CHAPTER IV

METHODOLOGY

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METHODOLOGY

Methodology of any educational research programme occupies a unique place in collecting data from all sources. Variety of methods and procedures has been developed to aid in the collection of data. Methodology is a procedure of technique adopted in research. It describes the various steps of the plan of action to be adopted in solving the research problem. “The Machinery of Methodology occupies a very important position in any kind of research. The selection of a suitable method is a key to the successful completion of research. There is no clear-cut distinction among the different methods and the method to be adopted depends on the nature of the problem and type of data required for the purpose.

Research methodology involves ways of organizing the fund of available knowledge as well as of exploring, creating new knowledge, adoption of appropriate techniques and adoption of suitable statistical procedures. A pre-planned and well described method will provide the researcher a scientific and feasible plan for attacking and solving the problems under investigation.

According to Mc Millian and Schumacher (1989), methodology refers to the way one collects and analyses, data for acquiring knowledge by reliable trustworthy procedures.

The details of the method adopted, Design of the study, variables of the study, tools used, and samples selected, and procedure adopted in the
administration of the tools and statistical techniques used for the analysis of the data are given below.

4.1 METHOD ADOPTED

Since the study was intended to find the effectiveness of certain Behaviour Modification Models in comparison to the Activity Oriented Method, experimental method was found to be the best to conduct the study.

Experimental method is a systematic and logical method of hypothesis testing under carefully controlled conditions. It is the most sophisticated, exacting and powerful method for discovering and developing an organized body of knowledge. It is the only type of research that directly attempts to influence a particular variable and can carefully test hypothesis about cause and effect relationship. The results of experimental research permit prediction and it provides for much control and therefore establishes a systematic and logical association between manipulated factors and observed effects. Experimental research has repeatedly confirmed that systematically applied positive reinforcement leads to improved behaviour.

Design of the Study

Experimental design attempts to ensure valid casual inferences from randomized experiments conducted within practical constraints of available resources and time. “Experimental design is the blue print of the procedures that
enables the researcher to test hypothesis by reaching valid conclusions about the relationship between independent and dependent variables” (Best & Khan, 2004).

In this study the research design selected was pre-test post-test non-equivalent group design. This design is often used in classroom experiments when experimental and control groups are such naturally assembled groups as intact classes, which may be similar (Best & Khan, 2004). In this study the design is symbolically presented as:

\[ \begin{align*}
  &G_1 \quad T_1 \longrightarrow X_1 \longrightarrow T_2 \\
  &G_2 \quad T_1 \longrightarrow X_2 \longrightarrow T_2 \\
  &G_3 \quad T_1 \longrightarrow X_3 \longrightarrow T_2 \\
  &G_4 \quad T_1 \longrightarrow X_4 \longrightarrow T_2 \\
\end{align*} \]

Where;

- \( G_1 \) = Experimental Group One (CMM Group)
- \( G_2 \) = Experimental Group Two (DIM Group)
- \( G_3 \) = Experimental Group Three (Combined Group)
- \( G_4 \) = Control Group (CAOM)
- \( X_1 \) = Treatment of Contingency management Model Strategies (CMM)
- \( X_2 \) = Treatment of Direct Instruction Model Strategies (DIM)
- \( X_3 \) = Treatment of Combined Model Strategies; i.e. CMM & DIM Strategies
X₄=Treatment of Conventional Activity Oriented Method of Teaching (CAOM)

T₁=Pre-test

T₂=Post-test

**Stages of the Study**

The present study is carried out in three stages. In the first stage the students were compared on their previous achievement in Commerce and general intelligence. Then the students were tested on Achievement in Commerce, Interest in Commerce and Attitude towards Commerce. The second stage was the treatment stage in which the experimental groups were taught using Behaviour Modification Models and the control group was taught in the conventional way. The third stage was the stage of post testing, i.e. after completing the experimental treatment; the students in the experimental groups and control group were tested on Achievement in Commerce, Interest in Commerce and Attitude towards Commerce. The following table gives an overview of the different stages of the study.
### Table 4.1

#### Stages of the study

<table>
<thead>
<tr>
<th>Stage</th>
<th>Experimental Group I</th>
<th>Experimental Group II</th>
<th>Experimental Group III</th>
<th>Control Group C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-testing</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Measurement of student's......</td>
<td>Measurement of student's......</td>
<td>Measurement of student's......</td>
<td>Measurement of student's......</td>
</tr>
<tr>
<td>1</td>
<td>Previous achievement in Commerce (Previous marks)</td>
<td>Previous achievement in Commerce (Previous marks)</td>
<td>Previous achievement in Commerce (Previous marks)</td>
<td>Previous achievement in Commerce (Previous marks)</td>
</tr>
<tr>
<td>2</td>
<td>General Intelligence (Raven’s Standard Progressive Matrices)</td>
<td>General Intelligence (Raven’s Standard Progressive Matrices)</td>
<td>General Intelligence (Raven’s Standard Progressive Matrices)</td>
<td>General Intelligence (Raven’s Standard Progressive Matrices)</td>
</tr>
<tr>
<td>3</td>
<td>Present Knowledge in Commerce (Achievement test)</td>
<td>Present Knowledge in Commerce (Achievement test)</td>
<td>Present Knowledge in Commerce (Achievement test)</td>
<td>Present Knowledge in Commerce (Achievement test)</td>
</tr>
<tr>
<td>4</td>
<td>Present Interest in Commerce (Interest Inventory)</td>
<td>Present Interest in Commerce (Interest Inventory)</td>
<td>Present Interest in Commerce (Interest Inventory)</td>
<td>Present Interest in Commerce (Interest Inventory)</td>
</tr>
<tr>
<td>5</td>
<td>Present Attitude towards Commerce (Attitude Scale)</td>
<td>Present Attitude towards Commerce (Attitude Scale)</td>
<td>Present Attitude towards Commerce (Attitude Scale)</td>
<td>Present Attitude towards Commerce (Attitude Scale)</td>
</tr>
<tr>
<td>Treatment</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Teaching Commerce using CMM</td>
<td>Teaching Commerce using DIM</td>
<td>Teaching Commerce using CMM &amp; DIM</td>
<td>Teaching Commerce using CAOM</td>
</tr>
<tr>
<td>1</td>
<td>Achievement in Commerce (Achievement test)</td>
<td>Achievement in Commerce (Achievement test)</td>
<td>Achievement in Commerce (Achievement test)</td>
<td>Achievement in Commerce (Achievement test)</td>
</tr>
<tr>
<td>Post-testing</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Achievement in Commerce (Achievement test)</td>
<td>Achievement in Commerce (Achievement test)</td>
<td>Achievement in Commerce (Achievement test)</td>
<td>Achievement in Commerce (Achievement test)</td>
</tr>
<tr>
<td>2</td>
<td>Interest in Commerce (Interest Inventory)</td>
<td>Interest in Commerce (Interest Inventory)</td>
<td>Interest in Commerce (Interest Inventory)</td>
<td>Interest in Commerce (Interest Inventory)</td>
</tr>
<tr>
<td>3</td>
<td>Attitude towards Commerce (Attitude Scale)</td>
<td>Attitude towards Commerce (Attitude Scale)</td>
<td>Attitude towards Commerce (Attitude Scale)</td>
<td>Attitude towards Commerce (Attitude Scale)</td>
</tr>
</tbody>
</table>
4.2 VARIABLES OF THE STUDY

Something that can change in value and can be measured is a variable. It can be an aspect of an experimental situation or a characteristic that changes in different individuals. Variables are the conditions or characteristics that the experimenter manipulates, control or observes. (Best, 1995). In the present study, we take into consideration mainly two types of variables- Independent and dependent variable.

**Independent Variables**

The independent variables are the conditions or characteristics that the experimenter manipulates or controls in his attempt to ascertain their relationship to observed phenomena. It is under direct control of the experimenter, who may vary it in any way desired (Sarc, 1979). In this study, the methods of teaching, i.e., the Contingency Management Model, Direct Instruction Model, Combination of Contingency Management Model & Direct Instruction Model and Conventional Activity Oriented Method are the independent variables.

**Dependant Variables**

“The dependent variables are the conditions or characteristic that appear, disappear or changes as the experimenter introduces, removes or changes independent variable”(Best and Khan, 2007). In the present study the dependent variables are the Achievement in Commerce, Interest in learning Commerce and Attitude of students towards Commerce.
4.3 POPULATION OF THE STUDY

The population of the study consists of all the students studying in Standard XII in the Higher Secondary Schools of Kerala.

4.4 SAMPLES SELECTED FOR THE STUDY

In any form of research intending to draw generalization for specified population, sampling is fundamental. A sample is a small portion of a population selected for observation and analysis. By observing the characteristics of the sample, one can make certain inferences about the characteristics of the population from which it is drawn (Best, 1996). According to Koul (1984), sampling stands for the process by which a relatively small number of individuals or measures of individuals, objects or events selected and analysed in order to find out something about the entire population from which it was selected.

A detailed description of the selection of the school, class and groups are given below;

4.4.1. Selection of the School

The samples for the study are selected from two schools, Cardinal Higher Secondary School, Thrikkakara, Ernakulam (Government Aided School) and Govt. Hither Secondary School, Muppathadam, Ernakulam (Government School). The authorities and students were very co-operative and were ready to provide ample help at any time to conduct the study.
4.4.2 Selection of the Class

The investigator decided to conduct the present study on standard XII students. So, four XII grade Commerce classes of two schools were selected for the study. The pupils of standard XII belong to the 15+ age group. According to the classification of Piaget, they come under the formal operational stage. “At this stage they can logically solve all types of problems, think systematically, solve complex verbal and hypothetical problem and their cognitive structure is mature” (Wardsworth, 1989).

4.4.3 Selection of the Groups

The investigator selected four non-equivalent groups in each school with the help of the concerned teachers. To make the experimental groups and control group, around 30 students of standard XII from each division of the selected institution were joined together to form one group. Likewise total four groups were formed. Then three of the parallel groups were randomly selected as the experimental groups and the other as control group. Even though the initial sample consisted of 55-60 students in each group, those who are not attended in the pre-test and post-test were avoided from the sample selected. Thus, the final sample was reduced to 200 students.

4.5. TOOLS USED IN THE STUDY

Data collection is essentially an important part of the research process so that the inferences, hypotheses, or generalizations tentatively held might identify as
valid, verified as correct or rejected as untenable (Koul, 1984). To gather necessary
data, the investigator prepared various tools. In the present study, the tools used for
collecting data were;

i. Lesson transcripts based on Contingency Management Model

t ii. Lesson transcripts based on Direct Instruction Model

iii. Lesson transcripts based on the combination of Contingency
Management Model and Direct Instruction Model

iv. Lesson Transcripts based on Conventional Activity Oriented Method
of Teaching.

v. Achievement Test in Commerce.

vi. Commerce Interest Inventory

vii. Commerce Attitude Scale

viii. Raven’s Standard Progressive Matrices

The details regarding to tools used for the study are given below;

4.3.1 Lesson Transcripts based on Contingency Management Model

The investigator prepared the lesson transcripts according to the
Contingency Management Model. The content of the selected unit for teaching was
subjected to a careful pedagogical analysis. The investigator decided to prepare
lesson transcripts based on Contingency Management Model on the subunit
“Accounting for Partnership Business” of XII Class. The sample lesson transcripts
Methodology

Based on Contingency management Model was prepared by the investigator following the syntax of the model. Then it was given to experts in the field of Commerce teaching and teacher education. The draft lesson transcripts were modified by the investigator based on the feedback and comments received from the experts. Then two lesson transcripts were taught by the investigator as try-out to a class of XII commerce students. Then the lesson transcripts were again modified and restructured based on the actual experience of the investigator to increase the clarity of the lesson.

To develop lesson transcripts according to the Contingency Management Model, the theoretical basement presented by Joyce and Weil (1992) were taken as the guidelines. The model contains the following phases:

PHASE I - Specifying the final performance- defining target behaviour in terms of behavioural outcomes

PHASE II - Assessing the entering behaviour- observe and record frequency of behaviour and study the nature and context.

PHASE III - Formulating the contingency- taking decisions regarding the environment to be created. Select the reinforcer and reinforcement schedule.

PHASE IV - Instituting the programme - arranges the environment- inform the student - maintain the reinforcement and behaviour - shaping schedules.

PHASE V - Evaluating the programme -measures the desired response.
The investigator prepared 25 Contingency Management Model lesson transcripts. Model lesson transcripts are given as Appendix-1

4.3.2 Lesson Transcripts based on Direct Instruction Model

The investigator prepared the lesson transcripts according to the Direct Instruction Model. The content of the selected unit for teaching was subjected to a careful pedagogical analysis. The investigator decided to prepare lesson transcripts based on Direct Instruction Model on the subunit “Accounting for Partnership Business”. The sample lesson transcripts based on Direct Instruction Model was prepared by the investigator following the syntax of the model. Then it was given to experts in the field of Commerce teaching and teacher education. The draft lesson transcripts were modified by the investigator based on the feedback and comments received from the experts. Then two lesson transcripts were taught by the investigator as try-out to a class of XII commerce students. Then the lesson transcripts were again modified and restructured based on the actual experience of the investigator to increase the clarity of the lesson.

To develop lesson transcripts according to the Direct Instruction Model, the theoretical basement presented by Joyce and Weil (1992) were taken as the guidelines. According to them, each transcript contains the following phases:
1. Orientation

2. Presentation

3. Structured practice

4. Guided practice and

5. Independent practice.

**Orientation Phase**

Phase one is the orientation phase in which a framework for the lesson is established. During this phase the teacher’s expectations are communicated, the learning task is clarified, and student accountability is established. Three steps are particularly important in carrying out the intent of this phase;

i. The teacher provides the objectives of the lesson and the level of performance.

ii. The teacher describes the content of the lesson and its relationship prior knowledge and experience, and

iii. The teacher discusses the procedures of the lesson, i.e., the different parts of the lesson and student’s responsibilities during those activities.

**Presentation phase**

Phase two is presentation phase in which the teacher explains the new concept or skill and provides demonstrations and examples. If the material is a new concept, it is important that the teacher discuss the characteristics of the concept, the rule or definition, and several examples. If the material is a new skill, it is
important to identify the steps of the skill with examples of each step. In either case, it is helpful to convey this information both orally and visually so that students will have the visual representation as a reference in the early stages of learning. The latter is sometimes called a visual representation of the task (VRT). Another part of this phase is checking to see that the students have understood the new information before they apply it in the practice phase. Checking for understanding (CFU) requires that students recall or recognize the information that they have just heard. In structured practice, they will apply it.

**Structured Practice Phase**

The third phase the structured practice phase. In this, the teacher leads students through practice examples, working in lockstep fashion through each step of the problem as it appears on the VRT. The students practices as a group, offering to write answers. The teacher’s role in this phase is to give feedback on student’s responses, to reinforce accurate responses, and to correct errors. While working the practice examples, the teacher should ensure that students understand it so that they can use it as a resource during their semi-independent practice phase.

**Guided Practice Phase**

Phase four is the guided practice phase, which gives the students the opportunity to practice on their own while the teacher is still in the environment. Guided practice enables the teacher to assess the student’s abilities to perform the learning task by assessing the amount and types of errors the students are making.
The teacher’s role in this phase is to monitor student’s work, providing corrective feedback when necessary.

**Independent Practice Phase**

Providing time for students to independently practice new skill to the point of mastery is an important component of effective instruction. Thus, independent practice is the last phase of the direct instruction model. It begins when students have achieved an accuracy level of 85 to 90 percent in guided practice. The purpose on independent practice is to reinforce the new learning to ensure retention as well as to develop fluency. In independent practice, students practice on their own without assistance and with delayed feedback. It may be homework or group or individual work in the class. The teacher’s role in this phase is to make sure the independent practice work is reviewed soon after the completion to assess whether the student’s accuracy level has remained stable and to provide corrective feedback for those who need it. An independent practice activity can be short in length of time and number of practice items; however, it should not be a one-time venture. The investigator prepared 25 Direct Instruction Model lesson transcripts. The Model lesson transcripts were given as Appendix-2

**4.3.3 Lesson transcripts based on the combination of Contingency Management Model and Direct Instruction Model**

From the topics selected for teaching, the investigator has located the concepts which could be taught effectively using the combination of Contingency Management Model and Direct Instruction Model and the investigator prepared the
lesson transcripts. The content of the selected unit for teaching was subjected to a careful pedagogical analysis. The investigator decided to prepare lesson transcripts on the subunit “Accounting for Partnership Business”. Lesson transcripts were prepared by blending the syntax of the two models selected for the study after a careful analysis of the content to be taught, the concepts to be clarified, the difficulty level of the content and according to situations and relevance. In developing these transcripts the theoretical constructs presented by Joyce and Weil (1992) was taken as the guideline. The sample lesson transcripts based on the combination of Contingency Management Model & Direct Instruction Model was prepared by the investigator following the syntax of the two models. Then it was given to experts in the field of Commerce teaching and teacher education. The draft lesson transcripts were modified by the investigator based on the feedback and comments received from the experts. Then two lesson transcripts were taught by the investigator as try-out to a class of XII commerce students. Then the lesson transcripts were again modified and restructured based on the actual experience of the investigator. Support systems to be used in each class were also developed by the investigator. The investigator prepared 25 lesson transcripts and the model lesson transcripts are given as Appendix-3.

4.3.4 Lesson Transcripts based on Conventional Activity Oriented Method of Teaching

The control group was taught using the Conventional Activity Oriented Method of teaching. 25 lesson transcripts were prepared from the sub unit “Accounting for Partnership Business” based on the Activity Oriented Method
existing in the schools of Kerala state. The lesson transcripts were prepared by taking into account the curriculum objectives, the mental process etc. and instructional aids were used and activities were also given in the class to make the classes effective. The teacher gives explanation regarding the terms, facts, concepts, principles and rules etc connected with the topic. Appropriate learning activities were used to transact the content area. Model lesson transcripts based on Traditional Method is given as Appendix-4.

4.3.4. Achievement Test in Commerce

Since the present study is undertaken with the objective of testing the effectiveness of selected behaviour modification models on achievement in Commerce of Higher Secondary students, the Investigator prepared an achievement test in Commerce ‘Accounting for Partnership Business’ and administered them to the experimental groups and control group as pretest and posttest. Achievement tests are designed to measure the specific outcomes of a typical cross-section of instruction in subject area. In the present study the investigators himself prepares and standardised an achievement test (Sajikumar K. B. & Dr. P.J.Jacob). Various steps involved in the construction of an achievement test include the following;

Planning of the test

Preparation of a Design

Preparation of the Blue Print

Writing of Items
Planning of the test

The investigator decided to construct a test for XII students based on the topic ‘Accounting for Partnership Business’. The test is designed to measure the outcomes in terms of instructional objectives namely, knowledge, understanding, application, analysis’, synthesis, interest and attitude. The test consisted of objective type questions only to make the test objective. The duration of the test was fixed for 75 minutes and the maximum mark fixed was 50.

Preparation of the Design

After determining the broad scope of the test, a design was developed in tune with it. Due weightage was given to the various objectives, content areas and difficulty level of items. The items in the achievement test were prepared keeping in mind the taxonomy of instructional objectives (Bloom's, 1956) of the cognitive domain. The details regarding the weightage given to objectives, content, difficulty level and form of question, details of blue print and the type of scoring are given below.

Weightage to Objective

In constructing an achievement test, due weightage has been given to objective viz: Knowledge, understanding, application and analysis, which were taken from Bloom’s Taxonomy (1956) of educational objectives.
Knowledge: - Knowledge is defined as the remembering of previously learned material. This may include any of the following behaviour; to recall, recognize, to show information on charts, diagrams etc. without involving any substantive manipulative skill.

Understanding: - Understanding is the ability to grasp the meaning of material and may include any of the following behaviour; to compare, to explain, to define, to represent symbolically, to translate etc.

Application: - Application refers to the ability to use learned material in new and concrete situations and include any of the following behaviour; to complete, to construct, to solve, to perform, to generate etc.

Analysis: - Analysis refers to the ability to break down material into its component parts so that its organizational structure may be understood and includes the behaviours such as breaks down, to discriminates, to distinguishes, to illustrate etc.

Synthesis: - It is a complex ability at a higher level of cognition. This involves the ability of an individual to put together elements or parts so as to form a meaningful whole or
a new pattern. It involves the ability to give new shape or structure to statements or procedures.

**Evaluation:**
This is the highest level of cognitive structure. It is also the most complex ability which involves all the earlier abilities such as knowledge, understanding, application, analysis and synthesis. It enables an individual to judge a material, method, product or process against a standard and to establish the worth of it. Judgments are both quantitative and qualitative.

The weightage given to different objectives in the achievement test are presented in the table 4.2

### TABLE 4.2

**Weightage to Objective**

<table>
<thead>
<tr>
<th>SI No</th>
<th>Instructional objective</th>
<th>Marks</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Knowledge</td>
<td>10</td>
<td>20</td>
</tr>
<tr>
<td>2</td>
<td>Understanding</td>
<td>10</td>
<td>20</td>
</tr>
<tr>
<td>3</td>
<td>Application</td>
<td>10</td>
<td>20</td>
</tr>
<tr>
<td>4</td>
<td>Analysis</td>
<td>10</td>
<td>20</td>
</tr>
<tr>
<td>5</td>
<td>Synthesis</td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td>6</td>
<td>Evaluation</td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>50</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>
Weightage to Content

When the test was prepared, proper weightage was given to each subunit of the content. The whole select area of the content was divided into three sub units; which was again divided into 25 lessons. A detailed description of the weightage given to each sub unit is given below in the table 4.3

TABLE 4.3

<table>
<thead>
<tr>
<th>SI No</th>
<th>Topic</th>
<th>Marks</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Accounting for partnership- basic concepts</td>
<td>10</td>
<td>20</td>
</tr>
<tr>
<td>2</td>
<td>Reconstitution of the partnership firm</td>
<td>6</td>
<td>12</td>
</tr>
<tr>
<td>3</td>
<td>Admission of a partner</td>
<td>34</td>
<td>68</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>50</td>
<td>100</td>
</tr>
</tbody>
</table>

Weightage to Difficulty Level

Proper weightage was given to the difficulty level of the questions asked. Questions were included to consider the bright, average and dull students. The weightage given to difficulty level of the test is shown in table 4.4
TABLE 4.4
Weightage to Difficulty Level

<table>
<thead>
<tr>
<th>SI No</th>
<th>Difficulty level</th>
<th>Marks</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Easy</td>
<td>10</td>
<td>20</td>
</tr>
<tr>
<td>2</td>
<td>Average</td>
<td>30</td>
<td>60</td>
</tr>
<tr>
<td>3</td>
<td>Difficult</td>
<td>10</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>50</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

Distracter Analysis

Since the achievement test consists of multiple choice question items, there may be chances of guessing. If the distracters are properly given, guessing can be eliminated. Thus, a distracter analysis is also done by the investigator at the time of preparing the test to eliminate the chances of guessing.

Blue Print of the Achievement Test

The blue print is a three dimensional chart showing the distribution of question objective-wise, content-wise and the form of question wise. The blue print specifying the content covered by the test in relation to the weightage assigned to different objectives and form of question was prepared by the investigator and is shown in table 4.5.
<table>
<thead>
<tr>
<th>Sl No</th>
<th>Objectives</th>
<th>Knowledge</th>
<th>Understanding</th>
<th>Application</th>
<th>Analysis</th>
<th>Synthesis</th>
<th>Evaluation</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Type of Question</td>
<td>Content</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Objective type question</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Accounting for partnership- basic</td>
<td>(4) (^1)</td>
<td>(4) (^1)</td>
<td>(2) (^1)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>concepts</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Reconstitution of the partnership</td>
<td>(2) (^1)</td>
<td>(1) (^1)</td>
<td>0</td>
<td>(1) (^1)</td>
<td>(1) (^1)</td>
<td>(1) (^1)</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>firm</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Admission of a partner</td>
<td>(4) (^1)</td>
<td>(5) (^1)</td>
<td>(8) (^1)</td>
<td>(9) (^1)</td>
<td>(4) (^1)</td>
<td>(4) (^1)</td>
<td>34</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>5</td>
<td>5</td>
<td>50</td>
</tr>
</tbody>
</table>

Numbers inside the brackets indicate the number of questions.
Numbers outside the bracket indicates the marks.
Writing of Items

All the items are written as per the prepared blue print and ensure that due weightage was given to the content, objective selected for the study, difficulty level etc. This helped the investigator to ensure that no items were omitted from the question as per blue print.

While preparing questions for the achievement test, the following mental process were also given due consideration.

- Retrieves/recollects/retells information.
- Readily makes connections to new information based on past experiences and formulates ideas/concepts.
- Detects similarities and differences.
- Classifies/categories/organizes information appropriately.
- Translates/transfer knowledge/understanding and applies them in new situations.
- Establishes cause and effect relationship.
- Makes connections/relates prior knowledge to new information/applies reasoning and draw inferences.
- Communicates knowledge/understanding through different media.
- Imagine/fantasises/designs/predicts based on received information.
Judges/appraises/evaluates the merits or demerits of an idea/develops own solutions to a problem.

**Arrangement of Questions**

Writing the preliminary details such as the name of the examination, title of the paper, maximum marks and time, instruction for answering etc., the items are arranged in the order of difficulty.

**Try out of the test**

The pilot test prepared as per the blueprint was administered on a sample of 370 students of STD XII selected from the schools of the Ernakulam district by random sampling procedure. Prior arrangements were made with the authorities for the proper conduct of the test. The investigator himself administered the test with the help of the teachers of the school in ideal conditions, especially regarding the instructions given to the examinees. Enough time was given so as to enable the students to complete the test. The scoring was conducted according to the scoring key prepared by the investigator. The draft form of the Achievement test, scoring key and response sheet given to students are shown as Appendices- 5, 6 and 7 respectively.

**Item Analysis**

It is the process of establishing the suitability of an item for inclusion in the final test. The quality of the test is determined by the quality of each item and hence
each item should be analysed to study the two important characteristics of items namely;

Difficult Index and

Discriminating Power

Item analysis may help the test constructor to think twice on his ability to make good tests. The percentage of students who answer a particular item correctly is known as the Index of item Difficulty. The Discriminating Power of test item is its ability to differentiate between students who have achieved well and those who have achieved poorly. Thus for the study 370 score sheets were selected and scored. Then they are arranged in descending order. 27% of answer sheet having the highest scores were termed as Highest Group and 27% answer sheets having the lowest Scores were termed as Lower Group. The rest were removed of for determination of Discrimination Indices.

The investigator used the following formula for calculating Difficulty Index

\[
DI = \frac{(U+L)}{2N}
\]

The Discriminating Power of each item was found out by calculating Discriminating Index using the formula,

\[
DP = \frac{(U-L)}{N}
\]

Where  \( U = \) Number of right responses in the Upper Group

\( L = \) Number of right responses in the Lower Group
N = Number of students in each group.

After finding out the DI and DP, items having Difficulty Index between 0.4 and 0.6 and Discriminating Power above 0.4 were selected. Table showing Difficulty Index and Discriminating Power of the Achievement test is given as Appendix 8.

**Preparation of the Final Test**

Out of the 65 items in the try out 50 items were selected for the final test based on Difficulty Index and Discriminating Power. The selected items were arranged according to the difficulty level of the items. It was decided to give 75 minutes for answering the test. The final form of Achievement test is given as Appendix-9.

**Preparation of Scoring Key**

A scoring key consists of the correct answer of the items in the achievement test and marks allotted to them were prepared. The final form of the scoring key and response sheet given to students are shown as Appendices-10 and11 respectively.

**Reliability and Validity of the Achievement Test**

The reliability and validity of the achievement test was assessed before it was used in the final data collection. Reliability is the consistency of the test, yielding the same results in measuring whatever dies it measures. In the present study the investigator use split half method to find the reliability of the test. A sample of 120 pupils studying in standard XII was used for this purpose. Here, the odd numbered items were treated as one half of the test and scored separately and all the even
numbered items were treated as another half and scored for each examinee. The scores of the halves were correlated and the reliability of the test was found to be 0.81.

Making questions based upon pre-determined specific behaviours, ensuring that the expected answers are definite and objective, providing clearly spelt-out scheme for scoring and conducting test under identical and ideal examinations conditions helped in enhancing reliability of the test.

**Content Validity**

Before the construction of the test, a thorough analysis of the curricular objectives was done with the help of standard textbooks in XII class. The test was constructed keeping in view the weightage given for content area with instructional objectives on one hand and experts' comments and opinions on the other. So it can be treated as a valid test.

**Empirical or Statistical Validity**

The empirical validity of the test was calculated by correlating the scores of the test with marks of accountancy of students in the first year annual examination and the co-efficient of correlation obtained was 0.75. This value ensures the empirical validity of the test.

In the prepared achievement test, objectivity was ensured by including only objective type items and by using scoring key for valuation. The test was easy to administer as it was in the booklet form. It was economical, as it was reusable, since
the answer sheets were provided separately. Time needed for scoring was minimum as the window stencil method was adopted. Hence, the test had good practicality.

**PREPARATION OF COMMERCE INTEREST INVENTORY**

Since the study aims to compare the effectiveness of Behaviour Modification Models of Teaching with the Activity Oriented Method of Teaching on the Commerce Interest of the students at Higher Secondary Level, the investigator prepared and standardised a ‘Commerce Interest Inventory’. The procedure followed in the preparation of the Commerce Interest Inventory is described below.

**Selection of items**

To prepare the Commerce Interest inventory, the investigator prepared 50 activities with three choices and prepared the draft form of the test. Out of the 50 activities, one choice is related with the interest in learning Commerce and the other two choices are related with other areas of study. One mark is given to each correct response. Scoring sheets were given to the students to mark their choice from the given three alternatives and they were analysed to find out the interest in learning Commerce.

**Try out of the test**

The pilot test prepared was administered on a sample of 370 students of STD XII selected from the schools of the Ernakulam district. The investigator himself administered the test with the help of the teachers of the school in ideal conditions. The draft form of Commerce Interest Inventory and response sheet given to students are given as Appendices-12 and 13.
Item Analysis

It is the process of establishing the suitability of an item for inclusion in the final test. The quality of the test is determined by the quality of each item and hence each item should be analysed to study the two important characteristics of items namely;

Difficult Index and Discriminating Power

Item analysis may help the test constructor to think twice on his ability to make good tests. The percentage of students who answer a particular item correctly is known as the Index of Item Difficulty. The Discriminating Power of test item is its ability to differentiate between students who have achieved well and those who have achieved poorly. Thus for the study 370 score sheets were selected and scored. Then they are arranged in descending order. 27% of answer sheet having the highest scores were termed as Highest Group and 27% answer sheets having the lowest Scores were termed as Lower Group. The rest were removed of for determination of Discrimination Indices.

The investigator used the following formula for calculating Difficulty Index

\[ DI = \frac{(U+L)}{2N} \]

The Discriminating Power of each item was found out by calculating Discriminating Index using the formula,

\[ DP = \frac{(U-L)}{N} \]
Where \( U \) = Number of right responses in the Upper Group

\[ \text{L} = \text{Number of right responses in the Lower Group} \]

\[ \text{N} = \text{Number of students in each group.} \]

After finding out the DI and DP, items having Difficulty Index between 0.4 and 0.6 and Discriminating Power above 0.4 were selected. Table showing Difficulty Index and Discriminating Power of Commerce Interest Inventory is given as Appendix-14.

**Preparation of the Final Test**

Out of the 50 items in the try out 31 items fall in the category of difficulty index between 0.4 and 0.6 and discriminating power above 0.4 and then 30 items were selected for the final test. It was decided to give 30 minutes for answering the test. The final form of Commerce Interest Inventory and Scoring Sheet is given as Appendices-15 and 16.

**Reliability and Validity**

The reliability of the Commerce Interest Inventory was found by split half method. The reliability coefficient of the test was found to be 0.81. This shows that the Commerce Interest Inventory has high reliability. To establish the validity of the test, the test scores are validated against teacher’s ratings. The co-efficient of correlation of the two was found the 0.69. This shows that the C Commerce Interest Inventory has high empirical validity.
PREPARATION OF SCALE OF ATTITUDE TOWARDS COMMERCE

An attitude is an organization of motives around an individual’s responses to a person, situation or institution. It refers to a learned predisposition to react consistently in a given manner to certain persons, objects or concepts. An attitude shows evaluative personal reaction of a person. Attitudes are positive or negative feeling that an individual hold about objects, persons or ideas and are generally regarded as enduring and modifiable by experience.

Among the techniques available for construction of attitude scale, Turnstone’s Equal Appearing Scale and Likert’s Summated Rating Scale are frequently used. Likert’s method of summated Rating Scale has been perceived significantly and relatively most reliable and valid test understood and easiest to full in (Shukla, 1972). In the present study Likert’s method of Summated Rating scale has been employed.

Preparation of Items

All the statements are prepared according to the criteria suggested by Edwards (1957), Edwards and Kilpartic (1948) and Likert (1932). According them, a statement;

a. Should refer more to the prevailing conditions than to the past

b. Should not be factual, but capable of eliciting an opinion

c. Should be clear, precise, straightforward and not liable to be interpreted in more than one ways
d. Should contain only one complete thought

e. Should have unambiguous words, and simple and not too much sentences

f. Should not contain double negatives

g. Should be so worded as can be easily understood by the subjects

h. Should not be irrelevant to the topic under study

i. Likely to be endorsed by everyone or by one must be avoided and

j. Favorable and unfavorable statements must be approximately equal in number.

**Planning of the Attitude Scale**

Since the study aims to compare the effectiveness of Behaviour Modification Models of Teaching with the Activity Oriented Method of Teaching on the Commerce Attitude of the students at Higher Secondary Level, the investigator himself prepared and standardised an Attitude Scale to find out the attitude of students towards learning Commerce.

For the construction of the attitude scale the investigator collected 50 items to measure the attitude of students towards Commerce. Out of the 50 items 25 are positive statements and the remaining 25 are negative statements. The items collected were then edited and modifications were made in the statements with respect to language and meaning of words. Then the items were arranged randomly
on a three point scale. The three responses of agreement or disagreements are given as

1. Strongly agree (SA)
2. Agree (A), and
3. Disagree.

Corresponding to each statement, the columns are given to mark the responses regarding the attitude towards Commerce using a (√) mark and the draft form of the attitude scale was constructed.

**Try Out of the Attitude Scale**

The draft form of Attitude Scale prepared was administered on a sample of 370 students of STD XII selected from the schools of the Ernakulam district. The investigator himself administered the attitude scale with the help of the teachers of the school in ideal conditions. The scores of all the items were summated to obtain the Attitude of students towards Commerce. The draft form of the Attitude Scale and Scoring sheet is given as Appendices-17 and 18.

**Item Analysis**

It is the process of establishing the suitability of an item for inclusion in the final test. The quality of the test is determined by the quality of each item and hence each item should be analysed. Item analysis was done to find out;

a. Whether the items yielded satisfactory and usable data and
b. To ascertain the discriminating power of each item.

Thus, the data obtained were then statistically treated. Firstly arbitrary weightages 3, 2, 1 were assigned to responses Strongly Agree, Agree and Disagree for the positive items and the numerical weights were reversed for the negative items. The scores for each individual were computed by summing up the weights of the individual item responses. Secondly the ‘t’ values were calculated for the final selection of items. Thus for the study 370 score sheets were selected and scored. Then they are arranged in descending order. 27% of answer sheet having the highest scores were termed as Highest Group and 27% answer sheets having the lowest Scores were termed as Lower Group. The ‘t’ values for each item was calculated by the formula suggested by Likert (1932). As suggested by Likert, the thumb rule of rejecting items with ‘t’-values less than 2.58 was followed. Based on this rule 9 positive items with serial numbers 4, 11, 12, 13, 14, 21, 32, 33, 36 and three negative items with serial numbers 45, 46, and 47 were dropped out from the scale and 38 statements of which 16 were positive and 22 were negative are retained. In order to have balance between the positive statements and negative statements in the final scale, another one positive item numbered 5 and seven negative items numbered 2, 3, 8, 24, 26, 30 and 49 were deleted and remaining 15 positive statements and 15 negative statements with the highest ‘t’-values are retained in the final scale. Table of ‘t’ values indicating difficulty index and discriminating power of commerce attitude scale is shown as Appendix-19.
It was decided to give 30 minutes for answering the test. The final form of Commerce Attitude Scale and Scoring sheet is given as Appendices- 20 and 21.

**Reliability and Validity of the Attitude Scale**

The reliability of the Commerce Attitude Scale was found using the split half method. The reliability coefficient of the Attitude scale was found to be 0.86. This shows that the Commerce Attitude Scale has high reliability. Evidence regarding the validity of an attitude scale lies mainly in the procedure adopted for developing the scale. To establish the validity of the test, the test scores are validated against teacher’s ratings. The co-efficient of co-relation of the two was found the 0.66. This shows that the Commerce Attitude Scale has high empirical validity.

**RAVEN’S STANDARD PROGRESSIVE MATRICES**

Raven’s Standard Progressive Matrices (1938, 2003) are widely used non verbal test of intelligence. The RSPM was designed to measure a person’s ability to form perceptual relations and to reason by analogy independent of language and formal schooling, and may be used with persons ranging from 6 years to adult. The matrices measure two complementary components of general intelligence; the ability to think clearly and make sense of complex date, which is known as deductive ability; and the ability to store and reproduce information, known as reproductive ability. It is the first and most widely used of those instruments known as the Raven’s Progressive Matrices. Taking into consideration the opinions of the experts in the field, the investigator decided to use RSPM to measure the general mental ability of the samples.
Scoring

Raven’s Standard Progressive Matrices are multiple choice tests of abstract reasoning. It is published in 1938 is a non verbal test administered to measure a person’s capacity to apprehend meaningless figures presented for observation, see the relationship between items, conceive the nature of the figure completing each system of relationship presented and so develop a systematic method of reasoning. The RSPM consists of 60 items arranged in five sets (A, B, C, D and E) of 12 items each. Each item contains a figure with a missing piece. Below the figures are either six (for set A & B) or eight (for set C, D & E) alternative pieces to complete the figure, only one of which is correct. Each set involves a principle or “theme” for obtaining the missing piece, and within a set the items are arranged in increasing order of difficulty. All items are presented in black ink on a white background. In each set, the first problem is easiest one and the consecutive problems become generally difficult.

Reliability

Test-retest correlations range from a low of 0.46 for an eleven year interval to a high of 0.97 for a two day interval. The median test-retest value is approximately 0.82 coefficients close to this median values have been obtained with time intervals of a week to several weeks, with longer intervals ascertained with smaller values. Raven’s provide test-retest coefficient for the age group 13 years plus as 0.88.
Validity

The majority of students which have factor analysed the RSPM along with other cognitive tests. A concurrent validity coefficient between the RSPM and the Standard-Binet and Weshler scales ranges between 0.54 and 0.88, with the majority in the 0.70s and 0.80s.

Norms

Norm groups included in the manual are; British children between the age group of 6 and 16; Irish children between the ages of 6 and 12; military and civilian subjects between the age group of 20 and 65.

Marking Procedure

A student’s score on the scale is the total number of problems solved correctly when allowed to work quickly through the series from the beginning to the end. The total scores provide an idea of his intellectual capacity. To record the answers, a record form is available with the booklets of RSPM. The scoring key of the RSPM is given as Appendix-22.

4.6 PROCEDURE ADOPTED IN EXPERIMENTATION

The experiment was conducted to study the effect of certain Behaviour Modification Models namely Contingency Management Model and Direct Instruction Model and the combined effect of Contingency Management Model and Direct Instruction Model on Achievement in Commerce of students at higher secondary
level as compared to the Conventional Activity Oriented Method of teaching. For that, the investigator developed and standardised the tools.

After finalizing the samples and tools to be used, the investigator approached the authorities of the schools and sought the permission for conducting the study. The investigator met the heads of the schools and class teachers and had discussions with them and their co-operation was ensured.

Before starting the experiment, the investigator compared the previous achievement in Commerce of the students in the experimental groups and control group and also administered Raven’s Standard Progressive Matrices to compare the general mental ability of the four groups selected for the study. Then the investigator started the experiment to collect the data. The adopted procedure in conduction the experiment is given below.

4.6.1 Administration of Pre-test

4.6.2 Learning by the experimental groups.

4.6.3 Learning by control group.

4.6.4 Administration of Post-test

4.6.5 Administration of Commerce Interest Inventory and

4.6.6 Administration of Commerce Attitude Scale.
4.6.1 Administration of Pre-test

After getting permission from the heads of the schools, the investigator administered the pre-test to the four groups, prepared on the topic ‘Accounting for Partnership’. Then the investigator administered the achievement test in Commerce, as pre-tests in the experimental groups and control group. A short explanation of the aim and scope of the study was given to the students and their co-operation ensured. The rules and procedure prescribed for each type of test were strictly followed. The answer sheets were collected back after the allotted time and were scored.

4.6.2 Learning by Experimental Groups

After administering the Pre-test, the experimental groups (EI, EII & EIII) were taught using Contingency Management Model of Teaching, Direct Instruction Model of teaching and Combination of Contingency Management Model & Direct Instruction Model of teaching by the investigator. There were 25 lessons and the duration of each lesson is 40 minute. The teacher gives a clear explanation of how to do something, and the students observe, practice collectively and individually and eventually master the skill. The investigator guided them through proper channel as and when needed.

4.6.3 Learning by the Control Group

After administering the Pre-test to control group, they were taught the content using the lesson transcripts based on Activity Oriented Method of teaching. The
investigator explained the facts, concepts, principles, laws etc. connected with the topic. Equal time and effort was given to the control group also. The investigator took 25 periods of 40 minutes duration to complete the whole units selected.

4.6.4 Administration of Post-test

After the completion of the lessons to the experimental groups and control group, the investigator administered the achievement test in Commerce as post-tests in the experimental groups and control group. Separate question papers were given to each student. The investigator also gave additional instructions to the students. The answer sheets were collected back and the test was scored with the help of the scoring key and the scores were gathered and subjected to statistical analysis.

4.6.5 Administration of Commerce Interest Inventory

Before starting the experiment, the investigator administered Commerce Interest Inventory to the students in the experimental groups and control group prepared and standardised by the investigator to find out the interest of students towards the subject Commerce as pre-test. After the completion of the experiment, the same Commerce Interest Inventory was given to the experimental groups and control group as post-test. Then the scores obtained were subjected to statistical analysis to find out the effectiveness of the selected behaviour modification models on the Commerce Interest of the students in the experimental groups and control group.
4.6.6 Administration of Commerce Attitude Scale

Before starting the experiment, the investigator administered Commerce Attitude Scale prepared and standardised by the investigator to the students in the experimental groups and control group to find out the interest of students towards the subject Commerce as pre-test. After the completion of the experiment, the same Commerce Attitude Scale was given to the experimental groups and control group as post-test. Then the scores obtained were subjected to statistical analysis to find out the effectiveness of the selected behaviour modification models on the Attitude towards Commerce of the students in the experimental groups and control group.

Due care was taken to collect the data after administering each tool. About two months time was taken to complete the data collection procedure.

4.7 STATISTICAL TECHNIQUES EMPLOYED

To test the tenability of the hypothesis formulated for the present study the following statistical techniques were employed.

A. Descriptive Statistics

Descriptive statistical analysis limits generalization to the particular group of individuals observed.

Mean

\[
\text{Mean} = \frac{\sum X}{N}
\]

Mean is obtained by dividing the sum of the scores by the total number of scores.
Standard Deviation (SD) for large sample

\[
S.D, \sigma = \sqrt{\frac{\sum X^2}{N} - \left(\frac{\sum x}{N}\right)^2}
\]

\(\sum x\) = Sum of ‘x’ scores
\(\sum x^2\) = Sum of squares of ‘x’ scores
\(N\) = Number of sample

B. Inferential Statistics

This analysis always involves the process of sampling and the selection of a small group that is assumed to be related to the population from which it is drawn.

Critical Ratio (C.R)

\[
C.R = \frac{M_1 - M_2}{\sigma_D}
\]

where,
\(M_1\) = Mean of first sample
\(M_2\) = Mean of second sample
\(\sigma_D\) = Standard error of the difference between the means

Standard Error, \(\sigma_D\)

(a) For correlated means

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

The pretest and posttest scores of the experimental groups and control group were consolidated for statistical analysis. The mean and standard deviation of the scores for each pretest were found out and ensured the equivalence of the two groups by adopting critical ratio test. A preliminary analysis was done using the
method of critical ratio and test of significance to compare the performance of experimental and control groups.

The experiments were done using intact, previously non equated class room groups. Analysis of covariance is a method that enables the researcher to equate the pre-experimental status of the groups in terms of relevant known variables. Difference in the initial status of the group can be removed statistically so that they can be compared as though their initial status had been equated.(Best,2004). Thus in the present study the technique of ANCOVA was adopted for sharper experimental comparison of performance between experimental and control groups.

**Analysis of Covariance**

The pre-test and post-test scores of all the groups were consolidated for statistical analysis. Since the aim of the study was to determine the Effectiveness of Contingency Management Model, Direct Instruction Model, and their combined effect on achievement in Commerce, it was necessary to find out whether there is significant difference between the mean scores. The technique of ‘Analysis of Covariance’ was applied. This technique was also applied to test the effectiveness of Contingency Management Model, Direct Instruction Model, and the combined effect of these models on achievement in Commerce at knowledge, understanding and application, analysis, synthesis, evaluation, Commerce Interest and Attitude towards the subject Commerce. Analysis of Covariance represents an extension of analysis of Variance to allow for the correlation between initial and final scores. It is advocated, especially when equation experimental and control groups become
difficult “Through Covariance analysis one is able to effect adjustments in final or terminal scores which will allow difference in some initial variables”. (Garret, 1981).

In applying this statistical technique, the procedure suggested and illustrated by Garret (1981) was followed. It includes nine major steps as follows.

**Step 1**

Determine the correction terms $C_x$, $C_y$ and $C_{xy}$ being correction of ‘$X$’ scores, ‘$Y$’ scores and ‘$XY$’ scores respectively which are required to make adjustments of the standard deviation calculated from original measures, taking zero as the assumed mean. These are calculated using the formula:

$$
C_x = \frac{(\Sigma x)^2}{N} ; \quad C_y = \frac{(\Sigma y)^2}{N} ; \quad C_{xy} = \frac{(\Sigma x)(\Sigma y)}{N}
$$

Where $N$ = Number of scores of both the groups.

**Step 2**

Calculation of total sum of squares (SS) for ‘$x$’, ‘$y$’ and ‘$xy$’.

These are calculated using the formulae:

- Total (SS) for $X = \Sigma X^2 - C_x$
- Total (SS) for $Y = \Sigma Y^2 - C_y$
- Total (SS) for $XY = \Sigma XY - C_{xy}$
Step 3

Calculation of Sum of Squares (SS) Among group means. These are calculated using the formulae:

For $X = \frac{(\Sigma X_1)^2 + (\Sigma X_2)^2}{n} = C_x$

For $Y = \frac{(\Sigma Y_1)^2 + (\Sigma Y_2)^2}{n} = C_y$

For $XY = \frac{(\Sigma X_1)(\Sigma Y_1) + (\Sigma X_2)(\Sigma Y_2)}{n} = C_{xy}$

Where $n =$ No. of scores in one group

$X_1, X_2 =$ The $X$ scores of two groups

$Y_1, Y_2 =$ The $Y$ scores of two groups

Step 4.

Calculation of Sum of Squares within groups. These are calculated by using the formula.-

For $X =$ Total SS for $X$ – Among Group mean SS for $X$

For $Y =$ Total SS for $Y$ – Among Group mean SS for $Y$

For $XY =$ Total SS for $XY$ – Among Group mean SS for $XY$
Step 5

Calculation of Variance of ‘X’ and ‘Y’ scores are taken respectively. The F-test is applied to the two sets of scores of scores. This is a preliminary analysis of Variance to decide whether the scores approach close significance.

Step 6

Computation of Y (SS_{yx})

\[ SS_{yx} = SS_y - \frac{(SS_{yx})^2}{SS_x} \]

This is meant for correcting the final Y-scores for difference in initial X-scores. This is calculated for the Total ‘SS’ and within ‘SS’. Then among mean ‘SS’ determined by subtracting Within ‘SS’ from Total ‘SS’.

From the adjusted sum of Squares thus calculated, the Variance can be computed by dividing each ‘SS’ for its degree of freedom.

Then F-test is applied to the adjusted, among and within variance to determine whether the adjusted means differ significantly.

Step 7

From the Sum of Squares (SS) in ‘X’, ‘Y’ and ‘XY’, it is possible to compute several co-efficient of correlation. These are helpful in the interpretation of results obtained in step-6. The general formula used is
It may be applied to the appropriate SS’s for Total, Among Means and Within Groups. The correlation among scores and the correlation among means may be used in preliminary way to decide Analysis of Covariance is worthwhile.

**Step 8**

Calculation of adjusted ‘Y’ means by using the formula

\[ M_{xy} = M_y - b_{\text{within}} (M_x - G_m) \]

This step is to find which mean difference noticed in step-6 are significant.

**Step 9**

Testing the significance of difference among adjusted Y means. For this the standard error of difference between two means is calculated using the formula

\[ SE_D = SD_{yx} \sqrt{1/N_1 + 1/N_2} \]

Then the ‘t’ value is found from Table ‘D’ and by substituting in the equation \( t = D/SE_D \). Now we obtain the level of significance of difference at .05 or .01 level.

The details of analysis of data using relevant statistical methods have been compiled in the next chapter.