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CHAPTER-III

METHOD AND PROCEDURE

3.1 INTRODUCTION

In this chapter, the investigator has presented procedure followed by her and also a scheme for presentation. It describes the teaching procedure presented by Bruner for CAM and by Ausubel for AOM. In order to test the effectiveness of the Models, prior preparations have been made by the investigator. The preparations were:

a) To acquire the Mastery of CAM and AOM,
b) Preparation of Lesson plans, and
c) Preparation of tools. The procedure of the study has been given in the table-

TABLE 3.1 : PROCEDURE OF THE STUDY

— Brief Description of the CAM
— Objectives of the CAM
— Syntax of the CAM
— Brief Description of the AOM
— Objectives of the AOM
— Syntax of the AOM
— Design of the Study
— Sample
— Tools
— Experimental Treatment
— Statistical Analysis

3.2 BRIEF DESCRIPTION OF THE CAM

The Concept Attainment model was originally designed by Bruce Joyce and Weil Marsha (1972) and is based on the research efforts of Jerome Bruner, et al. (1956). It is an inductive model designed to teach concepts. The Concept Attainment Model is a teaching strategy to teach concepts. It
facilitates the conceptual type of learning in contrast with rote learning. There are three variations of the CAM:

1) Reception Model
2) Selection Model
3) Unorganised/Mixed Material Model

1) Reception Model is more direct in teaching students the elements of a concept.
2) Selection Model permits students to apply the conceptual activity more actively by using their own initiation and control.
3) Unorganised/Mixed Material Model is much more a group discussion than an instructional exercise as in the Reception and Selection models. In this mode, the role of the teacher is to facilitate group discussion.

In this present study, the investigator is mainly concerned with Reception Concept Attainment Model.

3.3 **BRUNER'S VIEW ABOUT CONCEPT LEARNING**

Bruner has described the processes by which people acquire concepts on the basis of researches in his book 'A Study of Thinking'. All types of concept learning depends upon nature of concepts which Bruner has given as 'Theory of Concept' and also described the thinking strategies used by learners in order to acquire concepts.

**Theory of Concept:**

According to Bruner, any concept has five elements –

i) Name,
ii) Example (Positive and Negative)
iii) Attribute (essential and non-essential)
iv) Attribute Value, and
v) Rule.

**Name:** The name is a term given to a category. For example vegetable, tree, table – are all names given to different categories.
Example- ‘Example’ refers to instances of a given concept. The instances which possess a concept are called positive examples and others are called negative examples.

Attribute- Attributes are common characteristics that cause to place example in the same category. Essential attributes are those characteristics which are critical to the domain under consideration. Exemplars of a category have many other attributes that may not be relevant to the category itself, are called non-essential attribute.

Attribute Value- This refers to the degree to which an attribute is present in any particular example.

Rule - This refers to the method followed to categorize the concepts.

3.4 OBJECTIVES OF CAM

The concept attainment strategy can accomplish several instructional goals depending on the emphasis of the particular lesson. They are designed for instruction on specific concepts and on the nature of concepts. They also provide practice in inductive reasoning and opportunities for altering and improving students’ concept building strategies. Finally, especially with abstract concepts, the strategies nurture an awareness of alternative perspectives, a sensitivity to logical reasoning in communication and a tolerance of ambiguity.

So, the CAM produces two types of effects, the instructional effects and nurturing effects. The major instructional objectives of CAM are:

a) to teach specific concept
b) to understand the nature of concept
c) to create awareness about thinking strategy and improve concept building strategies.
d) To provide practice in inductive reasoning with abstract type of concept.

Certain nurturing effects are also produced by CAM.

These are –
i) an awareness of alternative perspectives,
ii) A sensitivity to logical reasoning in communication, and
iii) Tolerance of ambiguity.

These instructional and Nurturant effects are presented or showed diagrammatically in Dig. 3.1.

**INSTRUCTIONAL AND NURTURANT EFFECTS**

**CONCEPT ATTAINMENT MODEL**

--- INSTRUCTIONAL --- NURTURANT

![Concept Attainment Model Diagram](image)

**3.5 CONCEPT FORMATION AND CONCEPT ATTAINMENT**

The categorizing process has two components- the act of concept formation and the act of concept attainment. In the former act, new categories are formed. In the latter act, the concepts which already exist are attained.

**3.6 ASSUMPTIONS**

Bruner and his associates assumed that though the content of categories may differ from one culture to another culture, the thought process
of forming categories is nevertheless the same. Therefore, they assumed that
the means of acquiring any concept is essentially the same in all cultures.

3.7 WHY TO USE CONCEPT ATTAINMENT METHOD

A concept attainment method involves students learning to classify a
set of objects or events in a way that scientists classify. The students will be
using the categories that scientists use, and will be attempting to determine the
rationale behind the categories. The concept attainment method has a high
tolerance for ambiguity. This means that the students might seem to be
following the wrong path, but eventually, they will come up with the expected
answer. One can use this method when the concept, the students are expected
to learn is fairly clear. This method is used instead of just telling the students
or having them read, because students will learn the material much better
when they figure it out for themselves. As well as learning the material better,
and remembering it longer, the students will learn how to learn by using this
model. We want students to become independent learners and critical thinkers.
This method will help them with both these goals.

This method encourages certain of the common Essential Learning.
The most obvious are critical and creative thinking, communication, and of
course, independent learning. Personal and social values and skills might be
included if the teacher helps his/her students work in a positive way with their
peers. As well, if the particular concept involves understanding a technology,
technological literacy might also be addressed. Of course, as the students
classify in the ways that scientists do, they will be learning a technique of
science, and understanding techniques can be part of technological literacy.

3.8 SYNTAX OF CAM

CONCEPT ATTAINMENT MODEL

Planning for
Concept Attainment
Activities

Implementing
Concept Attainment
Activities

Evaluating
Concept Attainment
Activities
PHASE ONE: Phase one is related with ‘Planning for Concept Attainment Activities.'

Planning for Concept Attainment Activities

Identification of Goals → Selection of Exemplars → Sequencing Exemplars → Medium of Presentation

a) Identification of Goals: The first step in a Concept Attainment activity is the identification of goals. As in the planning for any instruction, the use of teaching models demands clear thinking about instructional goals. Before selecting a strategy to attain a goal, the teacher must have a clear idea of what that goal is. The Concept Attainment Model should only be used when the teacher is interested in teaching a concept in a process oriented manner.

b) Selection of Exemplars: Having identified concept learning as the goal and selected the Concept Attainment Model as a means to reach that goal, the teacher’s next task is the preparation of examples to illustrate the concept. The teacher should also decide the number of exemplars necessary to teach the concept. The more diverse or complex the concept, the more exemplars are needed. The term ‘exemplar’ is used to refer to examples which have been chosen by the teacher because of their suitability in teaching a particular concept.

c) Sequencing Exemplars: Once exemplars have been selected, the next task for the teacher is arranging the exemplars in a sequence appropriate for presentation to students. The sequence is partially determined by the extent to which the teacher is interested in promoting process skills in the students. If the teacher is interested in having students develop their process skills, exemplars should be arranged in such a way that the students’ opportunity to use
processes is maximized. The shortest or quickest route to a concept may neither give students this opportunity nor may it be the best way to insure optimal retention of the concept.

d) **Medium for Presenting Exemplars**: The final task for the teacher in the planning phase of the Concept Attainment Model is selecting the appropriate medium for presenting exemplars. This selection process generally involves consideration of the type of concept being taught and characteristics of the learner. In selecting the medium for presentation, the teacher must consider at least two primary factors: the students’ ability and their previous experience with the concept. In general, a medium which illustrates as many of the characteristics of the concept as possible is best, even if students have previous experience with the concept. If a choice between words and pictures exists, choose pictures, if a choice between actual objects and pictures exists, choose actual objects, and in case where real objects or pictures are not appropriate use words.

**PHASE TWO : Implementing Concept Attainment Activities**

Presenting Exemplars  
Analysis of Characteristics

a) **Presenting Exemplars**: The first step in the implementation phase of the model is the presentation of exemplars. These exemplars provide the data with which students process to attain the concept. Before actual exemplars can be presented, carefully worded directions as to the nature of a Concept Attainment lesson will be essential if for the first time the activity is used in a class.

A typical Concept Attainment activity begins with the teacher presenting a positive and negative exemplars of the concept to be taught. Following the presentation of a positive and negative
exemplars, the teacher asks the students to suggest possible categories that would encompass the positive exemplars. After recording as many hypotheses as the students can suggest, the teacher presents additional exemplars (either positive or negative) and then calls for students’ reanalysis of their inferences in light of the new data. The analysis of hypotheses amounts to the acceptance or rejection of these tentative hypotheses based on the available data. Students state a definition according to the essential attributes. It is essential that during this phase of the model, the teacher refrains from passing judgement on the hypotheses.

The process of presenting and analyzing hypotheses continues until the hypothesis encompasses all the isolated data. This category of data becomes the concept.

b) **Analysis of characteristics**: Once the process of presenting exemplars is complete and the teacher is satisfied that the concept has been formed, the final step in implementing the activity is an analysis of the concept’s characteristics. The analysis begins by having the students observe the examples and list the characteristics they see. This again demonstrates the importance of selecting a medium in which as many of the characteristics as possible are observable.

**THE ANALYSIS OF ATTRIBUTES IS ESSENTIAL BECAUSE**

(i) Students are often able to classify examples without being able to describe the basis for the classification.

(ii) What occasionally happens in a Concept Attainment activity is that one student or a small group of students will attain the concept, while others in the class are not completely sure about the concept. Asking the students to list characteristics insures that the essential attributes are shared with everyone.
When the student can identify the characteristics of the concept, he has truly attained it. Through the identification of characteristics, the student has a means of verbally storing the concept in his memory.

**PHASE THREE**: Students’ attainment of a concept can be measured in one or more of four primary ways which are outlined as follows:

1. The most common way of measuring for Concept Attainment is by asking students to provide or identify additional examples of the concept.
2. The second way of measuring for concept learning is to ask students to identify characteristics of the concept.
3. A third way of measuring for concept learning is by asking the students to relate concepts to other concepts.
4. A fourth method of measuring for concept learning is to ask students to provide a definition of the concept or to identify the concept definition from a list of alternatives.

Probably the most thorough way of measuring for concept learning is to combine the measurement techniques described above to gain a comprehensive picture.

**SOCIAL SYSTEM**

Prior to teaching with the concept attainment model, the teacher chooses the concept, selects and organizes the material into positive and negative examples, and sequences the examples. When using the concept attainment model, the teacher acts as a recorder, prompter (cue), and presenter of additional data.

**PRINCIPLES OF REACTION**: During the flow of the lesson, the teacher needs to be supportive of the students’ hypotheses – emphasizing, however, that they are hypothetical in nature – and to create a dialogue in which students test their hypotheses against each other’s. In the later phases of the model, the teacher must turn the students’ attention towards analysis of their
concepts and their thinking strategies, again being very supportive. The teacher should encourage analysis of the merits of various strategies rather than attempt to seek the one best strategy for all people in all situations.

**SUPPORT SYSTEM**; Concept attainment lessons require that positive and negative exemplars be presented to the students. It should be stressed that the students' job is not to invent new concepts, but to attain the ones that have previously been selected by the teacher. When students are presented with an example, they describe its characteristics (attributes), which can then be recorded.

### 3.9 MASTERY OF CAM

In order to acquire mastery of the CAM the investigator had followed training strategy as developed by Bruce Joyce and Weil Marsha. This training strategy comprises of four components:

- a) Describing and understanding the Model
- b) Viewing the Model
- c) Planning of Lessons
- d) Adopting the Model

Out of these four components, fourth one was not included as a part of the training taken by the investigator; because it is concerned with the reformulation of curriculum according to the Model. The first three components of training strategy can be grouped into two main classes:

- a) Theoretical understanding of CAM
- b) Application of theory in practice

### 3.10 THEORETICAL UNDERSTANDING OF THE CAM

Prior to actual presentation of lesson plans according to CAM, the investigator had thoroughly read the theoretical part of the model. The main steps required for theoretical understanding were:

- a) To understand Bruner's views about concept learning.
- b) To know instructional goal of the CAM.
- c) To learn the syntax of the model.
d) To evaluate understanding about CAM.

First part of the training strategy is understanding the model and related concepts. These specific related terms are – theory and overview, goals and assumptions, categorizing, concept formation and concept attainment, theory of concepts, analyzing thinking strategies for attaining concepts, concept attainment as a Model of Teaching, The Teacher’s Role, elements of a concept, type of concepts and distinguishing concepts from other types of concepts.

There are three phases of CAM. In each phase of the model, there are different types of activities. A thorough knowledge of all these activities in the phases contributes to the theoretical understanding of this model.

The description of these phases of CAM and there activities are given in Table 3.2.

**Table : 3.2**

<table>
<thead>
<tr>
<th>PHASE</th>
<th>ACTIVITIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase One: Presentation of Data and</td>
<td>1. Present labeled examples.</td>
</tr>
<tr>
<td>Identification of the Concept</td>
<td>2. Compare attributes in positive and negative exemplars.</td>
</tr>
<tr>
<td></td>
<td>3. Generate and test hypothesis.</td>
</tr>
<tr>
<td></td>
<td>4. Name the concept.</td>
</tr>
<tr>
<td></td>
<td>5. State the definition according to essential attributes.</td>
</tr>
<tr>
<td>Phase Two: Testing attainment of the concept</td>
<td>1. Identify additional unlabelled examples as ‘yes’ or ‘no’</td>
</tr>
<tr>
<td></td>
<td>2. Generate examples</td>
</tr>
<tr>
<td>Phase Three: Analysis of Thinking Strategies</td>
<td>1. Describe thoughts.</td>
</tr>
<tr>
<td></td>
<td>2. Discuss role of hypothesis and attributes.</td>
</tr>
<tr>
<td></td>
<td>3. Discuss type and number of hypothesis.</td>
</tr>
<tr>
<td></td>
<td>4. Evaluate the strategies.</td>
</tr>
</tbody>
</table>
When the investigator became well acquainted with the theoretical phase of the model, she tried to learn the practical phase.

3.11 PREPARATION OF LESSON PLAN

The investigator had taught XIth standard students through CAM. For this, the investigator had prepared lesson plans exactly on the lines of lesson plan guide (LPG-available in the package prepared by Weil Marsha and Bruce Joyce (1978 & 1990). The broad outline of this lesson plan guide (LPG) are as follows:

- Analysis of concept
- Name of the concept
- Essential attributes
- Non-essential attributes
- State the rule
- Type of Concept.
- Behavioural objectives
- Describe ‘Yes’ exemplars
- Describe ‘No’ examples
- Presentation
- Phases of the Model
- Questions that illicit response from student.

The topics for the lesson plans were selected from XI class Economics book.

3.12 BRIEF DESCRIPTION OF ADVANCE ORGANIZER MODEL

Advance Organizer Model (AOM), designed by Ausubel, is a deductive Information Processing Model which acts as a cognitive roadmap, guiding the students over the new content to be learned. In the course of an Ausubel lesson, the teacher helps students break major ideas down into smaller, related ideas. To ensure that these new ideas are retained and connected to existing cognitive structures, the teacher helps students determine the relationship between the new ideas and the old, and among the new ideas
Ausubel’s theory of meaningful verbal learning deals with three concerns:

1) How knowledge (curriculum content) is organized;
2) How the mind works to process new information (learning); and
3) How teachers can apply these ideas about curriculum and learning when they present new material to students (instruction).

Ausubel’s primary concern is to help teachers organize and convey large amounts of information as meaningfully and efficiently as possible. He believes that the acquisition of information is a valid, indeed an essential, goal of schooling. In this approach, the teacher is responsible for organizing and presenting what is to be learned. The learner’s primary role is to master ideas and information.

The AOM is designed to strengthen students’ cognitive structures’, a term used by Ausubel for a person’s knowledge of a particular subject matter at any given time and how well organized, clear and stable it is (Ausubel, 1963, P.27).

(i) GOAL AND ASSUMPTIONS OF AOM

According to Ausubel, meaningfulness of the material depends more on the presentation of the learner and on the organization of the material than it does on the method of presentation. So, if learner begins with the right ‘set’, and if the material is solidly organized, then meaningful learning will occur. A person’s cognitive structure is the foremost factor governing whether new material will be meaningful and how well it can be acquired and retained. Before presenting new material, the stability and clarity of the students’ cognitive structures should be increased. Reception learning is not passive, provided proper conditions are set up. During a lecture or other form of expository teaching, the listener’s mind can be quite active, but they must be involved in relating material to their own cognitive structure.

ii) ORGANIZING INFORMATION

According to Ausubel, there is a parallel between the way subject matter is organized and the way people organize knowledge in their minds
(their cognitive structures). Each academic discipline has a structure of concepts/prepositions that are organized hierarchically. Like the disciplines, mind is a hierarchically organized set of ideas and serves as a storehouse for them. New ideas can be usefully learned and retained only to the extent that they can be related to already available concepts or propositions that provide ideational anchors.

iii) **IMPLICATIONS FOR CURRICULUM**

Ausubel's ideas have direct implication for organization of curriculum and for instructional procedures. He uses two principles, 'progressive differentiation' and 'integrative reconciliation', to guide the organization of content in the subject fields in such a way that the concepts become a stable part of a students' cognitive structure and to describe the student's intellectual role.

'Progressive differentiation' means that the most general ideas of the discipline are presented first, followed by a gradual increase in detail and specificity. 'Integrative reconciliation' means that new ideas should be consciously related to previously learned content.

iv) **IMPLICATIONS FOR TEACHING**

Advance Organizers are the primary means of strengthening cognitive structure and enhancing retention of new information. The most effective organizers are those that use concepts, terms, and propositions that are already familiar to the learners as well as appropriate illustrations and analogies.

There are two types of advance organizers- 'expository' and 'comparative'. 'Expository' organizers provide a basic concept at the highest level of abstraction and then perhaps some lesser concepts. 'Comparative' organizers are used most with relatively familiar material. They are designed to discriminate between the old and new concepts in order to prevent confusion caused by their similarity.
3.13 **WHEN TO USE AOM**

We should use this strategy when:

- There is a large amount of new material to be covered in lectures or readings.
- The learner plays a passive role in the reception of the already formulated and organized material.
- The content is well structured.
- Transfer of prior knowledge is essential.
- General ideas or concepts, rather than details, are the focus.
- Simulations or other similar activities are not providing the necessary transfer and retention of learning.

3.14 **WHY TO USE AOM**

Advance Organizers are efficient strategies that allow students to see the big picture of an idea and relate it to their current understanding of a subject before going in depth into the new material. Story (1998) also discusses the merits of using advance organizers, focusing on research in this area and concluding that there is, ‘a small but consistent advantage for groups of students using advance organizers’.

Perhaps one of the greatest strengths of the advance organizer is that it facilitates good teaching by requiring instructors to organize their content well in advance of the delivery of the instruction. This extra preparation not only solidifies the lesson following the organizer, but also, according to Downing (1994), assists in organizing subsequent lessons.

3.15 **POTENTIAL PROBLEMS**

According to story, there is a possibility of the advance organizer being glossed over or skilled by instructors who are unaware of their effectiveness and the proper methods of use.

Instructional designers without a firm grasp of the content structure may have a difficult time generating an advance organizer. If an organizer is generated without a clear understanding of the knowledge hierarchy, it may be detrimental to the learners’ understanding and recall to the new material.
3.16 **INSTRUCTIONAL AND NURTURANT EFFECTS**

The probable instructional values of this model seem quite clear—the ideas themselves that are used as the organizer are learned, as well as information presented to the students. Actually the AOM was developed for getting the following instructional effects in the classroom:

i) Conceptual Structures

ii) Meaningful assimilation of information and Ideas.

The AOM helps in linking the new information with the cognitive structure of the person. If this happens, learning by rote will not take place but active reception learning will be promoted. Once concepts become clear, understanding improves. Consequently, the learning will strengthen.

At present, students' understanding of concept is poor. Consequently, they cram the content which they forget after sometime. That is, students are not able to assimilate the content. When students are taught through AOM, understanding improves, which helps in meaningful assimilation of information and ideas.

Apart from instructional effects, there are also the nurturant effects of the advance organizer Model. These are as follows:

i) Habit of precise Thinking

ii) Interest in Inquiry

Students start learning the technique of abstracting learning material and presenting it in precise words when they are taught with AOM. This may lead in the development of habit of precise thinking. Also meaningful assimilation of information and ideas takes place. It helps in developing interest in inquiry.

Instructional and Nurturant Effects of AOM are shown with the help of following diagram:
3.17 SYNTAX OF ADVANCE ORGANIZER MODEL:
The AOM has been structured to comprise three phases:

**Phase One (Planning): Presentation of Advance Organizer**
- Clarify aims of lesson
- Present organizer
  - i) Identify defining attributes
  - ii) Give examples
  - iii) Provide multi-context
  - iv) Repeat terminology of sub-sumer
- Prompt awareness of relevant knowledge and experience from learners' background.

**Phase Two (Implementation): Presentation of the Learning Material**
- Make logical order of learning material explicit to student
— Maintain attention
— Make organization explicit

**Phase Three (Evaluation): Strengthening Cognitive Organisation**
— Using principles of integrative reconciliation
— Promote active reception learning
— Elicit critical approach to subject matter
— Clarify

**Phase One: Presentation of Advance Organizer**

In phase one, there are mainly three activities:

Clarifying the aims of lesson, presenting the advance organizer, and prompting awareness of relevant knowledge and experience. After specification of objectives, the advance organizer has to be presented. It may be expository or comparative depending upon the situation. The essential features of the concept or proposition must be pointed out and carefully explained in short, in the language already familiar to the students. This must be explained in multiple context with the help of examples to make it more general. In order to develop an integrative cognitive structure, an awareness to that previous knowledge which is relevant to the learning task, is prompted.

**Phase Two: Presentation of the Learning Material**

In this phase the teacher makes logical order of learning material explicit to students, maintains attention and makes organization explicit to students. There are several procedures for making organization explicit. Among them are employing the rule-example-rule technique, known-to-unknown using explaining links, making the organization explicit by means of an outline or diagram, using verbal markers of importance and repetition. During the presentation, the students’ attention is to be maintained because without maintaining attention, learning on the part of students cannot be ensured. The teacher can take the help of lectures, discussions, films, experiments or readings in this phase.
Phase Three: Strengthening Cognitive Organisation

In this phase, new knowledge is inter-connected with the existing cognitive structure, i.e., to strengthen the students' cognitive organization. For this, Ausubel has identified the following four activities:

i) prompting integrative reconciliation,
ii) prompting active reception learning,
iii) eliciting a principle approach to subject matter, and
iv) clarification.

For facilitating reconciliation, some of the methods which are found working are:

a) reminding students of the previous ideas,
b) eliciting summary of the new material,
c) repeating precise definitions
d) discussing the difference and similarity in the two contents progressively.

Active responding can be promoted by:

a) asking students to describe how new material relates to the existing knowledge,
b) asking students for additional examples of the concepts,
c) asking students to verbalize the essence of the material,
d) asking students to examine material from the alternative points of views.

Finally, many questions can be asked about various aspects of content and learning material, or task, such as films, lectures or reading etc. for clarification. For any particular situation, combination of two or more procedures may be employed.
TYPES OF AOM: There are two types of AOM—Expository organizers and comparative organizers. Expository organizers are used when the new learning material is completely unfamiliar. Comparative organizers, on the other hand, are used when new learning material is relatively familiar or can be related to previously learned ideas.

3.18 SOCIAL SYSTEM

The social system is highly structured, but requires active collaboration between the teacher and learner. The teacher retains control of the intellectual structure, as it is continually necessary to relate the learning material to the organizers and to help students differentiate new material from previously learned material. The successful acquisition of the material will depend on the learners desire to integrate it with prior knowledge, on their critical faculties, and on the teacher's presentation and organization of the material.

3.19 SUPPORT SYSTEM

Well-organized material is the critical support requirement of this model. The effectiveness of the advance organizer depends on an integral and appropriate relationship between the conceptual organizer and the content.
This model provides guidelines for building (or reorganizing) instructional materials.

3.20 **PRINCIPLES OF REACTION**

The teacher's solicited or unsolicited responses to the learner's reactions will be guided by the purpose of clarifying the meaning of the new learning material, differentiating it from and reconciling it with existing knowledge making it personally relevant to the students, and helping to promote a critical approach to knowledge. Ideally, students will initiate their own questions in response to their drives for meaning.

3.21 **MASTERY OF AOM**

In order to acquire mastery of the AOM, the investigator had followed training strategy as developed by Bruce Joyce and Weil Marsha. This training strategy comprises of four components.

a) Describing and understanding the model

b) Viewing the Model

c) Planning of Lessons

d) Adopting the Model

Out of these four components, fourth one was not included as a part of the training taken by the investigator; because it is concerned with the reformulation of curriculum according to the model. The first three components of training strategy can be grouped into two main classes:

a) Theoritical understanding of AOM

b) Application of theory in practice

3.22 **THEORITICAL UNDERSTANDING OF THE AOM**

Prior to actual presentation of lesson plans according to AOM, the investigator had thoroughly read the theoretical part of the model. The main steps required for theoretical understanding were:

a) To understand Ausubel's views about AOM.

b) To know instructional goal of the AOM.

c) To learn the syntax of the model.
d) To evaluate understanding about AOM.

First part of the training strategy is understanding the model and organizing the material. There are three phases of AOM already stated.

3.23 PREPARATION OF LESSON PLAN

The investigator had taught X1th standard students, through AOM. For this, the investigator had prepared lesson plans exactly on the lines of lesson plan guide (LPG-available in the package prepared by Weil Marsha and Bruce Joyce).

Actually, several books, including Joyce and Weil (1990) were consulted for guidance in the preparation of the lesson plans in addition to suggestions given by other economics-teachers. The prescribed syllabus of X1th class economics was completely read and the content was thoroughly analysed by reading different books on economics of XI class. Several topics were identified. Three types of lesson plans were prepared by the investigator, using the Bruner’s Concept Attainment Model, Ausubel’s Advance Organizer Model and Conventional method of teaching. The medium of instruction of the subjects in these school (Shri Ram Public School, D.A.V. School and Shiksha Bharti Public School) being English, the lesson plans were prepared and delivered in English. As per the specific aid in normal lesson planning the transparencies related to the lesson plans (where needed) were prepared by the investigator and were shown to the students during treatment period with the help of O.H.P. (Overhead Projector).

Specimen of all the three types of lesson plans and transparencies have been shown in Appendix. Broad outlines of the lesson plan of AOM are given below:

i) Considering the goals.

ii) Hierarchical Organisation of Content.

iii) Formulating an Advance Organizer.

3.3.1 METHOD

The purpose of the present study was to compare the effectiveness of Concept Attainment Model and Advance Organizer Model on students’
achievement in Economics. As it was an experimental study, the students were divided in three groups and the students in these three groups were matched on the basis of age, mark secured in X class, intelligence and socio-economic status. To match the groups on the basis of socio-economic status, Socio-Economic Status Scale by Rajbir Singh, Radhey Shyam and Satish Kumar was used.

In this study, pre-test, post-test controlled group design was used. It involved three groups of students: the experimental group (E₁) taught Economics through Concept Attainment Model; the experimental group (E₂) taught Economics through Advance Organizer Model and Controlled group taught Economics through conventional method of teaching.

### 3.3.2 DESIGN OF THE STUDY

The design consisted of three stages. The first stage involved pre-testing of students on achievement in Economics, intelligence and socio-economic status. The second stage involved treatment of 16 weeks. The experimental treatment consisted of teaching of Economics through Concept Attainment Model and Advance Organizer Model and control group was taught through conventional method of teaching.

The third stage, the stage of post-testing included testing of achievement of students in Economics.

#### Table 3.3

<table>
<thead>
<tr>
<th>Stage</th>
<th>Duration</th>
<th>Control Group</th>
<th>Experimental Group (E₁)</th>
<th>Experimental Group (E₂)</th>
</tr>
</thead>
<tbody>
<tr>
<td>II</td>
<td>16</td>
<td>Teaching Economics</td>
<td>Teaching Economics</td>
<td>Teaching Economics</td>
</tr>
<tr>
<td>Treatment Administration</td>
<td>Weeks through</td>
<td>through Concept Attainment Model</td>
<td>through Advance Organizer Model</td>
<td></td>
</tr>
<tr>
<td>--------------------------</td>
<td>--------------</td>
<td>----------------------------------</td>
<td>---------------------------------</td>
<td></td>
</tr>
<tr>
<td>III Post-testing</td>
<td>One Week</td>
<td>Measurement of: Achievement in Economics</td>
<td>Measurement of: Achievement in Economics</td>
<td></td>
</tr>
</tbody>
</table>

3.3.3 IDENTIFICATION OF VARIABLES

In experimental researches the relationship between two types of variables namely 'independent variable' and 'dependent variable' is studied. Independent variables are the cause while dependent ones are the effects. Another category of variables, which is equally important, is of intervening variables. All these three kinds of variables which were identified for the study are discussed below:

1. Independent Variable: Different methods of teaching which were used in the present study to see their effect on the achievement of pupils in Economics, constituted the independent variable. The experimental group I was taught through Concept Attainment Model, the experimental group II was taught through Advance Organizer Model and the control group was taught through Conventional Method. Thus, CAM, AOM and Conventional Method were the three independent variables for the present study.

2. Dependent Variable: Achievement in Economics was the dependent variable. This dependent variable was measured twice during the course of the study, first, before the experimental treatment which was pre-test stage and then after providing the experimental treatment, i.e. post-test stage.

3. Intervening Variables: There are certain variables which have their effect on the learning outcome. These variables are known as intervening variables. It is necessary to control all these variables that may effect the dependent variables. Different intervening variables in a research study can be: nature of school, grade level, subject to be taught, intelligence of pupils, socio-economic status.
of pupils, previous knowledge of pupils etc. These intervening variables were controlled either experimentally or statistically.

**CONTROLS APPLIED**

To increase the precision of the investigation, due attention was paid to control different errors arising during the experiment. As pointed out by Lingguist (1956) three basic errors arise in performance the experiment, namely, type S, type G and type R.S. errors, which characterize simple random sampling, were minimized by group matching on age, academic level intelligence and SES.

Type G errors arise due to numerous factors in each group, which thus tend to have same effect on all the subjected on one treatment group which creates systematic differences in the criterion variables from group to group. These group differences were minimized by assigning the same teacher i.e. the investigator to all the three groups for administration of treatment. Every effort herself was made to administer the treatment under similar conditions. The R errors could not arise because there was no replication of treatment in the experiment.

Attention was also paid to establish proper rapport with the students to ensure a healthy interaction during pre-test, treatment and post-test. To eliminate the inter-group interactions, the students of one school were treated with only one model, whereas the students of other schools were treated with other models.

- **Nature of School**: The sample was selected from Shri Ram Public School, D.A.V. Public School and Shiksha Bharti Public School, all in Rohtak. These schools are situated in urban area of Rohtak.
- **Grade Level**: XI class selected for the present study and the grade level was thus kept constant same during the study.
- **Subject**: all the three groups were taught same units of Economics.
- **Socio-Economic Status**: This variable was controlled statistically by employing Analysis of Co-variance (ANCOVA) for the scores
obtained by administering Socio-Economic Status Scale by Rajbir Singh, Radhey Shyam and Satish Kumar.

❖ Intelligence of Pupils: This variable can greatly affect the achievement of pupils. It was also controlled statistically by employing ANCOVA to the intelligence test scores which were obtained by employing Jalota’s Verbal Group Test of general mental abilities.

The independent variables, dependent variables and control variable with the kind of control employed in the study have been summarized in Table 3.4:

**Table 3.4**

<table>
<thead>
<tr>
<th>Independent Variable</th>
<th>Dependent Variable</th>
<th>Control Variable or Intervening Variable</th>
<th>Control Employed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Methods of Teaching:</td>
<td>Achievement in Economics</td>
<td>- Nature of School</td>
<td>Administrative (All Schools belong to Urban area of Rohtak and same units of Eco. Taught to all groups). Statistical Analysis of Co-Var.</td>
</tr>
<tr>
<td>i) CAM</td>
<td></td>
<td>- Subject to be taught</td>
<td></td>
</tr>
<tr>
<td>ii) AOM</td>
<td></td>
<td>- Pupil’s Socio-Economic Status</td>
<td></td>
</tr>
<tr>
<td>iii) Conventional</td>
<td></td>
<td>- Pupil’s Achievement</td>
<td></td>
</tr>
<tr>
<td>Method</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3.3.4 SAMPLE

In the present study, XI class students enrolled in Shri Ram Public School, D.A.V. School and Shiksha Bharti Public School were selected through purposive sampling. In all 90 students of the three schools were included into three different groups, each having the students of one school only. After matching the groups, the group wise break-up of the students is given in Table 3.5.
Table 3.5
GROUP-WISE BREAK-UP OF SAMPLE

<table>
<thead>
<tr>
<th>Name of School</th>
<th>Group</th>
<th>Group Treated as</th>
<th>Total No. of students</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shri Ram Public School, Rohtak</td>
<td>I</td>
<td>Experimental Group E₁</td>
<td>30</td>
</tr>
<tr>
<td>D.A.V. School, Rohtak</td>
<td>II</td>
<td>Experimental Group E₂</td>
<td>30</td>
</tr>
<tr>
<td>Shiksha Bharti Public School, Rohtak</td>
<td>III</td>
<td>Control Group</td>
<td>30</td>
</tr>
</tbody>
</table>

As shown in Table 3.5 the experimental group E₁ having students from Shri Ram Public School, Rohtak, were given treatment according to lesson plans prepared by using Concept Attainment Model. The experimental group E₂ having students from D.A.V. School, Rohtak, were given treatment according to the lesson plans prepared by using Advance Organizer Model. The control group having students from Shiksha Bharti Public School, Rohtak, were given treatment according to the lesson plans prepared by conventional method of teaching.

3.3.5 TOOLS

In this study, following tools were used by the investigator:

1. Criterion Test in Economics (Based on objective type of items – MCT i.e. multiple Choice Type) was developed by the investigator by consulting the subject experts, (Appendix A).
2. Lesson Plans developed by the investigator according to Concept Attainment Model, Advance Organizer Model and Conventional method of teaching.
3. Transparencies were also prepared by the investigator.
4. Jalota’s Verbal Group Test of General Mental Ability to measure Intelligence.
5. Socio-Economic Status Scale by Rajbir Singh, Radhey Shyam and Satish Kumar.
Information regarding students' age and marks obtained in 10th class were taken from schools records.

3.3.6 CRITERION ACHIEVEMENT TEST IN ECONOMICS

A criterion test based on objective type of items was developed by the investigator. This test is given in Appendix-A. This test was administered as pre-test and post-test to measure the initial and terminal behaviour of students.

(i) CONSTRUCTION OF THE TEST

Achievement test is a systematic procedure for measuring a representative sample of learning task (Gronlund, 1988). To achieve the objectives of the present study, an achievement/criterion test in Economics was constructed by the investigator from five units of XI grade Economics syllabus. It was employed to assess knowledge of students in the content to be taught and to measure the final achievement of the students after teaching the contents. The different steps followed in developing the test are summarized below:

(a) PLANNING THE TEST

The selected topics were divided into five units. All the behavioural objectives of the test were framed. Books and material related to the topic were analysed. Chapters of the text book, question papers of the past years and thought questions at the end of the text book were also studied thoroughly. The planning of achievement test takes into account

(i) determining the purpose of the test,
(ii) identification and defining the intended learning outcome,
(iii) preparing the test specifications,
(iv) Constructing relevant test items (N.E. Gronlund, 1988).

(b) ITEM WRITING

Objective type items (multiple choice) were constructed keeping in view the objectives, course content and the expected behavioural outcomes. A large number of items with wide range of difficulty were constructed from five
units of Economics syllabus prescribed for class XI. Experts in measurement and evaluation, experienced teachers of economics and teacher educators were consulted. Items which were found to be ambiguous or structurally flawed were either improved or dropped. Finally 100 items were selected for preliminary try-out.

Each item carried a score of one. The preliminary tryout test was given to 50 students of class XI. The result of the test revealed a few more points requiring modifications and improvements.

(c) TEST ADMINISTRATION

After making the required improvements, the test was printed and administered on a sample of 60 students of class XI who had already studied the content covered in the test. Detailed instructions were provided to the students. No time limit was fixed for try-out test. It was found that students took on an average 90 minutes to answer all the questions.

The marking was done using scoring key already prepared by the researcher. There was one mark for a correct answer and zero for an incorrect answer.

The tryout test and scoring key are given in Appendix.

(d) ITEM ANALYSIS

— After scoring the try-out test, the investigator took 60 answer sheets and arranged them in descending order from highest score at the top to the lowest score at the bottom.

— Then divided these 60 answer sheets into three groups on the basis of scores. The upper 20 answer sheets with the highest scores formed the upper group, the next 20 answer sheets formed the middle group and the rest 20 answer sheets with the lowest scores formed the lower group.

— After forming the three groups, the next step was to find out and tabulate the number of correct responses of an item in each group. The difficulty of an item is indicated by the total number of pupils who answered it correctly, the larger the number the easier the item. Item
difficulty was estimated by determining the percentage of pupils who answered the item correctly. The percentages were converted into proportions. The average of the proportions of correct responses on each item in the three groups was taken to be an estimate of the difficulty value of that particular item.

The formula for computing difficulty value ‘dv’ of each item was

\[ dv = \frac{Pu + Pm + Pl}{3} \]

Where

- \( dv \) — difficulty value of the item;
- \( Pu \) — Proportion of correct responses to the item from the upper group.
- \( Pm \) — Proportion of correct responses to the item from the middle group
- \( Pl \) — Proportion of correct responses to the item from the lower group

Internal Consistency Discrimination Index (rb)

The relationship between the total scores derived from a test and item scores are referred to as internal consistency discrimination index of an item.

It was found out by using the following formula:

\[ Rb = Pu - Pl \]

Where

- \( rb \) — internal consistency discrimination index
- \( Pu \) — proportion of correct responses to the item from the upper group
- \( Pl \) — proportion of correct responses to the item from the lower group.

(e) **FINAL SELECTION OF THE ITEMS**

Final selection of the items was made on the basis of difficulty value and discrimination index of each item.
(i) **DIFFICULTY VALUE**

Most of the items selected were having medium difficulty value and few items with high and few items with low difficulty values were also taken. Linderman (1971) emphasized that easy item should be included in a test in order to encourage the pupils of low ability. Some difficult items should also be included to challenge the able pupils. However, in the interest of constructing a measuring instrument of maximum quality and utility, most items included should be in the middle range of difficulty.

(ii) **Internal Consistency Discrimination Index:**

According to Garrett (1967), items with validity indices of 0.20 or more are regarded as satisfactory. Thorndike (1955) considered an item with a validity co-efficient as high as 0.25 as an outstanding 'valid' item. Hence the researcher retained those items for the final draft which were having internal consistency of 0.25 and higher. The items with zero discriminating power and negative discriminating power were discarded while selecting items for final draft.

Gronlund (1988) states, "Zero discrimination power (0.00) is obtained when an equal number of pupils in each group answer correctly. Negative discrimination power is obtained when more pupils in lower group answer correctly than pupils in the upper group. Both types of items should be removed from norm-referenced test or improved.

A bivariate scatter diagram was prepared for the achievement test, placing each item in the appropriate column and row according to its difficulty value and discrimination index respectively. Thus 75 items were retained in the final form of the test. The bivariate scatter diagram is given in Appendix.

(f) **STANDARDIZATION OF ACHIEVEMENT TEST**

75 items were selected for the final form of the achievement test. This selection sets the stage for the standardization or experimental validation of the test which includes establishing reliability and validity.
(i) RELIABILITY
Reliability refers to the consistency of test scores. The reliability of a tool is generally expressed as correlation co-efficient. In test that have a high reliability co-efficient, errors of measurement have been reduced to minimum. There are a number of tests of reliability of estimating reliability: test-retest method, parallel form method, split-half methods and Kuder-Richardson method. Fracenkel and Wellen (1993) believed that Kuder-Richardson method is the most frequently employed method for determining of consistency of tools. Therefore, in this study, Kuder-Richardson formula was found to be the most suitable method to calculate reliability. The criterion test was administered to a group of students studying in class XI, which did not form the experimental sample of population. The test formula used is given below:

\[
R = \frac{n}{n-1} \left( 1 - \frac{m (n-m)}{n (SD^2)} \right)
\]

Where 
- \( R \) - Reliability Co-efficient
- \( n \) - the no. of items in the test
- \( m \) - mean of the set of test scores
- SD - Standard deviation of the test scores.

Here 
- \( n = 75 \)
- \( m = 32.8 \)
- \( SD = 9.82 \)

\[
R = \frac{75}{74} \left( 1 - \frac{32.8 (75-32.8)}{75 (9.82)^2} \right)
\]

\[
= 0.83
\]

The reliability co-efficient of the test was revealed to be equal to 0.83 which is quite high. Therefore the criterion test in Economics was accepted as a reliable tool for the purpose of the present study.

(ii) CONTENT VALIDITY OF THE TEST
Validity is the extent to which a test measures what it purports to measure (Cronback, 1970). The validity of the achievement test constructed
for the present study was taken for granted because this achievement test was constructed after preparing the blue print and ascertaining the weightage of different topics and items. This is in concordance with Guilford (1971) who says, "There are some measures whose validity is taken for granted, for example, achievement test scores."

Content related evidence of validity is especially important in achievement tests. Gronlund (1988) emphasizes that we can build a test that has high validity by (i) identifying the learning outcomes to be measured; (ii) preparing a test plan there after specifying the sample of the items to be used; and (iii) constructing a test that closely fits the set of test specifications.

Anastasi (1961) had the opinion that content validity when applied to educational achievement test, is often called curricular validity. The preparation of test items was preceded by a thorough and systematic examination of relevant course syllabi and text books as well as by consultation with subject experts and test construction experts.

3.3.7 **JALOTA'S VERBAL GROUP TEST OF GENERAL MENTAL ABILITY**

The investigator used Jalota's Verbal Group Test of General Mental Ability for the measurement of intelligence of the experimental groups and the control group. For the following reasons the investigator decided to use this test:

(a) It is an standardized test and it can be easily administered.
(b) Separate instructions and extra time are not necessary for its sub-tests.
(c) The directions are simple and clear.
(d) The test items are so appealing that they give the necessary drive on the part of the students for taking the test.
(e) The test items do not need any precise arrangements to be made and can be administered under normal classroom conditions.
(f) The best objective is to measure ability rather than efficiency.
(i) **VALIDITY OF THE TEST**
The test was validated by Jalota and a similar validation was done to check content validity. However, the panel of experts in this included teachers, parents, guidance and counseling personnel.

(ii) **RELIABILITY OF THE TEST**
The investigator decided to use split half method to determine the reliability of the test. In this study, the reliability for the pilot sample was found to be 0.82. As such the Jalota’s Verbal Group Test of General Mental Ability was found to be valid and quite reliable. 100 multiple choice items comprised the intelligence test. Time limit was 20 minutes. At the end of the test an answer sheet was given. The students were to respond to the items by writing their right answer on the answer sheet. In this study, the test was given to group I, II and control group.

(iii) **SCORING FOR INTELLIGENCE TEST**
This was done strictly according to the scoring scheme prescribed in Jalota’s manual. Hence each score of the student represented his or her intelligence scores for the study.

3.3.8 **SOCIO-ECONOMIC STATUS SCALE**
Socio-Economic status is considered as one of the important variable in social science research. To match the experimental and control groups on the basis of socio-economic status, “Socio-Economic Status Scale” developed by Rajbir Singh, Radhey Shyam and Satish Kumar was used. This scale is valid for both rural and urban people or having allegiance to both areas. Due to the following reasons, this scale was preferred:

a) All the essential variables which determine the socio-economic status in a modern society were included in the scale.

b) The directions are simple and clear,

c) The test can be given under normal classroom conditions.
(i) **VALIDITY OF SOCIO-ECONOMIC STATUS SCALE**

To assess the validity of the questionnaire, manifold criteria were set. Firstly, 150 subjects were asked to rate their own SES on a three point scale. 1 indicates low SES, 2 indicates middle class SES and 3 indicates high SES category. Secondly, the neighbours and colleagues of the respondents were also asked to rate the respondents’ SES. Thus, two types of criterion scores were available i.e. self rating and other’s rating. The ratings were correlated with the obtained SES scores, the coefficient of correlation between self and other’s rating was \( r = 0.98 \). Self rating correlated with SES score positively, \( r = 0.737 \). Other’s rating were also found to be correlated significantly with SES scores, \( r = 0.55 \).

Thirdly, SES questionnaire of Singh and Saxena (1981) and present SES questionnaire were administered to 50 subjects simultaneously and the score of both correlated significantly to the tune of \( r = 0.689 \).

Fourthly, the factorial validity of the scale was also determined by factor analysis. Scores of 500 subjects on SES scale were firstly transformed into normalized T-scale with a mean of 50 and S.D. of 10. The normalized T-scores were, then, subjected to principal component method of factor analysis with varimax rotation alongwith Kaiser normalization restriction to four factors.

(ii) **RELIABILITY OF SOCIO-ECONOMIC STATUS SCALE**

Coefficient of stability was calculated by test-retest method. The coefficient of stability was found to be 0.693 when one hundred subjects were administered the SES scale twice after a gap of one year. Fifty subjects were administered the scale again after a gap of 30 days and the coefficient of reliability was 0.944. For internal consistency Cronbach alpha was calculated on normalized (with a mean of 50 and S.D. 10) T-scores (\( N=500 \)) and was found to be 0.791.
(iii) **ADMINISTRATION OF THE SOCIO-ECONOMICS STATUS SCALE**

The printed scale was given to the students before the commencement of the actual experiment. The purpose of the instrument was explained. They were asked to put a tick (✓) against the statements which fit them. There was no time limit for completing the test scale.

(iv) **SCORING OF THE SOCIO-ECONOMIC STATUS SCALE**

There are 25 statements in the scale. One item each for caste and occupation. Two items for family (type and size), one item for educational qualification of self and other members. The scoring procedure was followed as given in scoring key.

3.3.9 **EXPERIMENTAL PROCEDURE**

It consisted of three stages:

(i) Pre-testing,

(ii) Experimental treatment, and

(iii) Post-testing.

3.3.9 (a) **PRE-TESTING**

Before the commencement of experiment, pre-tests were conducted. They were administered in all the three groups by the investigator herself. Co-operation of class teacher was sought for conducting the tests properly. All the instructions were explained clearly to the students before administering the test. The pre-testing programme is given in Table 3.6.

**Table 3.6**

**PROGRAMME OF PRE-TESTING**

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Test administered to Control Group</th>
<th>Test administered to experimental Group-I</th>
<th>Test administered to experimental Group-II</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Intelligence Test</td>
<td>Intelligence Test</td>
<td>Intelligence Test</td>
</tr>
<tr>
<td>2</td>
<td>Socio-economic Status Scale</td>
<td>Socio-economic Status Scale</td>
<td>Socio-economic Status Scale</td>
</tr>
<tr>
<td>3</td>
<td>Achievement Test</td>
<td>Achievement Test</td>
<td>Achievement Test</td>
</tr>
</tbody>
</table>
3.3.9 (b) EXPERIMENTAL TREATMENT

After pre-testing, the experimental treatment of teaching Economics to class XI students was started. All the three groups (Control group, Experimental group-I and Experimental group-II) were taught by the investigator herself.

The control group was taught through conventional method of teaching, the experimental group-I was taught through Concept Attainment Model and the experimental group-II was taught through Advance Organizer Model. The lesson plans for experimental group-I and experimental group-II were prepared according to guide lines of Lesson Plan Guide provided by Weil Marsha and Bruce Jyoce, and were based on Concept Attainment Model and Advance Organizer Model respectively. Unlike these two experimental groups, the treatment given to control group was based on lesson plans prepared by using conventional method of teaching simultaneously with the other groups.

This treatment was maintained for 16 weeks for one period of thirty five minutes for each working day in each institution for each of the groups.

3.3.10 POST-TEST STAGE/TERMINAL STAGE

After teaching the contents to all the three groups, the students were given post-tests. The programme of post-test is summarized in Table 3.7.

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Test administered to Control Group</th>
<th>Test administered to experimental Group-I</th>
<th>Test administered to experimental Group-II</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Achievement Test</td>
<td>Achievement Test</td>
<td>Achievement Test</td>
</tr>
</tbody>
</table>

3.3.11 SCORING

Responses of each student to Achievement Test were measured using the prescribed scoring key or we can say the key prepared for the purpose. These scores were then tabulated and statistical analysis done.
3.3.12 STATISTICAL ANALYSIS

Statistics has become an indispensable tool for research. It is fundamental to the proper analysis of data. In order to achieve the objectives of the study, the data collected were statistically analysed using the following techniques:

1. Analysis of co-variance (ANCOVA) was used in order to adjust pupil’s achievement in Economics on intelligence and socio-economic status. ANCOVA was used on pre-test, post-test and gain scores of achievement test in Economics.

2. Mean and Standard Deviations were computed in respect of intelligence, socio-economic status and achievement.

3. ‘t’-test was employed for testing the significance of difference between the means of students’ achievement in Economics. This test was used on post-test and gain scores. The value of ‘t’ is computed with the help of the formula:

\[
t = \frac{M_1 - M_2}{SE_D}
\]

\[
SE_D = \sqrt{\frac{\sigma_1^2}{N_1} + \frac{\sigma_2^2}{N_2}}
\]

Where \( M_1 \) – Mean of first group
\( M_2 \) – Mean of second group
\( \sigma_1 \) – Standard deviation of first group
\( \sigma_2 \) – Standard deviation of second group
\( N_1 \) – Number of students in first group
\( N_2 \) – Number of students in second group

Thus, the procedure and design outlined in the foregoing pages was employed to pursue the objectives of the study. The methodology, tools and techniques described above were used during the course of this attempt. This provided the investigator with the data which is presented in the next chapter.

The analysis and interpretation of this data also follows in the chapter to come.