Chapter 4
METHODOLOGY

4.1 METHODOLOGY ADOPTED FOR THE STUDY
4.2 DESIGN SELECTED
4.3 VARIABLES OF THE STUDY
4.4 TOOLS USED FOR THE EXPERIMENT
4.5 SAMPLE SELECTED FOR THE STUDY
4.6 EXPERIMENTATION PROCEDURE
4.7 STATISTICAL TECHNIQUES EMPLOYED
INTRODUCTION

Research is an endless quest for knowledge or unending search for truth. “Research is considered to be the more formal, systematic, intensive process of carrying on the scientific method of analysis. It involves a more systematic structure of investigation usually resulting in some sort of formal record of procedures and report of results or conclusions” (Best, 1990). All significant research leads to progress in one field of life or the other. Research has three-fold objectives – theoretical, factual and application. In order to get factual knowledge, it is necessary to take into consideration the method that will provide the basis for the construction of knowledge about whatever is being researched. Thus methodology of the investigation is the core of every research work and the success of all research studies depends on the methodology adopted and the tools employed. A pre-planned and well-designed methodology provides the researcher with a scientific and feasible plan for solving the problems under study. According to Good, Barr and Scates (1954), “The vehicle of research cannot perform its function without methodology, since it is methodology, which lays down the way in which formal research is to be carried out and outlines the detailed description of research variables and procedures”. The purpose of the present study is to identify the study processes of learners and to develop a powerful Instructional
Plan, which will help to change their Study Approach from Surface to Deep learning. In this study, an attempt was made to compare the effectiveness of Certain Embedded Strategies with that of Constructivist Strategies in enhancing Metacognitive Awareness, Approaches to Studying, Academic Performance in Economics, and Retention Capacity of Higher Secondary School Students.

4.1 METHOD ADOPTED FOR THE STUDY

Research method may be understood as all those methods or techniques that are used for the conduct of research. According to Best and Kahn (1998), Research method “refers to the behaviour and instruments used in selecting and constructing research techniques”. Different methods and procedures are developed to aid in the acquisition of data. These tools employ distinctive ways of describing and qualifying the data gathered. Data collection is essentially an important part of the research process so that the inferences, hypotheses or generalizations, tentatively held, may be identified as valid, verified as correct, or rejected as untenable (Koul, 1993).

The investigator used the Quasi-Experimental Method, which was found to be the most suitable method for the conduct of this study. The Experimental Method provides a systematic and logical method for answering the question “If this is done under carefully controlled conditions, what will happen?” Experimentation provides
Methodology

a method of hypothesis testing. It tests the hypothesis and confirms or disconfirms it in the light of controlled variable relationships that are observed. Experimentation is a classic method of the science laboratory, where elements are manipulated and effects that are observed can be controlled. It is the most sophisticated, exacting, and powerful method for discovering and developing an organised body of knowledge. The Quasi-Experimental Method is one of the means for settling disputes regarding educational practices, the way of verifying educational improvements, and the only way of establishing a cumulative tradition in which improvement can be introduced without the danger of faddish discard of old wisdom in favour of inferior novelties. It helps to find out whether one method of teaching is more effective than the other or not. Hence, this was found to be most appropriate for the study to compare the effectiveness of Embedded Strategies of teaching with that of Strategies based on Constructivism.

4.2 DESIGN SELECTED

Research design is the arrangement of conditions of data in a manner that aims to combine relevance to the research purpose with economy in procedure. In fact, a research design is the conceptual structure within which research is conducted; it constitutes the blueprint that enables the researcher to test hypothesis by researching and arriving at valid conclusions about
Research design refers to the plan and structure of the investigation used to obtain evidence to answer research questions. The design describes the procedure for conducting the study, including when, from where, and under what conditions the data will be obtained. In other words, design indicates how the research is set up, what happens to the subjects, and what methods of data collection are used (Mac Millian & Schumacher, 1989). Among the various experimental designs, the Pretest-Posttest Non-Equivalent Group Design was adopted for the study. This design is used for classroom experiment when Experimental and Control groups are taken as regular intact classes. The reason for this is that in a school situation, it is practically not possible to upset class schedules, to gather subjects for obtaining a sufficiently large sample or to recognize classes in order to employ randomisation of groups.

In the present study, the investigator made use of the previous achievement marks in Economics and the general mental ability [by employing Kerala University Verbal Group Test of Intelligence (Nair, Pillai and Amma, 1968)] so as to equate the students and group them into two. These groups were then randomly assigned as the Experimental group and the Control group. Pre-Tests were initially administered on the two groups. The Experimental treatments...
were conducted and then Post-Tests administered. A comparison of the relative effectiveness of the experimental treatments in the two groups decides which of the two Strategies are better.

The layout of the design is presented below.

In this design,

- $O_1$ and $O_3$ are Pre-Tests and $O_2$ and $O_4$ are the Post-Tests.
- $X$ is the Experimental Group that is taught using Certain Embedded Strategies.
- $C$ is the Control Group that is taught using Constructivist Strategies.

The research design adopted for this experimental study is presented in Figure 4.1.
4.3 VARIABLES OF THE STUDY

“Variables are the conditions or characteristics that the experimenter manipulates, controls or observes” (Best, 1995). In
the present study, the dependent, independent, and extraneous variables play a vital role.

**Independent variables**

Independent variables are the conditions or characteristics that the experimenter manipulates or controls in his or her attempt to ascertain their relationship to the observed phenomena (Best, 1995). It is under the direct control of the experimenter, who may vary it in any way desired. Such variables influence the dependent variables. In experimentation, the manipulating variables are called independent variables.

The independent variables used in the present study are

- Embedded Strategies of Instruction
- Constructivist Strategies of Instruction

**Dependent Variables**

Dependent variables are the conditions or characteristics that appear, disappear or change as the experimenter introduces, removes or changes independent variables (Best, 1995). It is hypothesized that such variables depend on or are caused by another variable, i.e. the independent variable.

The dependent variables used for the present study are:

- Metacognitive Awareness
- Approaches to Studying
- Academic Performance in Economics.
- Retention Capacity
Extraneous Variables

Extraneous variables are independent variables that are not related to the purpose of the study, but may affect the dependent variables. They control the relationship between the independent and dependent variables either in the research design or through statistical procedures.

The extraneous variables in this study are

- Gender
- Locale of School.

The variables used for the study are diagrammatically presented in Figure 4.2.
4.4 TOOLS USED FOR THE EXPERIMENT

A tool is one of the most important devices to acquire data. A measuring tool is an instrument that has general acceptance and is used for taking measurement in acceptable units. These tools employ distinctive ways of describing and quantifying the data. The selection of suitable and appropriate devices for the collection of new and unknown data for the study of any problem is vital for successful research. For each and every type of research, certain instruments are needed to gather facts. The instruments thus employed are called tools. According to Best (1977), “like tools in the carpenter’s box, each research tool is appropriate in a given situation to accomplish a particular purpose”. The researcher needs various instruments to gather new facts for the research work. The instruments thus employed are called tools. The nature of the tools plays an important role in any research study.

The following tools were employed for gathering relevant data for the study.

(1) Metacognitive Awareness Inventory (Schraw and Dennison, 1994)

(2) Inventory on Approaches to Studying (Jaise and Rajan, 2009)

(3) Instructional Plans based on Embedded Strategies
(4) Instructional Plans based on Constructivist Strategies

(5) Academic Performance Test in Economics *(Jaise and Rajan, 2009)*

(6) Delayed Memory Achievement Test in Economics.

**Description of the Tools**

Each of the tools employed for the study are described below.

I. **Metacognitive Awareness Inventory**

The investigator used the Metacognitive Awareness Inventory, prepared and standardised by *Shraw and Dennison (1994)* to assess the Metacognitive Awareness of Higher Secondary School Students. The Inventory consists of the 52 items. It is long and comprehensive and assesses various facets of Metacognition, such as monitoring, planning, comprehension, debugging, information management, regulation of cognition, and evaluation.

The two main components of Metacognition, ‘knowledge about Cognition’ and ‘regulation about Cognition, are studied using the inventory’ are studied using this Inventory. The distribution of items in the Inventory under the two components of Metacognition that are spread out in seven aspects are presented in Table 4.1.
Table 4.1

Distribution of items in the Metacognitive Awareness Inventory

<table>
<thead>
<tr>
<th>Components</th>
<th>Aspects</th>
<th>Items Nos.</th>
<th>No. of items</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge about cognition</td>
<td>Declarative knowledge</td>
<td>5,10,1,16,17,20,32,46</td>
<td>8</td>
<td>17</td>
</tr>
<tr>
<td></td>
<td>Procedural knowledge</td>
<td>3,14,27,33</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Conditional knowledge</td>
<td>15,18,26,29,35</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Regulation of cognition</td>
<td>Planning</td>
<td>4,6,8,22,23,42,45</td>
<td>7</td>
<td>35</td>
</tr>
<tr>
<td></td>
<td>Information management strategies</td>
<td>9,13,30,31,37,39,,41,43,47,48</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Comprehension monitoring</td>
<td>12,2,11,21,28,34,50,</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Debugging strategies</td>
<td>25,40,44,51,52</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Evaluation</td>
<td>7,19,24,36,38,49</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>52</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Scoring Procedure**

The Metacognitive Awareness Inventory comprises of statement type items, the responses of which are to be marked on a seven-point scale. The responses and the scores assigned to each response are as follows.
Methodology

Scoring Key of Metacognitive Awareness Inventory

<table>
<thead>
<tr>
<th>Response</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not at all true of me</td>
<td>1</td>
</tr>
<tr>
<td>Disagree</td>
<td>2</td>
</tr>
<tr>
<td>Undecided</td>
<td>3</td>
</tr>
<tr>
<td>Sometimes true of me</td>
<td>4</td>
</tr>
<tr>
<td>less true of me</td>
<td>5</td>
</tr>
<tr>
<td>True of me</td>
<td>6</td>
</tr>
<tr>
<td>Very true of me</td>
<td>7</td>
</tr>
</tbody>
</table>

The maximum score that can be attained by an individual for Metacognitive Awareness Inventory is 364 (i.e. 52 x 7) and the minimum score is 52 (i.e. 52 x 1).

Validity

The concept of test validity pertains to “what the test measures and how well it does so” (Deighton, 1971, p. 393). In other words, it accurately reflects the concepts it is intended to measure. It is the degree to which the items in an instrument adequately represent the universe of the content. The content validity of the test was ensured.

Reliability

Reliability refers to the degree to which observations of the study are repeatable. The Cronbach Alpha Reliability Coefficient of the Metacognitive Awareness Inventory devised by Schraw and Dennison (1994) is 0.90.
Methodology

A copy of the Metacognitive Awareness Inventory used for the study is provided as Appendix A.

II. Inventory on Approaches to Studying

The investigator reviewed the literature related to Approaches to Studying in detail. The tools used by the previous researchers to measure Approaches to Studying were also examined. Inventories that are available are constructed and standardised in foreign countries. An Inventory on Approaches to Studying prepared under Indian context is available but is meant for science subjects. In this context, it was decided to prepare and standardise a general Inventory on Approaches to Studying.

The Inventory on Approaches to Studying, developed by Jaise and Rajan (2009), consists of 50 items, which encompasses the Approaches to Studying [Deep and Surface Approaches]. Items relating to the Deep Approach consist of sophisticated conceptions of learning with an intention to reach a personal understanding of material presented, whereas items relating to the Surface Approach involve simple conceptions of learning such as memorisation and intention to satisfy the course demand. A brief explanation of the steps involved in the construction of the Inventory follows.

Preparation of the Inventory

The Inventory on Approaches to Studying that was developed comprises of two sections relating to Deep Approach and Surface
Methodology

Approach, each with eight components. The details of the sections and components of the Deep and Surface Approaches to Studying used for preparation of the Inventory are detailed in Table 4.2.

<table>
<thead>
<tr>
<th>Sub-sections</th>
<th>Components</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Deep Approach</strong></td>
<td>1. Ability to relate new information to previous knowledge.</td>
</tr>
<tr>
<td></td>
<td>2. To study different aspects in order to obtain the entire picture.</td>
</tr>
<tr>
<td></td>
<td>3. To search for a relevant meaning and connecting point between learning materials and daily life and personal experience.</td>
</tr>
<tr>
<td></td>
<td>4. Tendency to use Metacognitive skills</td>
</tr>
<tr>
<td></td>
<td>5. Maintaining feeling of great satisfaction</td>
</tr>
<tr>
<td></td>
<td>6. Inner needs to reach a complete understanding.</td>
</tr>
<tr>
<td></td>
<td>7. Search for self-fulfillment.</td>
</tr>
<tr>
<td></td>
<td>8. Deep or intrinsic motivation.</td>
</tr>
<tr>
<td><strong>Surface Approach</strong></td>
<td>1. Tendency to choose quickest way.</td>
</tr>
<tr>
<td></td>
<td>2. To acquire the learning material without asking in depth.</td>
</tr>
<tr>
<td></td>
<td>3. To study material in a linear manner.</td>
</tr>
<tr>
<td></td>
<td>4. To relate minimal aspects without interest</td>
</tr>
<tr>
<td></td>
<td>5. To learn by rote</td>
</tr>
<tr>
<td></td>
<td>6. To be concerned with the time need to fulfil the task</td>
</tr>
<tr>
<td></td>
<td>7. Focuses on memorization the main</td>
</tr>
<tr>
<td></td>
<td>8. Surface motivation or extrinsic motivation.</td>
</tr>
</tbody>
</table>
Items were prepared for 16 components so as to fall within the two sections. Utmost care was taken to make the items clear, precise and comprehensive with regard to the construct measured. Items were prepared and subjected to expert judgment, based on which, some items were deleted and some others modified. The Draft Inventory on Approaches to Studying, consisting of 77 items, and its Response Sheet are provided as Appendix B.

**Try out of the Draft Inventory**

The Draft Inventory comprising 77 items was administered on a sample of 600 Higher Secondary School Students who were randomly selected. As per the instructions in the Draft Inventory on Approaches to Studying, students were required to answer on the three-point scale for their response ‘Always’, ‘Sometimes’ or ‘Never’. For positive items in the Inventory, a score of two was given for the response ‘Always’, one score for the response ‘Sometimes’, and zero score for the response ‘Never’. For negative items, the scoring scheme was reversed.

**Items Analysis**

For item analysis, 380 Response Sheets, complete in all respects, were selected. The item analysis was carried out using the method suggested by Edwards (1969). In order to facilitate computational procedures, 370 sheets were randomly drawn and arranged in descending order of scores. The upper 100 sheets (27%)
and lower 100 sheets (27%) were treated as Higher and Lower groups respectively.

Under each group, for each item, the number of pupils making response to ‘Always’, ‘Sometimes’ and ‘Never’ were found out and presented in the form of a frequency table. Then the t-value for each item was calculated to find out the discriminating power. The t-value showed the extent to which the Higher group and Lower group are differentiated on a given item in the inventory.

The following formula was used to calculate the t-value.

\[
t = \frac{X_1 - X_2}{\sqrt{\frac{\sigma_1^2}{N_1} + \frac{\sigma_2^2}{N_2}}}
\]

Where,

\[
X_1 = \text{Arithmetic mean of the given item for higher group}
\]

\[
X_2 = \text{Arithmetic mean of the given item for lower group}
\]

\[
\sigma_1 = \text{Standard deviation of higher group}
\]

\[
\sigma_2 = \text{Standard deviation of lower group}
\]

\[
N_1 = \text{Number of subjects in the higher group}
\]

\[
N_2 = \text{Number of subjects in the lower group}
\]
Those items exceeding a t-value of 3.33 were selected for the final inventory. The table of t-values of all 77 items in the Draft Inventory is given in Appendix C.

**Validity**

The investigator selected the Higher Secondary School Students of Kozhikode district, since they represent the subset of the population to which the results are to be generalised. The previous achievement marks in Economics were correlated with the scores in Approaches to Studying for computing Validity using Pearson’s Product-Moment Correlation. The Validity Index obtained was 0.625.

**Reliability**

The Test-Retest Method was used to establish the reliability of the Inventory on Approaches to Studying. The Retest was conducted three weeks after the first administration. The Reliability Index obtained after correcting with Spearman-Brown Formula was found to be 0.729.

**Determination of Norms**

Norm is the desirable measure used to distribute the sample under the specified group. The availability of norms is often useful because norms offer, in essence, a built-in comparison group. In the present study, there exist two groups, viz. Deep and Surface Approach groups. The Mean and Standard Deviation were 62.45
and 7.42 respectively. The norms of the Inventory on Approaches to Studying are presented below

A copy of the final Inventory on Approaches to Studying and its Response Sheet is provided as *Appendix D.*

**III. Instructional Plans based on Embedded Strategies**

Instructional Plans, for the Unit “Reforms in India” from the Macro Economic Text Book of Standard XI, were prepared for teaching in the Experimental group. The Unit selected comprised of four major Sub Units, which were subjected to thorough analysis prior to preparation of Instructional Plans.

Instructional Plans based on Certain Embedded Strategies, viz. Cognitive, Metacognitive, Macro, Social and Resource Management Strategies, were designed following the concept shared by Biggs’ theory on Deep Learning. According to Biggs, Deep
Approach is based on Metacognitive awareness, intrinsic motivation, self-regulation, effort and interest and students seek an understanding of the learning material by using Mnemonic devises. Students also critically interact with the content, relating it to previous knowledge and experience, as well as examine evidence and evaluate the logical steps by which conclusions are derived. The Strategies selected for Embedding in the Instructional Plans designed for the Experimental group conform to the concept of Deep Learning. The Deep Learning factors involved in the Instructional Plans based on Embedded Strategies are presented diagrammatically in Figure 4.3.
Figure 4.3
Deep Learning Factors involved in the Instructional Plans based on Embedded Strategies

MACRO + RESOURCE MANAGEMENT + METACOGNITIVE STRATEGIES

which moderate STUDENT LEARNING FACTORS like

- EFFORT
- INTEREST
- INTRINSIC MOTIVATION
- ATTENTION
- METACOGNITION
- POSITIVE ENVIRONMENT
- TIME MANAGEMENT
- EFFICIENCY
- SELF EFFICACY
- CRITICAL THINKING

SOCIAL + COGNITIVE STRATEGIES

which comprise TEACHING AND LEARNING FACTORS like

- REFLECTION
- CONNECTEDNESS
- MNEMONIC DEVICES
- SELF QUESTIONING
- ELABORATION
- ORGANIZATION
- SCAFFOLDING
The investigator designed the Instructional Plans for the Experimental Group by embedding the five selected strategies in three Spells. The general format of the Instructional Plan prepared for the study is presented below.

**SPELL-ONE: Instigation**

In the first Spell, Macro Strategy was used to warm up and motivate students to the lesson content by linking to the preceding knowledge and arousing their interest. This appeals to their senses and prepares their mind to receive new knowledge – it may be by way of a perplexing activity, a demonstration, or a story – through the use of the Social, Cognitive and Metacognitive Strategies.

Warming up /Preparation/Instigation
(Metacognitive Strategy +Cognitive Strategy +Resource Management Strategy)

**SPELL-TWO: Solidarity Enhancement Process and Multimedia Graphics**

The **Solidarity Enhancement Process** involves the use of Social Strategy for Deep Learning and “doing together”. Doing in itself, isn’t enough. The teacher must connect activity to abstract conceptions that makes sense of it, by peer and group collaboration among students. Thus students acquire dimensions of learning that lectures and self-reading cannot attain. For engaging in activities, students also use Resource Management Strategy that involves
managing and controlling time, effort and study environment. Thus they have a personal commitment, which enhances the Deep Learning process. The teacher provides both individual and group activities exercising the power of Social Strategy, in which lie the ability to promote Deep Learning. Deep Learning does not simply happen; it occurs from the careful sequenced assignments and activities given by the committed teacher.

The **Multimedia Graphics** involves the employment of slide shows, video clippings, and Web-based resources, which is analysed by the groups of students thereby improving student learning because they are confronted with different interpretations of the given situation. Only the cavernous learner is willing to go deep inside the available devises. The peer support system makes it possible for the students to successfully use the Multimedia Graphics, which develops thinking skills that promote Deep Learning.

The Cognitive and Metacognitive strategies thus enable students to analyse the learning points in the Graphics and use Mnemonic devices like the Memory-directed tactics that helps a learner transform or organize information so as to promote retention. This is a leap towards Deep Learning.

Social cohesion/solidarity enhancement process

(Social Strategy +Cognitive +Macro Strategy+ Resource Management Strategy)
Multimedia Graphics
(Slide shows, Video clippings, Web-based Resources)

(Metacognitive + Cognitive Strategy + Macro Strategy)

**SPELL-THREE: Self-Regulation**

Self-Regulation is a task that helps students reach Metacognition, which plays a critical role in Deep Learning. A few critical questions posed about the topics analysed by students are included in a Self-Regulation Sheet, which makes it possible to determine how students can learn to better apply the cognitive resources.

Through Self-Regulation, a student is able to think, create, grow and share.
Methodology

Through Self-Regulation, students are also able to attain Metacognitive control by

- use of self–monitory processes.
- applying a variety of problem–solving process.
- thinking about thinking of the topics and critically evaluating them. Reflective thinking is a tool for problem resolution and operates through this process.
- using affection, which regulates the dialectic relationship between knowing and acting.

Self-regulation measurement sheet

(Metacognitive +Strategy Cognitive Strategy)

An Instructional Plan based on the Embedded Strategies is provided as Appendix E.

IV. Instructional Plans based on Constructivist Strategies

Instructional Plans were also designed for the Control group based on the conventional Constructivist Strategies for the Unit “Reforms in India” from the Macro Economics Text Book of Standard XI.

V. Academic Performance Test in Economics

The Academic Performance of each student was assessed on the basis of the predetermined instructional objectives, which act as the criteria of reference. A test meant for the above purpose is
known as an Achievement outcome test. Here, such a test was used to measure the Academic Performance in Economics of Standard XI students. The Test was constructed and standardised by the investigator along with the supervising teacher. The Test covered all the concepts in the selected unit, ‘Reforms in India’.

**Procedure of Test Construction**

The Test was prepared in accordance with the scientific procedure for assessing the achievement outcome in Economics. Bloom’s Taxonomy of Educational Objectives *(Bloom, 1976)* was followed for item construction. Since the main aim of the Academic Performance Test was to check whether students have undergone Deep Learning or not, the Test was prepared based on the higher order objectives of Bloom’s Taxonomy such as Understanding, Analysis and Synthesis.

In Deep Learning, students look for meaning in what they study and relate it with real life. Students constantly ask critical questions based on what they read and hear in lectures. Hence, higher order questions based on Analysis and Synthesis were included in the Test. The investigator decided to construct only objective type items to avoid subjectivity. Among these, multiple-choice items with four alternatives were preferred, whereby there is ease in answering and scoring.
The investigator, under the guidance of the supervising teacher, initially prepared 80 items in the Draft tool. Special care was taken in preparing the distracters so that there is least possibility of guessing. The items were handed over to Higher Secondary School Teachers of Economics and subject experts in the discipline and suggestions for improvement solicited. Based on these opinions, some questions were deleted and some others were modified. The items were carefully scrutinised with regard to language, accuracy, and clarity of content. The Blue Print of the Draft Test, specifying weightages to content and objectives is given in Table 4.3.

Table 4.3
Blue Print of the Draft Academic Performance Test in Economics

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Content</th>
<th>Objectives</th>
<th></th>
<th></th>
<th></th>
<th>Total Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Reforms in India before 1991</td>
<td>1</td>
<td>(14)</td>
<td>(7)</td>
<td>(2)</td>
<td>23</td>
</tr>
<tr>
<td>2</td>
<td>New Economic Policy of India</td>
<td>1</td>
<td>(6)</td>
<td>(9)</td>
<td>-</td>
<td>15</td>
</tr>
<tr>
<td>3</td>
<td>Reforms in India after 1991</td>
<td>1</td>
<td>(6)</td>
<td>(9)</td>
<td>(2)</td>
<td>17</td>
</tr>
<tr>
<td>4</td>
<td>World Trade Organization</td>
<td>1</td>
<td>(1)</td>
<td>(4)</td>
<td>(1)</td>
<td>6</td>
</tr>
<tr>
<td>5</td>
<td>L.P.G.</td>
<td>1</td>
<td>(13)</td>
<td>(5)</td>
<td>(1)</td>
<td>19</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td>40</td>
<td>34</td>
<td>6</td>
<td></td>
<td>80</td>
</tr>
</tbody>
</table>

N.B. Figures within brackets indicate number of questions. Figures outside brackets indicate marks.
Illustrations of one Item prepared under each objective are given below.

Objective: Understanding

According to Bloom (1979), ‘Understanding’ is the ability to grasp the meaning of informational material. In the Test, items to evaluate the objective ‘Understanding’ measures students’ ability to classifies, cites, converts, describes, estimates, explains, generalises, traces the Economic concepts.

E.g. Which among the following is a structural adjustment character.

(a) Delicensing (b) Macroeconomics
(c) Microeconomics (d) None of the above

Objective: Analysis

According to Bloom (1979), ‘Analysis’ includes breaking down material into its component parts so that its organisational structure may be understood. In the Test, items to evaluate the objective ‘Analysis’ measures students’ ability to analyse the Economic concepts.

E.g. Unfair trade practices are included in

(a) FERA (b) FEMA (c) MRTP

i) Synthesis

According to Bloom (1979), ‘Synthesis’ refers to putting together and arriving at meaningful concepts and principles.
E.g. Stabilisation refers to short-term measures to correct (a) Macro economics (b) Micro economics (c) Deficit in the budget

**Scoring Procedure**

The Academic Performance Test in Economics is an objective type test in which the answers are in the form of letters. This scoring scheme of the Test is to give ‘one score’ for each correct response and ‘zero score’ for incorrect responses.

The Draft Academic Performance Test in Economics, comprising of 80 items, its Response Sheet and the Scoring Key are given as *Appendix F*.

**Try out of the Draft Test**

Piloting was conducted to estimate the time required to complete the Test and to note any ambiguity in item construction. The Draft Test, which consisted of 80 items, was administered on 600 XI\textsuperscript{th} Standard Students of the Humanities group from Kozhikode district. Besides the directions given in the Draft Test, oral instructions were also provided for answering the Test. Separate Response Sheets were provided to students.

The average time taken by students to answer all the questions was fixed as the time needed to finish the Test. The ambiguous words were rectified for precision and clarity.
**Item Analysis**

Item Analysis is the process of examining the pupils’ response to each item. This determines the quality and merit of the Test. The procedure suggested by *Ebel (1969)* was adopted for this purpose.

From 600 Response Sheets, incomplete sheets were discarded and 370 were randomly selected. The random reduction to 370 was to facilitate easy computation of D.I. and D.P. Stenciled scoring was done. The Response Sheets were arranged in the order of scores from high to low. The highest and lowest 27 percent of the total group were taken for analysis. The number of correct responses for each item in the upper group and lower group were used for calculating the Difficulty Index (D.I.) and Discriminating Power (D.P.) using the formula suggested by *Ebel (1969)*.

**Difficulty Index (D.I.)**

The Difficulty Index of an item represents the proportion of the pupils who responds to the item correctly. It is calculated by using the formula,

\[
D.I = \frac{U+L}{2N}
\]

Where,
- \( U \) = Number of correct responses in the upper group
- \( L \) = Number of correct responses in the lower group
- \( N \) = Number of pupils in any of the group.
**Methodology**

**Discrimination Power (D.P.)**

The Discriminating Power of an item refers to the quality of each item to discriminate between pupils with high and low ability. It is calculated by using the formula,

\[ D.P = \frac{U-L}{N} \]

Where, \( U \) = Number of correct responses in the upper group.

\( L \) = Number of correct responses in the lower group.

\( N \) = Number of pupils in any of the group.

**Selection of items for Final Test**

The selection of items was done based on the psychometric characteristics of the items. Items having Difficulty Index between 0.3 and 0.6 and Discriminating Power above 0.3 were selected, which are shown in the table of Difficulty Index and Discriminating Power of Academic Performance Test in Economics given as Appendix G. Forty items satisfying these psychometric properties were included in the final Test.

**Validity and Reliability**

The Pearson Product-Moment Correlation was used for computing Validity of the Academic Performance Test in Economics by correlating its scores with the previous achievement marks in Economics. The Validity Index obtained was 0.650.
Methodology

The Test-Retest Method was used to establish the Reliability of the Academic Performance Test in Economics. The Retest was conducted three weeks after the first administration. The Reliability Index obtained after correcting with Spearman-Brown Formula was 0.712.

Determination of Norms

Norm is the desirable measure used to distribute the sample under the specified group. The availability of norms is often useful because norms offer, in essence, a built-in comparison group. In the present study, there exists three groups, viz. upper, average and lower groups. The Mean and Standard Deviation were 19.45 and 4.20 respectively. The norms of the Inventory on Approaches to Studying are presented below.
The final Academic Performance Test in Economics used as the Pre- and Post-Tests, its Response Sheet and the Scoring Key are provided in Appendix H.

VI. Delayed Memory Achievement Test in Economics

To assess the retention memory in Economics, the investigator constructed the Delayed Memory Achievement Test with the help of the supervising teacher. A delayed memory achievement test helps to find out the retention capacity of the subjects of study. For the present study, a Delayed Memory Achievement Test was prepared to check the retention capacity of students in the Experimental group and Control group. It is generally assumed that the Deep Learners possess longer memory. Higher retention ability involves thinking, guessing and information processing which leads to deeper engagement with the input, which in turn strengthens memory retention. Thus in this study, the Delayed Memory Achievement Test has a wider significance. The Test prepared is almost equivalent to the Achievement Test with respect to the weightages assigned to the objectives and content with only a slight change in the order and the wording of questions. The Delayed Memory Achievement Test used for the study, its Response Sheet and its Scoring Key are given in Appendix I.
4.5 SAMPLE SELECTED FOR THE STUDY

Sampling is the process by which a relatively small member of individuals, objects or events are selected and analysed in order to find out something about the entire population from which it was selected. Sampling procedures provide generalisations on the basis of a relatively small proportion of population (Koul, 1993). Selection of sample should be based upon the purpose of investigation and should consider the following factors:

1) Size of the sample
2) Distribution of Sample
3) Techniques of Sampling
4) Factors to be represented in the Sample

1. **Size of the Sample:** Optimum sample is one, which fulfils the requirements of efficiency, representativeness, reliability and flexibility. The sample should be small enough to avoid unnecessary expenses and large enough to avoid intolerable sampling error.

   According to Krech and Crutchfield (1998, p.298), a sample of 500 will give just about as precise results of a study as it will be for the whole population. In this study, 432 Higher Secondary School Students comprised the sample.

2. **Distribution of Sample**

   The break-up of the sample used for the study is shown in Table 4.4.
Table 4.4
Break-up of the Sample

<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>Name of School</th>
<th>Locale of School</th>
<th>Treatment</th>
<th>Number</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Government Model Higher School, Kozhikode</td>
<td>Urban</td>
<td>Experimental</td>
<td>52</td>
<td>106</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Control</td>
<td>54</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>K.P. Choi Memorial Higher Secondary School, Kunnamagalam</td>
<td>Rural</td>
<td>Experimental</td>
<td>50</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Control</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Government Higher Secondary School, Puthiyappa</td>
<td>Coastal</td>
<td>Experimental</td>
<td>59</td>
<td>116</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Control</td>
<td>57</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>St. Catherine’s Higher Secondary School, Payyampally.</td>
<td>Tribal</td>
<td>Experimental</td>
<td>52</td>
<td>110</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Control</td>
<td>58</td>
<td></td>
</tr>
</tbody>
</table>

3. Techniques of Sampling

Among the various sampling techniques, the Purposive Sampling Technique was found to be most appropriate for the present study. Purposive Sampling Technique was employed for gathering data. In this technique, the investigator has complete freedom in choosing his sample. This is a very simple technique of choosing the required sample and is useful in cases where the whole data is homogeneous and the investigator has knowledge of the various aspects of the problem under study.

4. Factors to be represented

Due representation is to be given to the basic factors which would possibly influence the performance of pupils. As such, it was
decided to give representation to the following categories in the sample selection.

a. **Boy and Girls**: Students’ population consists of boys and girls. To avoid discrimination and to genuinely represent the population, the investigator selected the schools in such a way that due representation is given to both genders of students.

b. **Students of Urban, Rural, Coastal, and Tribal Schools**: Research studies relating to locale of the school reveal that there is a strong relationship between locales of schools and performance of students. Hence, students studying in the Urban, Rural, Coastal and Tribal Higher Secondary Schools, which represent the true population of Kerala, comprised the sample for the study. Figure 4.4 gives the true representation of the sampling done.
Population: Higher Secondary School Students of Kerala

Sample: Districts Selected

Kozhikode

Locale

Urban

Experimental

Control

Rural

Experimental

Control

Coastal

Experimental

Control

Wynad

Locale

Tribal

Experimental

Control
On the basis of the above considerations, the sample comprised of 432 XIIth standard students studying in Higher Secondary Schools in four Locales of both Kozhikode and Wynad districts, viz. Urban, Rural, Coastal, and Tribal locales. Figure 4.5 shows the break-up of the final sample.
4.6 EXPERIMENTATION PROCEDURE

The Experimental group was taught using the Instructional Plans based on Embedded Strategies. Instructional Plans based on Constructivist Strategies was used to teach the Control group. The procedure followed for the conduct of the study in the Experimental and Control groups are detailed below.

A. EXPERIMENTAL GROUP

1. Pre-Tests
   a) Metacognitive Awareness Inventory
   b) Inventory on Approaches to Studying
   c) Academic Performance Test in Economics

2. Instructional Plans based on Embedded Strategies

   Instructional Plans embedded with five Deep Learning Strategies were used for the Experimental Group. Thirty Instructional Plans were prepared to complete the Unit selected for experiment.

3. Post-Tests
   a) Metacognitive Awareness Inventory
   b) Inventory on Approaches to Studying
   c) Academic Performance Test in Economics
   d) Delayed Memory Achievement Test in Economics
B. **CONTROL GROUP**

1. **Pre-Tests**
   a. Metacognitive Awareness Inventory
   b. Inventory on Approaches to Studying
   c. Academic Performance Test in Economics

2. **Instructional Plans based on Constructivist Strategies**
   Instructional Plans based on Constructivist Strategies were used for the Control group. Analogous to the Experimental group, 30 Instructional Plans were prepared to complete the Unit selected for the experiment.

3. **Post-Tests**
   a. Metacognitive Awareness Inventory
   b. Inventory on Approaches to Studying
   c. Academic Performance Test in Economics
   d. Delayed Memory Achievement Test in Economics

4.7 **STATISTICAL TECHNIQUES EMPLOYED**
Since the aim of the study was to test the effectiveness of Embedded Strategies over Conventional Strategies based on Constructivism on Economics, it became necessary to find out whether there is any significant difference between the Post-Test scores of Experimental and Control groups. For this, the Achievement Test scores for Pre-Tests and Post-Tests of students in
the Experimental and Control groups were subjected to the following statistical techniques.

1. Mean

2. Standard Deviation

3. Critical Ratio

4. Analysis of Variance

5. Analysis of Covariance

6. Karl Pearson’s Coefficient of Correlation

The formula used were:

1. **Mean**

   \[ \bar{X} = \frac{\sum fx}{N} \]

   Where,
   - \( \bar{X} \) = Arithmetic Mean
   - \( \Sigma \) = sum
   - \( f \) = frequency of the class interval
   - \( x \) = mid-value
   - \( N \) = total number of scores

2. **Standard Deviation**

   \[ \text{S.D.} = \sqrt{\frac{\sum fd^2}{N} - \left( \frac{\sum fx}{N} \right)^2} \times C \]

   Where,
   - \( f \) = frequency
   - \( d \) = deviation in terms of class interval
   - \( C \) = class interval
   - \( N \) = number of scores
3. **Critical Ratio**

\[
CR = \frac{M_1 - M_2}{SE_M}
\]

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

Where,

- \(M_1\) = mean of the first sample
- \(M_2\) = mean of the second sample
- \(\sigma_1\) and \(\sigma_2\) = standard deviation of the two groups.
- \(N_1\) and \(N_2\) = size of the two samples

4. **Analysis of Variance (ANOVA)**

The analysis of variance is an effective way to determine whether the Means of more than two samples are too different to attribute to sampling error. It involves the calculation of ‘F’ ratio. ‘F’ is calculated as follows.

\[
F = \frac{M_{sb}}{M_{sw}}
\]

Where,

- \(M_{sb}\) = mean squared between
- \(M_{sw}\) = mean squared within
- \(MS_b = \frac{SS_b}{df_b}\)
- \(SS_b = \frac{(\sum X_1)^2}{N_1} + \frac{(\sum X_2)^2}{N_2} + \cdots + \frac{(\sum X)^2}{N}\)
Methodology

Where,

\[ SS_b = \text{between groups sum of squares} \]
\[ n = \text{the number of subjects in a group} \]
\[ N = \text{the number of subjects for all the groups combined} \]
\[ df_b = K - 1 \]

Where,

\[ K \text{ is the number of groups} \]

\[ MS_w = \frac{SS_w}{df_w} \]
\[ SSw = \frac{\sum X_i^2 - (\sum X_i)^2}{n_1} + \frac{\sum X_i^2 - (\sum X_i)^2}{n_2} + \cdots + \frac{\sum X_i^2 - (\sum X_i)^2}{n_k} \]

Where,

\[ SSw = \text{within group sum of squares} \]
\[ df_w = n_1 + n_2 + \cdots - K \]

Where,

\[ K \text{ is the number of groups} \]

Also,

\[ SSw = SS_t - SSb \]

Where,

\[ SS_t = \frac{\sum X^2 - (\sum X)^2}{N} \]

5. Analysis of Co-variance (ANCOVA)

Since the experiment was conducted using intact, equated classroom groups, the technique of Analysis of Co-variance was
applied for analysing the data. Through Co-variance analysis one is able to effect adjustments in final or terminal scores which allow for difference in some initial variable.

Ancova (Analysis of Co-variance) is a powerful statistical tool for the test or significance. It represents an extension of ANOVA (Analysis of variance) to allow for the correlation between the initial and final scores. The main objective of ANCOVA is to examine whether there is any significant difference between the class means in view of inherent variability within separate classes.

6. **Karl Pearson’s Product-Moment Coefficient of Correlation**

Karl Pearson’s Product-Moment Coefficient of Correlation was used to explore the Retention Capacity of students in the Experimental group and Control group by finding the correlation of scores of Academic Performance and Delayed Memory test. The Pearson’s Product Moment Coefficient of Correlation formula for calculating ‘r’ is

\[
r = \frac{N \times \Sigma XY - (\Sigma X)(\Sigma Y)}{\sqrt{\left(N \Sigma X^2 - (\Sigma X)^2\right) \left(N \Sigma Y^2 - (\Sigma Y)^2\right)}}
\]

- \(r\) = Pearson Product Moment Coefficient of Correlation
- \(\Sigma X\) = Sum of the X scores
- \(\Sigma Y\) = Sum of the Y scores
- \(\Sigma X^2\) = Sum of the squared X scores
- \(\Sigma Y^2\) = Sum of the squared Y scores
Methodology

\[ \Sigma XY = \text{Sum of the products of paired X and Y scores} \]

\[ N = \text{Number of paired scores} \quad (\text{Best & Kahn, 2005}) \]

The details of analysis of data using the relevant statistical techniques have been complied in the next chapter.