research findings
Phase-I: DESIGN

Table 7
Table showing the Research Design of the present study

<table>
<thead>
<tr>
<th>Nature of study</th>
<th>Variables</th>
<th>Tools</th>
<th>Sample</th>
<th>Statistics used</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental study: Pre test Post test Design</td>
<td>1. Academic achievement</td>
<td>1. Achievement test</td>
<td>Control group 46</td>
<td>‘t’ test</td>
</tr>
<tr>
<td></td>
<td>2. Concept formation</td>
<td>2. Concept formation test</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3. Logical reasoning</td>
<td>3. Logical reasoning test</td>
<td></td>
<td>‘r’ test</td>
</tr>
<tr>
<td></td>
<td>4. Styles of Thinking</td>
<td>4. Styles of thinking test</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>5. Awareness to Nature of Knowledge</td>
<td>5. Awareness to Nature of Knowledge test</td>
<td>Experimental group 42</td>
<td></td>
</tr>
</tbody>
</table>

4.7.1 Formulation of hypotheses

The first step of the research paradigm was ‘formulation of hypotheses’. The researcher formulated the hypotheses, on the basis of the evidences available in the form of research reports and theories on Inductive Thinking Model, Concept formation, Logical reasoning, Styles of Thinking, Awareness to Nature of knowledge and sensitivity to language’.

“The hypotheses are a presumptive statement of a preposition or a reasonable guess, based upon the available evidences, which the researcher seeks to prove
through her study”. Hypotheses are classified as being directional or non-directional. The hypotheses that stipulate direction of the expected differences or relationships are termed as directional hypotheses, while non-directional hypotheses do not specify the direction of expected differences or relationships. The researcher formulated the hypotheses in directional form, because the directional form stipulated the direction of the difference between groups. Moreover, the hypotheses were stated in declarative form also, as the researcher made a prediction based on her theoretical formulations of what should happen if the explanations of the variables she had given in her theory were correct. The researcher carefully formulated the hypotheses following seven criteria of usable hypotheses, suggested by Traverse (1978). He stressed that Hypotheses should be:

1. Clearly and precisely stated
2. Testable
3. State expected relationship between variables
4. Limited in scope
5. Consistent with more facts
6. Stated as far as possible in simple terms
7. Amenable to testing within a reasonable time

Hence, the researcher checked her hypotheses with the above criteria to take up her study successfully through empirical testing.

4.7.2 Selection of appropriate curricular subject

The second step of research paradigm was selection of appropriate curriculum subject for the study. Usually the short-term objectives of any subject could be satisfied by the acquisition of ideas and skills taught through the relevant subject matter to the students. Long-term objectives require a child to be acquainted with basic knowledge of the subject, to develop its own observational skill to
understand interrelation between the subject and the society and to understand its concepts and theories thoroughly. These objectives aim at providing the students such types of knowledge, skills and attitudes as would develop an acceptable behavior in a democratic society in which they live. In other words, it means continuation and expansion of ideas initiated in the primary and upper primary classes. Until the end of schooling, the geography subject has as much as responsible for the achievement of these above goals.

The researcher was a master degree holder in geography and as a teacher educator; she intended to find out a suitable model of teaching geography subject at upper primary classes. The aim of teaching geography is that it provides mental discipline, which means that the subject trains the children’s whole mode of thought, which in its turn, influences its intellectual life and studies in the same field. This mental discipline comes through the application of ‘Scientific’ attitude in distinguishing facts, interpreting their effects, and drawing correct conclusion and inferences. Thus, it further substantiated by the research findings of Naresh Kumar Gupta (1997) which revealed that ‘Inductive Thinking Model promoted some mental processes like reasoning ability, problem awareness ability, scientific attitude and creativity. The content of standard seven geography as per Tamil Nadu government syllabus, includes mainly about climatology, the factors of climate, the causal relationship between the elements of climate, the impact of elements on earth, the awareness of natural phenomena and man’s reaction,. The geographical concepts behind these topics are abstract and students need to know and understand them through an appropriate model, which gives a lot of scope for learning. Hence, the researcher selected physical geography, which is found to be suitable for finding the effectiveness of Inductive Thinking Model.
4.7.3 Analysis of Topics

Seventh standard geography textbook was thoroughly studied by the researcher to select suitable topics for her investigation. Inductive Thinking Model aimed to bring out the ability to classify, analyze the facts and information and create concepts among schoolchildren. Classification is believed to be the fundamental higher order thinking skill and analytic and syntactic skills depend on the discriminations made through classification. The curriculum framework of physical geography consists of facts on three realms of Earth, structure and composition of Atmosphere, factors of climate such as Atmospheric temperature, pressure, winds, Humidity, rainfall and types of climate etc. which form the skeleton to all other facts of geography. The sheer force of memory best learns facts, which is very strong in children. However, the right understanding of them is possible by studying the relationship of one fact with other. Since the relationship that exists between one fact to another is universal, they are called the 'general conceptions, ideas, or principles'. The study of these principles work towards the development of mental abilities, especially 'reasoning power'.

The researcher from her experience observed that the physical geography lessons, taught through traditional method lead the children to merely 'parroting' of geographical facts, concepts and terms etc. The researcher’s intention, to teach physical geography through Inductive Thinking Model, was most appropriate for VII standard students to understand and think on facts, concepts and generalizations. The strategies of Inductive Thinking Model provided a lot of scope to students to understand the abstract physical geography concepts.

4.7.4 Selection of concepts for the study

The researcher selected the following 25 concepts from vii standard geography textbook to teach Students of Standard VII through Traditional and Inductive Thinking Model. They were:
1. Elements of earth
2. Origin of earth
3. Lithosphere
4. Atmosphere
5. Hydrosphere
6. Biosphere
7. Structure of Atmosphere
8. Composition of Atmosphere
9. Layers of Atmosphere
10. Isolation and terrestrial radiation
12. Conduction
13. Convection
14. Radiation
15. Latent heat
16. Horizontal distribution of temperature
17. Temperature zone of the earth
18. Torrid zone
19. Temperature zone
20. Humid zone
21. Altitude – a factor for heat distribution
22. Land and ocean variation
23. Wind direction
24. Distance from sea
25. Heat balance
4.7.5 Selection of appropriate Instructional setting

The researcher selected two Government High schools, located in rural areas, which were identical in their environmental setting. Because of rural location and its proximity to the researcher to conduct and observe classes, Government high school, Aduthurai was selected for experimental study. Government high school, Thirubuvanam was also selected as control school, which is 9 kilometers away from Aduthurai.

The presence of observers, experimental equipment and knowledge of participation of the subjects in the experiment may make the subjects aware of the fact that they are receiving experimental treatment and therefore they may change their normal behavior. Keeping in mind, the researcher did not give any possibility for ‘Hawthorne effect’ among the students and selected the schools far away from one another. The distance between schools provided adequate control to the experiment; so that, the effects of the independent variable on the dependent variable could be measured accurately. The schools selected for the study were identical with the following aspects:

- Both Experimental and control schools were located in rural areas.
- The schools were under the management of Tamil Nadu Government.
- The schools were co-educational institutions.
- The medium of instruction was Tamil in both the schools.
- The curriculum, syllabus and examination system were same in both the schools.
- Library, laboratory and playground facilities were found to be the same in both the schools.

4.7.6 Selection of variables

Different kinds of variables used in the study were as under:
4.7.6.1 **Independent variable**

Though age, gender and race were considered independent variables, the researcher decided to take only the age and gender of the students for her study.

4.7.6.2 **Treatment variable**

Inductive Thinking Model was taken as treatment variable since it was manipulated to study its effectiveness. Students of Standard VII were taught by the structured lesson plans of physical geography based on Inductive Thinking Model teaching strategies, conceived by Hilda Taba.

4.7.6.3 **Dependent variable**

The dependent variables of the study were:

1. Academic achievement
2. Concept formation
3. Logical reasoning
4. Styles of Thinking
5. Awareness to Nature of Knowledge
6. Sensitivity to language

The students of control group and experimental group were scored on these variables before and after the treatment.

4.7.6.4 **Co-variable**

To eliminate the initial variability of the subjects of control and experimental groups statistically, they were measured on general mental ability on pre test scores. General mental ability is an index of intelligence, which might have affected the criterion variables. General mental ability was the attribute variable that was thought to be controlled statistically through co-variable but since the two groups did not differ on general mental ability at pre test stage; there was no need to control co-variate.
4.7.6.5 Situation variables

Situation variables like teacher, time, duration of treatment, institutional variations, conditions of instructions, use of teaching Aids, subjects to be taught, sample size were controlled administratively through selection of the sample, equating the time, equating the groups through equal treatments etc. Students of Standard VII studying in the year 2003-2004 were selected as samples and they were studying in Government Schools nearly having the same Standard of Education. Both control and experimental Schools were located in rural areas having a considerable distance in order to avoid in the influence to one another. Some of these variables and their control were summed up in the following Table 4.2.
<table>
<thead>
<tr>
<th>Independent/Variable</th>
<th>Treatment Variable</th>
<th>Dependent Variable</th>
<th>Variable Control</th>
<th>Control employed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>Inductive Thinking Model</td>
<td>Academic achievement</td>
<td>Standard to be taught</td>
<td>Administrative. (only Standard VII students were taught)</td>
</tr>
<tr>
<td>Gender</td>
<td>Concept formation</td>
<td>Academic subject to be taught in treatment</td>
<td>Administrative only physical geography lessons were used as treatment.</td>
<td></td>
</tr>
<tr>
<td>Logical reasoning</td>
<td>Instructional variations</td>
<td></td>
<td>Administrative. (Experiment was conducted in a single school)</td>
<td></td>
</tr>
<tr>
<td>Styles of thinking</td>
<td>Teacher variations</td>
<td></td>
<td>Administrative. (The researcher alone taught the students)</td>
<td></td>
</tr>
<tr>
<td>Awareness to nature of knowledge</td>
<td>Sex variations</td>
<td></td>
<td>Administrative: (Male and female students)</td>
<td></td>
</tr>
<tr>
<td>Sensitivity to language</td>
<td>Size of the sample</td>
<td></td>
<td>Administrative. (Equal number of Students)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Average age of the sample</td>
<td></td>
<td>Students of both schools were of age between 11 to 13</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Initial ability of Students</td>
<td></td>
<td>Statistical pre-test technique</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Subjects</td>
<td></td>
<td>Only physical geography was selected</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Testing</td>
<td></td>
<td>Experimental design</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Environment</td>
<td></td>
<td>Administrative Same management (Govt. schools)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Same location (rural)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Contamination among the groups</td>
<td></td>
<td>Administrative. (Considerable distance between two schools)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Year</td>
<td></td>
<td>Administrative. (Students of VII in 2003-2004 were selected)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Instrumentation</td>
<td></td>
<td>Tool reliability and validity</td>
<td></td>
</tr>
</tbody>
</table>
4.7.7 Selection of sample

Since the present study is experimental with the aim of finding the effects Inductive Thinking Model, pretest, post test, experimental design was followed. The two groups should be equal in all aspects including academic achievement in geography, concept formation logical reasoning and style of the thinking. The following session describes the way by which the sample was selected.

The performance of all the VI standard students in social sciences, in Tanjore district were collected. Only two schools had more or less equal mean and range in social science scores. Hence, the researcher felt that these two schools were suitable for the present study. Further it is found that both schools were having more or less equal number of students, age, locale, and infrastructure. Thus the two schools, namely Government High School, Aduthurai as Experimental Group and Government High School, Thirubuvanam as control group were selected. All the students of standard seven of these two schools were the sample, for present study. Thus the experimental group had 42 students (21 boys and 21 girls), and control group had 44 students (23 boys and 23 girls). The matching of two groups was also justified by nonverbal group intelligence test.

No doubt, the sample was small for the results of the study to be generalized but availability of a large sample and flexibility of carrying out such experimental study with large sample is beyond the control of an investigator. Even earlier investigators conducting such studies through experimental designs were used small samples. Telegaonkar (1984) had taken 34 students of class IX for his study. Chitrive (1983) had taken 3 intact sections of class XI for his study with 35 students in each section as his sample. Singh and others (1986, 1987 and 1988) had taken sample of nearly 45 teacher educators. Koul took 50 students of standard X, for his experimental study, while Jemini (1990) has worked out in two sections of chemistry classes in a school. B.K. Passi and Sansanwal, while reviewing research
in teaching in Buch's Fourth survey of research in Education (1991) has justified the use of small samples in such experimental researches, due to deeper inquest of these and available methodological facilities. It is accepted that almost all studies of the experimental nature, as the present one, have worked on small samples only. Hence, the present researcher took a small group of sample, for her study.

Phase-2: ORGANISATION

4.7.8 Formation of groups

The researcher made an effort to form two equivalent groups: Experimental group and Control group. These two groups were identical in every aspect such as size, age, sex, academic achievement etc. The samples of two groups were natural and highly comparable in respect of size (42 and 46) average age (11 to 13) and especially in their achievement in geography. Further, both groups followed the same VII standard geography textbook prescribed by Tamil Nadu Government. The students of both groups were drawn from nearly similar socio-economic status. The school environment and school resources of both schools, contributed adequate input for the formation of two identical groups. Keeping in view, the availability, feasibility and objectives of the experiment, Students of Standard VII from 2 different schools respectively were taken for the study in an actual classroom setting.

The researcher matched the groups by analyzing the general performance of the sample in VI standard Annual common examination. It was found that the mean scores of both the groups were between 37.5% and 36.8%. Both the groups were considered equal in their academic achievement scores. Thus the groups were equated, based on their achievement in the pretests i.e. a) Academic achievement b) Intelligence test. It was found that there was no significant difference between the means of both the groups in their academic achievement. There was no significant difference between the means of both the groups in their intelligence.
Thus, based on the scores in the achievement test and intelligence test, the two groups were found equal.

4.7.9 Allocation of Treatment

Major objective of the study is related to find out the effectiveness of teaching through Inductive Thinking Model on Concept formation, Logical reasoning, Styles of thinking, Awareness to Nature of knowledge and sensitivity to language. For this, the researcher decided to apply Inductive Thinking Model to Experimental group and Traditional method of teaching to control group through the subject of physical geography. The researcher found it necessary to see the effect of Inductive Thinking Model after determining the initial level of their academic achievement and intelligence. She involved in giving treatment to experimental group. At the same time, the respective teacher, who was, guided and monitored by the researcher, conducted the traditional teaching.

4.7.10 Securing Administrative Support

The researcher made preliminary arrangements to conduct experiments in both schools. The permission of the concerned school Headmasters was sought after explaining them, the plan and purpose of the study. The Headmasters were readily accepted to co-operate and conduct the work in their respective schools, and their teachers were agreed to be co-operative in this regard. The teachers, teaching social science in these sections were taken into confidence. The teachers of both schools were well informed about the models of teaching. The permission for experiment was sought in the month of June 2004 from the very beginning of academic sessions, 2004-2005 i.e. from 20.6.04. The regular class periods were also adjusted with teachers and the school authorities for conducting the experiment. The whole experiment was conducted in the natural classroom setting.
4.7.11 Collection of source material

Being a teacher educator, the researcher used to give orientation training to upper primary teachers on geography content and methodology. Hence, she had a collection of many reference books such as climatology by Trewartha, Teaching of geography by Zoa A. Thralls, Geography teaching by O. P. Verma and Vedha Nayagam and down loaded materials from geography websites, were referred. Training modules prepared by DTERT and NCERT were taken as reference materials.

In order to have more orientation on Inductive Thinking Model, the researcher herself had collected and gone through the book ‘models of teaching’ written by Bruce Joyce and Wiel, Educational technology books like Advanced Educational written by Dr. R.A. Sharma and also Essentials of Teaching Learning by Dr. S.C. Oberoi. The geography textbook, which was available in the form of social science, published by Tamil Nadu Textbook Corporation, was thoroughly analyzed, by correlating the same topics with other source books, taken for the study. To give more information to the students, on geographical concepts, found in VII standard syllabus, reference materials like fun and games, data on geographical facts, Hamlyn Junior Encyclopedia, Britannica Learning Library, Janice Van Cleave’s Geography for Every kid, evaluation methods etc. were collected. Information were gathered by the researcher, to prepare ‘Activity based lesson plans’ to suit the frame of reference given by Hilda Taba, the proponent researcher of Inductive Thinking Model.

Phase-3: DEVELOPMENT

4.7.12 Lesson planning

Lesson plan is a kind of road map to achieve educational objectives. It gives a systematic and operational guide to follow in the classroom. Hence, the researcher carefully designed the lesson plans to realize the learning objectives, by selecting
and arranging subject matter based on the steps involved in Inductive Thinking Model of teaching. Since Hilda Taba’s Inductive Thinking Model lesson plan is based on the combination of Herbartian approach, Apperception mass theory of Learning and Evaluation approach by B.S. Bloom, the researcher had studied their theories before constructing the lesson plans. The content was presented in a logical and psychological sequence, comprising the opportunities for developing thinking skills. Because Inductive model was framed to develop mental abilities and to give emphasis on concept formation, which in turn, to involve cognitive tasks. A particular mental task and cognitive task require specific strategy to improve thinking. The entire study was focused on to develop thinking process, which would require questioning strategy to elicit answers from the students. Hence the researcher planned the lessons, with full of questions, by following the summary chart suggested by Hilda Taba.

4.7.12.1 Syntax

Concept formation, Interpretation of data and application of principles or ideas are three teaching strategies to be followed in three phases, strongly resemble each other. Each strategy involves overt activities that assume students must go through certain covert operations to perform the activities. Thus, the sequence of activities forms the syntax of the teaching strategies and is presumably accompanied by underlying mental processes. In each case, the teacher moves the strategy along by means of eliciting questions to guide the student from one phase of activity into the next at appropriate time.

Strategy I Concept formation

The teacher presents data by eliciting questions like:

1. What did you see? hear? note?
2. What belong together?
3. On what criterion?
4. How would you call these groups?
5. What belongs to what?

**The students respond by**

- Phase 1: Enumerating, listing the data
- Phase 2: Grouping the data
- Phase 3: Labeling, categorizing the data

**Strategy II Interpretation of Data**

The teachers interpret the categorized data made earlier by the students.

- Phase 4: The students identify the crucial relationships
- Phase 5: Exploring the relationships
- Phase 6: Making inferences from the data

**Strategy III Application of principles**

- Phase 7: The students predict consequences, explain unfamiliar phenomena and hypothesize
- Phase 8: Explain and support the predictions and hypotheses
- Phase 9: Verify the predictions

The researcher taught geographical concepts by leading the students through activities based on data set prescribed to them and in later lessons, students were practiced how to create and organize data sets.

**4.7.12.2 Social system**

In all three strategies, the atmosphere of the classroom is cooperative, with good deal of student’s activities. Teacher initiates and determines the sequence of activities well in advance. As the students learn the strategies, they assume greater control.
4.7.12.3 Principles of reaction

Teacher makes sure that the cognitive tasks occur in optimum order at right time. Teacher monitors how students are processing information to use at appropriate time and sensing the students’ readiness for new experience.

4.7.12.4 Support system

Teacher’s job is to help the students to process the data in increasingly complex ways and at the same time, to increase the general capacities of their systems for processing data. To orient in Inductive Thinking Model of classroom teaching the researcher prepared number of lesson plans. Traditional types of lesson plans were also prepared with the help of teachers, who handled geography in control school.

4.7.13 Preparation of Audiovisual Aids

The Audiovisual Aids aid to concretize the abstract geographical concepts among the students. The researcher took lot of efforts to collect and prepare teaching aids to teach the students. She had collected educational CDs on origin of earth, interior of earth, lithospheric differences, hydrosphere etc, and filmstrips on process of heating, Almanacs, Atlas, globe, maps, pictures and encyclopedia, relevant to geographical concepts, from her institution. Being a teacher educator, the researcher herself had already prepared her own Geocyclopaedia, and a working model depicting hydrosphere to train the teacher trainees, were also used for her research. Nature serves as a laboratory to teach geographical concepts. So small field trips were planned and executed. The students of experimental group were exposed to learn through exhibition, incidentally arranged by Teacher trainees of DIET, Aduthurai, which is located near to the experimental school.

Inductive Thinking Model of teaching insists the teachers to give a lot of data/information in order to enlist, classify, grouping and labeling by the students’ themselves. Hence, the researcher searched for related information and transcribed
them in Charts, Albums, Posters and for Power point presentation. They were displayed in the classroom throughout the treatment days to set the students to be motivated.

4.7.14 Training in the Model

Inductive Thinking Model and Traditional method of teaching were two different treatment variables, in which, the teachers must have thorough knowledge and action. The content dealt during teaching learning process is of vital importance. Hence, care was taken to have orientation in subject knowledge, methodology of teaching, preparation of appropriate teaching aids and suitable evaluation procedures, registering the results, interpretation of psychological variables etc. while teaching geographical concepts to Students of Standard VII of experimental group.

Orientation on Traditional teaching

The researcher worked as a postgraduate geography teacher for more than 15 years, with the possession of master’s degree in geography and education. These experience and qualification habituated the researcher to teach geography in Traditional method. The structured lesson plans suitable to the selected topics for study, relevant information from related magazines and reference books; most suitable Audio visual aids were prepared well in advance. With the consultation of the teachers, the teaching of physical geography was undertaken to the control group of students at Government High school, Trirubuvanam. The extent of cooperation of Head master and teachers of the school was boundless and the students’ involvement and participation were more, to conduct classes successfully. The researcher personally conducted the classes at many times when passing through the stages of teaching from fixing the classroom instructional objectives up to evaluation. Thus the researcher had lot of orientation in Traditional method and she trained the teachers, who involved in teaching of control group.
Orientation on Inductive Thinking Model of teaching

The main aim of this research was to find out the effectiveness of Inductive Thinking Model. More orientation on concept of Inductive Thinking Model, preparation of specific lesson plans, pooling of information, evaluation techniques were needed for the researcher to conduct classes for experimental group of students. Hence, the researcher studied many reference materials on models of teaching, and correlated with geographical concepts. Lesson plans based on nine steps, postulated by Hilda Taba were prepared. The earlier researchers prepared lesson plans in the form of question answers hiding the nine steps implicitly. But the present researcher structured the lesson plans in phase wise manner by following nine steps with eliciting question pattern, which obviously lead to ‘participatory method’ of classroom interaction.

Active role of the students and their motivation to learn more were observed by the researcher while conducting classes. The active participation of the students motivated the researcher immensely to get complete orientation for further activities. Since Taba’s teaching strategies are built on a particular mental or cognitive task, the primary application of the model is to develop ‘thinking capacity’. The researcher took great care in planning the activities and supply of data. Time management was considered as a significant one in this model because moving from one strategy to another by eliciting questions in appropriate time was a compulsory one, otherwise delaying too before moving to next phase would be to lose opportunities and interest. For example, the grouping of data would be premature if the data had not been identified and enumerated. Hence, the researcher took care to begin by leading the students through activities based on data sets, presented to them and in later lessons, how to create and organize data by students themselves. Thus, both researcher and students got orientation to Inductive Thinking Model. At one time, the students showed utmost interest and asked the
researcher, to take classes in all subjects. The researcher felt that was due to the impact of the process of Inductive Thinking Model.

4.7.15 Preparation of Tools

The objectives of the present study were to find out effectiveness of Inductive Thinking Model on:

- Academic achievement
- Concept formation
- Logical reasoning
- Styles of thinking
- Awareness to Nature of knowledge
- Sensitivity to language

As per the objectives of the study, to measure the students during pre test and post test on the criterion variables and the co-variant, following tools were prepared and used for collecting data. All the tools except Styles of thinking were prepared and standardized by the researcher.

1. The Academic achievement test - prepared by the researcher to measure the students' academic achievement in physical Geography.

2. Concept formation test - prepared by the researcher, based on the tool of Dr. M. C. Joshi, professor, Department of psychology, University of Jodhpur, was used to measure the concept formation of the students.

4. Logical reasoning test - the researcher modified the 'Reasoning ability test by Dr. Sadna Bhatnagar (1985)', to measure Logical reasoning of the students.

5. A style of thinking - 'solat' tool constructed by Dr. D. Venkataraman (1990) was used to measure the styles of thinking of the students.

6. Awareness to Nature of knowledge test - prepared by the researcher, was used to measure the Awareness to Nature of knowledge of the students.
7. Sensitivity to language test - devised by the researcher, was used to measure the sensitivity to language of the students.

Except SOLAT tool, the researcher standardized all these tests, considering the age group of population under study. The tools were used for both pre test and post test.

4.7.15.1 Academic Achievement test

The researcher prepared an academic achievement written test for measuring the achievement of Standard VII Students in physical geography taught through traditional and Inductive Thinking Model of teaching. The need of written test become increasingly important as children progresses through primary and upper primary grades, because,

1. In upper grades, pressures for more ‘objective evaluation’ in geography is greater as children are exposed to greater emphasis upon subject matter.
2. As children’s use of language increases then, can reasonably be greater emphasis upon meaningful written and verbal concepts developed.
3. As the child builds a background of physical geography concepts, facts, and understandings and interrelationships, a greater need is presented for accurately assessing the child’s knowledge.

Keeping in mind, the researcher prepared the test, which was accurate and easy to apply, score and interpret. She planned a detailed specification like the purpose of the test and the time, type and nature of the test items and methods of scoring the test. While making the preliminary draft of the test, the researcher selected 60 items, which were more than required items. The items were tried out on a small group of five, seventh standard students from the population. The items of difficulty were modified and edited. The value of difficulty and discriminative power were also established. The final manuscript of the preliminary draft was then submitted to three experts, one senior lecturer of DIET, who handled Geography,
one lecturer of geography and a seventh standard geography teacher of nearby school, for their opinion and criticism. The final draft of the test was given to the same small group of five students. By evaluating them the difficulty items were identified. After necessary modifications of removing difficulty items and considering the suggestion made by the experts, the final draft was multiplied for the administrating the test to samples of the study.

**Description of the tool**

Achievement test was constructed on 25 geographical concepts, which were undertaken for the study. It consisted of six parts, classified by the unique question pattern such as fill in the blanks; choose the best, very short answer, short answer and paragraph questions. Totally, there were 36 items, arriving to total of the 50 marks. The researcher carefully designed the test by following the Blue print based on Bloom’s taxonomy. Weightage was given by 40% on knowledge, 30% on understanding, 20% on application and 10% on skill. The whole test items were prepared on the basis of the Blue Print planned by the researcher.
## BLUE PRINT FOR ACHIEVEMENT TEST

<table>
<thead>
<tr>
<th>Domains</th>
<th>Knowledge</th>
<th>Understanding</th>
<th>Application</th>
<th>Skill</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Units</td>
<td>F</td>
<td>C</td>
<td>VS</td>
<td>S</td>
<td>P</td>
</tr>
<tr>
<td>1</td>
<td>1 (1)</td>
<td>1 (1)</td>
<td>1 (1)</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>1 (1)</td>
<td>1 (1)</td>
<td>1 (2)</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>1 (1)</td>
<td>1 (1)</td>
<td>1 (1)</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>1 (1)</td>
<td>1 (1)</td>
<td>1 (2)</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>1 (1)</td>
<td>1 (1)</td>
<td>1 (2)</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>8</td>
<td>4</td>
</tr>
</tbody>
</table>

### Grand Total

| %       | 40%        | 30%       | 20%        | 10%       | 100% |

### Note:

- **S. No.**
- **Type of questions**
- **Marks/Items**
- **No. of Items**
- **Total Marks**
- **Level of Difficulty**

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Type of questions</th>
<th>Marks/Items</th>
<th>No. of Items</th>
<th>Total Marks</th>
<th>Level of Difficulty</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Fill in the blanks F</td>
<td>1</td>
<td>10</td>
<td>10</td>
<td>Difficult : 10%</td>
</tr>
<tr>
<td>2</td>
<td>Choose the best © (c)</td>
<td>1</td>
<td>10</td>
<td>10</td>
<td>Average : 40%</td>
</tr>
<tr>
<td>3</td>
<td>Very short Answer VS</td>
<td>1</td>
<td>10</td>
<td>10</td>
<td>Easy : 50%</td>
</tr>
<tr>
<td>4</td>
<td>Short Answer S</td>
<td>2</td>
<td>5</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Paragraph P</td>
<td>5</td>
<td>2</td>
<td>10</td>
<td></td>
</tr>
</tbody>
</table>
**Scoring Key and Procedure**

The Scoring Key and Procedure of Academic Achievement test are explained in detailed in the following table:

<table>
<thead>
<tr>
<th>Table 9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Table showing the Scoring key and procedure for academic achievement test.</td>
</tr>
<tr>
<td>The duration of the test : 1 ½ hours, Total Marks: 50</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Part</th>
<th>Type of Questions</th>
<th>Score/item</th>
<th>No. of items</th>
<th>Total Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Fill in the blanks</td>
<td>1</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>II</td>
<td>Choose the best</td>
<td>1</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>III</td>
<td>Very short</td>
<td>1</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>IV</td>
<td>Short</td>
<td>2</td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td>V</td>
<td>Paragraph</td>
<td>5</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Grand Total</td>
<td></td>
<td></td>
<td>50</td>
</tr>
</tbody>
</table>

**Validity**

The researcher considered that achievement tool required to be validated through content validity. Content validity was estimated by evaluating the relevance of the test items, in relation to instructional objectives and actual subject matter studied individually and as a whole. It was estimated through a panel of experts consisting of lecturer in Geography and teachers who handled Standard VII Geography.

**Reliability of the Achievement tool**

The reliability of the tool was found by using test - retest method. The reliability coefficient was found to be 0.82. It gave a close estimate of the stability of the test. The same test was administered shortly after twenty days and two sets of scores were correlated to obtain reliability.
4.7.15.2 Concept Formation test

The objective of the researcher was to study the effect of Inductive Thinking Model on concept formation of the students through the teaching of physical geography among seventh standard students. Hence, the researcher, after a thorough analysis of earlier tests and manuals, developed a tool based on the test Dr. M. C. Joshi, Professor, and Head of psychology department, University of Jodhpur, by integrating the items of physical geography concepts, chosen for the study.

The Researcher developed the tool, by keeping Klausmeier's (1971) principles, pertaining the concept formation theory. There were:

✧ Attending to likeness and differences among things, qualities and events is essential to subsequent classification.
✧ Acquiring the names of concepts, attributes and instances facilitate initial learning of concepts.
✧ Cognizing the definitional basis and the structure of concepts to be learnt facilitates concept learning.
✧ Inferring a concept inductively requires cognizing the defining attributes and rules, remembering and evaluating information.

Based on these principles, the researcher constructed the tool by giving a lot of scope for testing the student's ability to attain concepts, formed by teaching of physical geography. With the consultation of experts and guide, the items were carefully selected.

Description of the tool

The tool consists of 20 test items. Each item represents five concepts. Each concept is different from one another. Despite their distinctiveness, four of the five concepts in each item, can be put under one broad group or class. The students were expected to underline one concept, which does not fit in with the remaining four. In
the right hand column, the students should give the reason how or why they consider some four in one class. The following example explains a test item:

Table 10
Table showing the example of a test item

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Definition:**
Dog is a living being and not the rest.

The researcher selected 20 physical geography concepts to frame 20 items, from the lessons prescribed for seventh standard geography, which were taken for study. The duration of testing was fixed as one hour that it was considered so, to the write up of 20 definitions. The difference between sun and planets, Atmosphere and celestial bodies, sunrays and chemical elements, Atmosphere and Biosphere, precipitation etc was selected items included in concept formation test tool.

**Scoring key and procedure**

Equal weightage was given to all the 20 items. Each item carries one mark, thus to arrive 20 marks.

**Validity of the tool**

Content validity of the test was established through the scrutiny by a panel of experts, who were two geography lecturers, one lecturer in Education and the researcher’s guide. Validity was estimated by evaluating the relevance of the test items and grouping the attributes of test items in relation to geographical concepts, which were actually the subject matter of seventh standard students.

**Reliability of the tool**

The test retest method was employed to find the reliability of the concept formation test. The test yielded same results when repeated measurements were taken from the same two students under same conditions after the interval of thirty
days. The coefficient of correlation was calculated as 0.87 and found that the test was reliable.

4.7.15.3 Logical Reasoning Ability test

The researcher was intended to find out the effectiveness of Inductive Thinking Model on Logical reasoning of seventh students through the teaching of physical geography. To measure the ability of Logical reasoning, the researcher, herself, constructed a tool based on a standardized test made by Dr. Sadhana Bhatnagar (1985). Logical reasoning occurs when the individual is confronted with a problem that demands a solution or required some adjustment. It is a highly purposeful, controlled selective thinking process, the material of which is predominantly factual reproduction of experience. Hence, the researcher, after getting a thorough reading on available standardized reasoning ability tests, constructed the test items, based on physical geography concepts.

Description of the tool

The Logical-reasoning test consists of 40 items in which each item represents the problem either in the form of a statement or in the form of a question, followed by four alternatives. One of the suitable answers from four alternatives should be chosen by the students/respondents to make a perfect answer to the stated problem. The right answer exhibits the Logical reasoning ability of the students.

Since, Logical-reasoning remains to be an important mental process for any knowledge acquisition; the researcher framed 40 items based on geographical concepts. The items were built like a problem that a respondent had to solve by choosing the given alternates.
Table 11
Table showing the example of a test item on Logical Reasoning

If atmosphere is responsible for climatic differences, it will cause

<table>
<thead>
<tr>
<th>1. Gravitational force</th>
<th>3. Eclipses</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Magma</td>
<td>4. Rainfall</td>
</tr>
</tbody>
</table>

In this instance, the respondent has to select ‘rainfall’, the most suitable alternate for climatic differences, since rainfall forms one of the climatic factors. Thus, the researcher selected 40 items, following the lines of quoted example.

Scoring key and procedure

The test items constructed in objective type, carried one mark for each item. Equal weight age was given to all items, thus to arrive 40 marks in total. Duration of the test was one hour.

Validity of the Logical reasoning test

The content of geography was included in the test. Hence, content validity of the test was established through the panel of experts who were senior lecturers and lecturers of geography and Education respectively. With the guidance of researcher’s guide, out of 50 items, 10 items were discarded due to repetition and ambiguity. Only 40 items were taken up for study.

Reliability of the test:

The test – re test method was conducted for establishing the reliability of the tool, by testing and re testing the same group of 20 students, with an interval of one month. The co-efficient of reliability was calculated as 0.78.
4.7.15.4 Styles of Thinking Test (SOLAT) - Dr. D. Venkataraman

The focus of the present study is to find out the effectiveness of Inductive Thinking Model on styles of thinking of seventh students through the teaching of physical geography. It is foremost important for the teachers to focus their attention on students favored thinking styles before imparting the subject matter. Since the method of teaching adopted by teachers often reflects their personal thinking styles, the students who the same thinking styles of the teachers are only benefited and rewarded. Others are labeled as ‘slow’, ‘Dull’. This mismatch exists between the preferred styles of the teacher to know the students preferred styles of thinking. So that the teachers can capitalize the opportunities for the students learning.

The study of related literature and earlier research studies enlightened the researcher to adopt the ‘SOLAT’ tool (styles of learning and thinking) constructed by D. Venkataraman in 1990. The present researcher’s study was limited to styles of thinking and so she selected the test items of styles of thinking from ‘SOLAT’ Tool.

Description of the tool

The thinking style part of the SOLAT tool consists of 25 pairs of items based upon accumulated research findings, concerning the specialized functions of the left and right hemispheres. Each item provided the respondent with three choices. One representing a specialized function of the left cerebral hemisphere, the second representing the specialized function of right cerebral hemisphere and the third is checking the both items representing integration of both right and left hemisphere. Five dimensions are included in styles of thinking part of SOLAT. They are as given below:
Table 12

Table showing the Dimensions of test items on style of thinking.

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Dimension</th>
<th>No. of pairs of items</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Logical/fractional</td>
<td>5</td>
</tr>
<tr>
<td>2</td>
<td>Divergent/convergent</td>
<td>5</td>
</tr>
<tr>
<td>3</td>
<td>Creative</td>
<td>5</td>
</tr>
<tr>
<td>4</td>
<td>Problem solving</td>
<td>5</td>
</tr>
<tr>
<td>5</td>
<td>Imagination</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>25</td>
</tr>
</tbody>
</table>

Scoring Key and Procedure

The students were asked to indicate which of the three specific styles of thinking best described about their own typical behavior.

SOLAT has a built in scoring key, which makes scoring easy. One has to count the number of first item of serials as R (right) and the second items of serials as L (Left). If both the items are checked, count it as I (integrated). There is no need to count if the items are not checked. The first item indicates left hemisphere and checking the both items indicate integrated hemisphere or whole brained (w). The hemispheres dominance is determined on the basis highest score in any of the three categories of dominance.

Validity of the tool

Content validity was made from an extensive survey of literature on specialized cerebral functions of the hemisphere. The items were constructed by attempting to translate research findings on hemispherity into a multiple-choice format, without representing particularly right hemisphere functioning or left hemisphere functioning. The items were selected for the inclusion based on the
sustained experts', opinion from professors, doctors connected in the field of psychology and neurosurgeons respectively.

**Concurrent validity**

The SOLAT tool was constructed by Dr. D. Venkataraman and validated with the help of standardized SOLAT tool constructed by Paul Torrance. The tool was administered to 300 subjects and the correlation between 2 tests Scores was 0.678%. The correlation coefficients reveal that this tool possesses level of concurrent validity.

**Reliability of the tool**

The reliability of the tool was measured by test - retest method, one month after the first test was conducted to 300 students of whom were 150 boys and 150 girls. The reliability co-efficient of correlation for the right hemisphere function was found to be 0.89 while left hemisphere 0.65. The co-efficient of correlation for integrated score was 0.71. They suggested that this tool possessed reliability to a significant level.

**4.7.15.5 Awareness to Nature of knowledge test**

The researcher wanted to measure the Awareness to Nature of knowledge, enhanced by the Inductive Thinking Model through the teaching of physical geography among the students of Standard VII. The researcher constructed 'Awareness to Nature of knowledge test' based on the nature of knowledge. After reviewing the literature available on knowledge, and consultation with guide and professors, the researcher identified that the nature of knowledge mostly rely upon the characteristics of knowledge such as to recalling, thinking, applying, developing divergent conclusions, writing new ideas, and giving judgments.

Keeping the age group of the students under study, in mind, and the subject of the study the researcher took effort to develop the test items based on Nature of knowledge, by including geographical concepts.
Description of the tool

The researcher made tool consists of 20 items in which the following items related of Nature of knowledge pertaining to physical geography are included.

- 1-5 items require the students to ‘recall’ factual knowledge of the content.
- 6-8 items require the students to ‘think’ more broadly to show in depth. Understanding and to explain using students’ own words, grouping the meaning of information.
- 9-11 items require the students to apply learning to a new situation and to develop ideas or a product.
- 12-14 items require the students to develop divergent conclusions by identifying causes, making inferences and finding evidences to support generalizations.
- 15-17 items require the students to write or produce new ideas, methods or procedure to go beyond present knowledge.
- 18-20 items require the students to give judgments to their ideas according to an explicit and detailed set of reasons.

Table 13

Table showing the example of test items on Nature of Knowledge

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>How will you protect environment from the damages caused by ultra-violet rays? Write any one of the activities.</td>
</tr>
</tbody>
</table>

Scoring key and procedure

The maximum score of the test was 30. 10 one-mark items and 10 two marks items were included in the test. Since the expected responses of the students vary from one item to another, in terms of its descriptions, to each item, equal weightage of marks could not be assigned to all items of the test. Hence, the scoring must be made cautiously. Duration of the test was one hour and 30 minutes.
Validity of the tool

Content validity of the tool was determined by the evaluation made by professors, senior lecturers of DIET and researcher's guide. Out of 25 items, initially constructed by the researcher, five items were discarded and finally 20 items were selected to measure the student's awareness of nature of knowledge.

Reliability of the tool

Test re-test method was applied to measure the reliability to the test. The researcher conducted the test for a group of 20 students studying in VII standard. Then after a span of 30 days, the test was conducted again to the same students under same condition. The reliability coefficient was established between the two tests were found to be 0.76 and it was said to be reliable.

4.7.15.6 Sensitivity to Language test

The focus of the researcher was to study to effectiveness of Inductive Thinking Model on sensitivity to language of seventh standard students through the teaching of physical geography. The researcher made so many attempts to find out a standardized tool to measure the sensitivity to language, which was considered as a nurturant effect of Inductive Thinking Model, but no tool was traceable. Hence, she devised a tool herself, appropriate to measure the extent of sensitivity to language by consulting the experts, professors and guide. The researcher selected specific points of view in language to frame the test items of the tool.

The five specific points in language were considered to be the

- Meanings of the terms
- Items of reference
- Items of difference
- Coinage of new terms to substitute the existing terms
- Usage and applicability of the terms.
The terms were chosen from the physical geography lessons taken for the study. Four main geographical terms were taken for constructing the test items on five specific points of language. Totally 20 items were finalized with the hope that the tool would give scope to determine whether the student knows the correct meaning of some technical terms which often spelt in content and to predict the size of the their (students) total vocabulary. Items of reference and difference in the tool determine the student’s ability to organize facts into meaningful and coherent structure of words. Coinage of new terms and applicability of terms indicate the creating and student’s level of social understanding respectively, which were responsible for any language development.

The researcher presumed that the students at the age of eleven plus are able to think of ideas with related sentences together and not of single words. The students answer would constitute both theır concept attainment and magnitude towards sensitivity to language. The use of words and sentences in the original test was not insisted in the tool in order to show evidences of their ability to write in their vocabulary based on listening, reading and comprehending the curricular materials.

**Description of the tool**

The tool consists of 20 items, replicating the five specific aspects of language with reference to four geographical concepts such as Biosphere, Ozone, Radiation, and pollution. The researcher selected these concepts because of their utmost usage and applicability in day today life of the students. Hence, the tool comprises four components based on the above said four geographical concepts. Each concept is provided with five items and each item represents the respective specific aspect of language i.e. meanings of the terms, items of reference, items of difference, coinage of new terms to substitute the existing terms and usage and applicability of the terms.
Table 14

Table showing the number of items in each component

<table>
<thead>
<tr>
<th>Items</th>
<th>Component</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-5</td>
<td>Biosphere</td>
</tr>
<tr>
<td>6-10</td>
<td>Ozone</td>
</tr>
<tr>
<td>11-15</td>
<td>Radiation</td>
</tr>
<tr>
<td>16-20</td>
<td>Pollution</td>
</tr>
</tbody>
</table>

Table 15

Table showing the model of a test item on Nature of Knowledge.

What is the term ‘Ozone’ mean?
List out any two terms, closely related to the term ‘Ozone’.
Bring out the difference between the terms ‘Ozone’ and Oxygen in a single sentence.
Coin a new term for ‘Ozone’ in your own words.
Quote any one of the circumstances when you used the term ‘Ozone’.

Scoring Key and Procedure

Equal weightage was given to the test items. The maximum score was remained to be 20 as there were only 20 items found in the tool. Each student was expected to give the answers in one sentence. Therefore, the duration was limited to one hour for conducting the test.

Validity of the tool

The items were selected after the consultation with guide, professors of geography and Education. Content validity was estimated by relating the relevance of test items with the objectives of the test and irrelevant items were discarded. The panel of experts approved the final draft.
Reliability of the tool

The reliability of the tool was established by using test – re test method. Two tests were conducted to a group of 20 students by administrating the same tool at an internal of 35 days. Two sets of scores were correlated to obtain the reliability and thus the correlation coefficient was calculated as 0.82.

Phase-4: IMPLEMENTATION

Methodology

The major objectives of the study are to find out the effect of Inductive Thinking Model on concept formation, Logical Reasoning, styles of thinking, Awareness to nature of knowledge, and sensitivity to language. For this, it was necessary to see the effect to Inductive Thinking Model after determining the initial level of attainment of students on said variables through pre test. Inductive thinking was used as treatment and final level of attainment was determined through post test. Thus to achieve these objectives, the design of the study has already been mentioned. As discussed, the relevant data were collected with the help of the tools used. Detailed procedure of the experiment is given below:

Phases of Experiment

The Researcher planned to conduct the experiment in two schools, which were selected as sample for the study. The geography teachers of control school and experimental school were given training and requested to cooperate for conducting the study. The researcher selected the students of VII standard as subjects for her research. They were in the age group between eleven to thirteen years, the early adolescent period. The researcher intended to observe the effect of Inductive Thinking Model on the dependent variables, which may change only after sufficient period. Hence, a period of incubation was given for the students under study. The researcher conducted the study for 4 months between June 2004 and
September 2004. The experiment was conducted in a phased manner in the form of a schematic view of the phases of experiment is presented in the table below:

**Table 16**

**Table showing the phases of experiment**

<table>
<thead>
<tr>
<th>No.</th>
<th>Stage</th>
<th>Experimental group</th>
<th>Control group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>09-06-04 to</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>16-06-04</td>
<td>Variables measured</td>
<td>Variables measured</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Academic achievement</td>
<td>• Academic achievement</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Concept formation</td>
<td>• Concept formation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Logical reasoning</td>
<td>• Logical reasoning</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Styles of thinking</td>
<td>• Styles of thinking</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Awareness to nature to knowledge</td>
<td>• Awareness to nature to knowledge</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Sensitivity to language</td>
<td>• Sensitivity to language</td>
</tr>
<tr>
<td>2.</td>
<td>Treatment</td>
<td>Teaching physical geography concepts through Inductive</td>
<td>Teaching physical geography concepts through Lecture</td>
</tr>
<tr>
<td></td>
<td>50 periods</td>
<td>Thinking Model of Hilda Taba.</td>
<td>cum demonstration method.</td>
</tr>
<tr>
<td></td>
<td>17-06-04 to</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>09-09-04</td>
<td>Variables measured</td>
<td>Variables measured</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Academic achievement</td>
<td>• Academic achievement</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Concept formation</td>
<td>• Concept formation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Logical reasoning</td>
<td>• Logical reasoning</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Styles of thinking</td>
<td>• Styles of thinking</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Awareness to nature to knowledge</td>
<td>• Awareness to nature to knowledge</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Sensitivity to language</td>
<td>• Sensitivity to language</td>
</tr>
</tbody>
</table>

As Inductive Thinking Model emphasized the analysis of thinking, more exercises were needed to be done, so that more time could be spent on. She took 50 periods of 45 minutes classes for both experimental group and control group, by using structured lesson plans for Inductive Thinking Model and traditional method of teaching respectively, on 25 geographical concepts. Before conducting the
classes, the researcher got orientation on Inductive Thinking Model by reading the literature, earlier research reports and writing of lesson plans.

4.7.15.7 Development of rapport with the students

Developing concepts along with scientific skill and social skill was the core of teaching through Inductive Thinking Model. To carry out these processes, 'Activity based teaching learning' situations must be created. Hence, the researcher framed a number of activities throughout the classroom teaching. The students with speed and accuracy could do activities interestingly, only when they get motivated. Hence, the researcher motivated the students by establishing good rapport between the teacher and students. Good rapport was made possible by the researcher through the intermittent talk and observation of the students. The accessible location of the experimental school, and solving interpersonal problems among students, also lead good relationship between the students and researcher. It was felt by the researcher that casual talks with students created positive feelings towards self and confidence and provided a pleasant laboratory to develop social skill and empathy for others. It was very helpful to structure the students in pairs for categorizing activity to make all the students actively engaged in Listing, grouping, labeling the data set, which were the overt activities of concept formation strategy of Inductive Thinking Model. Close relationship between the students and the researcher created a free and conductive classroom atmosphere, to undertake the experiments, throughout her study.

4.7.16 Administration of the pre tests

Both control group and experimental group were first oriented to academic achievement test, concept formation test, logical reasoning test, styles of thinking test, Awareness to Nature of knowledge test and sensitivity to language test one by one in the specified period. The administration of these tests were carried out as per the norms and instructions contained in their manuals. Since both groups were
found to be located more than nine kilometers apart, there was no scope of interaction among the students. The pre testing exercises were conducted simultaneously to both the control and experimental groups on the same day.

The researcher designed the test papers for each criterion test, with a provision of space to answer in the test paper itself. Each student of both the schools were supplied with six test papers and instructed to answer in the space, where the provisions were made. Sufficient number of copies were cyclostyled and supplied to the respective schools. With a kind cooperation and involvement of the teachers, the tests were conducted. 47 sets of 6 test papers for control groups and 43 sets of 6 test papers of experimental groups were issued for pre test. The test was conducted one by one to the students, in day-by-day basis, to monitor both the groups by the researcher. Thus, pre test scores were obtained on academic achievement, concept formation, logical reasoning, styles of thinking, Awareness to nature of knowledge and sensitivity to language of students of both control and experimental groups.

4.7.17 Application of treatment

Find the efficacy of treatment variables, the experimental variables were manipulated in the form of teaching based on Inductive Thinking Model and traditional method of teaching respectively to the criterion group. The lessons based on Inductive Thinking Model and traditional method of teaching was planned for 25 concepts, taken from VII standard geography textbooks. These lessons were related to physical geography concepts, covering abstract phenomena of climatic factors. Twenty-five structural lesson plans were prepared for both Inductive Thinking Model and traditional method of teaching. Model lesson plans for Inductive Thinking Model was given in the appendix.

Most of the lesson plans consisted of both ‘content objectives’ and ‘process objectives.’ The content dealt with during teaching learning process, plays central
importance in any research. Hence, great care was taken to deliver the exercises as per the teaching strategies of Inductive Thinking Model. Content objectives identify subject matter (facts, concepts, generalization, relationships) to be measured by the students while process objectives specify skills and procedure, in order to achieve content objective i.e. cooperation in a learning task. In order to achieve these objectives, the researcher involved all students to do cognitive tasks. The ‘content objectives’ for Inductive thinking reside in the information and concepts embedded in the data set. Hence, the students were instructed to categorize the items in the data set based on a common attribute of the items. For example, the students were supplied with a data set, consisted of a collection of living and non-living things of the biosphere. They classified them: by plants, animals, air, water and land. There, the content objectives for this data set included both the information about living and nonliving things in biosphere and the building of a typology. ‘Process objectives ‘included in this learning by the scientific skill of observation and classification as well as the social skills of problem solving.

To undertake this type of teaching learning process, learning situations were planned by the researcher, well in advance, especially in gathering the data sets, which included educational compact discs, picture albums, map, atlas, statistical data, related to content. The researcher grouped the students in pairs and instructed to enlist, group and to label the data. After labeling, they were asked to interpret the items in terms of their relationships. For example, the relationship between the man and atmosphere, plants and atmosphere, etc. were asked the students to trigger their ‘thinking process’. By asking ‘why’ questions, the researcher developed the cause and effect relationship between the items. Every student involved in doing these tasks to arrive logical predictions of the same items. The researcher asked questions like, ‘if there is no water in the earth, what would happen to entire world?’. Through these eliciting questions, the thinking process was sustained among the students throughout the classroom teaching.
The researcher found it difficult to control the students earlier at one or two classes due to over excitement among the students but gradually they began to perform the activities themselves, in a regular way, following the steps of Inductive Thinking Model. Throughout the classroom teaching, the researcher and students were interacted actively by questioning and responding each other. It was observed that the students’ ability to get inferences on given data set was gradually improved. At one time, they began to draw themselves about the concepts what they attained. Inductive Thinking Model instruction was practiced by well-planned classroom situations and well-structured lesson plans of content, selected for study. Evaluation was done immediately in each phase of the experiment.

The researcher herself, in order to avoid teacher variable and to maximise the precision, also conducted the traditional method of teaching initially. After wards by observing the classes of the researcher, the concerned class teacher of control group willingly came forward to conduct the classes with great care and plan. 23 boys and 23 girls were instructed by traditional method of teaching.

Duration of treatment for both experimental and control groups was 50 periods. The duration of each period is 45 minutes. However, geography classes were available twice in a week; special permission was sought from the headmasters to continue the experiments during coaching hours from 4 pm to 4.30 pm. Thus, the treatment was given for 3 months including term wise examinations.

The researcher could observe the effect of the treatment among the experimental group of students after four or five classes. They were collected the data related to content in the form of materials, specimen, pictures and information. They curiously welcomed the researcher when she happened to cross the school campus. Thus, the curiosity and interest were created and induced through Inductive model. The treatment variables were applied to both the groups of students.
4.7.18 Administration of posttests

After the application of treatment variables, the students of both groups were administered the posttests for all the dependent variables, using the same criteria tests as in the pre tests. To see the effect of Inductive Thinking Model on academic achievement, the researcher made achievement test was conducted. The post test scores on logical reasoning were measured through logical reasoning test. The styles of thinking, Awareness to Nature of knowledge and sensitivity to language were measured through SOLAT test, Awareness to Nature of knowledge test, and sensitivity to language test respectively. Both groups of students were subjected to these post tests one by one, as per the procedure prescribed in the tests. In this way post test scores were obtained for the above variables in both the groups of sample.

4.7.19 Statistics used

To find out the difference between pretest and posttest differential statistics ‘t’ test was used and to find out the relationship between the variables ‘r’ test was used. The interaction effect between the groups was find out by ANOVA.

4.7.20 Testing of Hypotheses

The hypothesis were tested through ‘t’ test and tested at 0.05 significant level. 48 hypotheses were formulated and tested through the differential, relational, and interaction analysis.

4.7.21 Arriving at Research Findings

The findings were arrived through the statistical calculations. The significant differences were found between the pretest and posttest scores. It shows the effectiveness of Inductive Thinking Model to teach Physical Geography at Upper Primary Level. Interpretations were made on the basis of the statistical findings. Objectives were realised.
4.8 PRECAUTIONS OBSERVED DURING EXPERIMENT

To ensure the effectiveness and precession in experimental conditions, the following precautions were undertaken by the researcher. All the subjects were oriented to test and treatment. No stress or control was imposed on the students at any time and the experiment was conducted in a relaxed natural setting. All the students of experimental group were taught by the investigator to avoid any variation in teacher variable. Treatment was ensured by establishing rapport in the school, maintaining natural setting, participatory approach, freedom to express thoughts, providing sufficient time to undertake activities etc. It was ensured that the contents of treatment had not been previously taught to the students. Treatment was to be given with in stipulated time. Teaching periods of 40 to 45 minutes were fully utilized for treatment and time was not wasted at any way.

4.9 CONCLUSION

Some of the difficulties faced by the researcher during the experiment should be mentioned herewith. The experimental school some of the students were not present at sometimes. So it was ensured that the sample groups were regularly attending the school excepting some unavoidable circumstances. However, no experimental treatment was executed when the attendance was poor. Factors like home environment, self concept, adjustment, social maturity, and emotional imbalance also had a marginal effect upon the experiment. But they were not taken into the account.

The researcher explained the research procedure in this chapter. It will be proceeded by Analysis and Interpretation of Data in the next chapter.