CHAPTER- III
RESEARCH DESIGN AND METHODOLOGY

3.1 INTRODUCTION
Methodology lays out the way that formal research is to carried out and outlines the detailed description of the research variables and procedures. According to Hayman “Method or Methodology refers to the way the study is to be conducted. It refers to the study design through which validity of results is to established”. The efficiency and generalizability attained by any study depends on the following factors:
(1) The selection of adequately representative sample
(2) The selection of valid and reliable tool for the collection of data required.
(3) The use of appropriate statistical techniques for analysis and interpretation of the obtained data.

This chapter gives an idea of the design of the study, how to proceed, research tool used for the study, nature and selection of sample procedure to just follow from other research studies.

3.2 RESEARCH DESIGN
According to Claire Selliz “A research design is the arrangement of conditions for collection and analysis of data in a manner that aims to combine relevance to the research purpose with economy in procedure”.

In fact, the research design is the conceptual structure within which the research is conducted. It constitutes a blue print for the collection measurement and analysis of data. As such research design includes an outline of what the researcher will do from writing the hypothesis to the final analysis of the data collected.
3.3 FEATURES OF RESEARCH DESIGN

It is a plan that specifies the sources and types of data relevant to the research problem. It is a strategy specifying the approach to be used for gathering and analyzing the data, it also includes the budget of time and cost.

In short we can say that a research design contains:

1. A clear statement of the problem
2. Procedure and techniques to be used for data collection.
3. Sample to be studied.
4. Method to be used for the analysis of the data.

This study aims to find out the effectiveness of Social Family Models of teaching on developing social competencies among higher secondary commerce students. After collection of adequate theoretical prospective from the related literature, appropriate hypotheses were formed regarding influence of variables like Social Family Models of teaching and social competencies. The following hypothesis were framed at the outset, so that they could be experimentally verified. The detailed outline of which is presented.

3.4 OBJECTIVES OF THE STUDY

The objectives of the present study are the following.

a. To compare the mean pre-test scores of social competencies of experimental and control groups.

b. To compare the mean post-test scores of social competencies of experimental and control groups.

c. To compare the mean gain scores of social competencies of experimental and control groups.

d. To study the effectiveness of social family models of teaching for the development of social competencies among higher secondary Commerce students.
### 3.5 HYPOTHESES OF THE STUDY

The following hypotheses are formulated for the present study.

a. There is no significant differences in the mean pre-test scores of social competencies of experimental and control group.

b. There is no significant differences in the mean post-test scores of social competencies of experimental and control group.

c. There is no significant difference in the mean gains scores of social competencies of experimental and control groups.

d. There is no significant difference in the development of social competencies between the students taught through social family models of teaching and through conventional method.

### 3.6 EXPERIMENTAL DESIGN ADOPTED

Experimental design is the blue-print of the procedures that enable the researcher to test hypotheses by relating independent and dependent variable. A knowledge of the important design will be very useful to research students. So that they can design their own study based on:

1. The purpose of the study
2. Variable involved and their nature and
3. Controls required

The important experimental designs are crude design and quasi experimental design in education. Under this the researcher select quasi-experimental designs for the present study.

In quasi-experimental designs, random assignment of members to the experimental and control groups is not made but random selection of experimental and control group among the groups available is made and as such the initial equivalence of groups is not assured.
In quasi-experimental design, the non-equivalent pre-test-Treatment-post test design is adopted by the investigator. The design is illustrated as follow:

\[
\begin{align*}
\text{Gr I} & \quad T_1 \xrightarrow{\text{X}} T_2 \\
& \quad \text{(Treatment)} \\
\text{Gain} & = T_2 - T_1 = DE \\
\text{Gr II} & \quad T^1_1 \quad \text{No Treatment} \quad T^1_2 \\
& \quad \text{Gain} = T^1_2 - T^1_1 = DC
\end{align*}
\]

Two groups as they exists are selected and one group is taken to be experimental group and the other the control group. Pre-tests were administered to both the groups. The control group does not received any treatment. Treatment was given only to the experimental group. After the treatment, post-tests are conducted. The differences in the pre-test and post-test measures are calculated separately for the two groups. The significance of difference between the different measures of the groups is computed. If the difference is significant, then conclude that the treatment is effective.

This is the most common design being adopted in the so called experimental researches in education. Randomization of groups generally will not be possible in the existing classroom and school administrative structures; so often we are satisfied with this design. Initial differences if any exists between the two groups, it can also be controlled by a statistical technique known as co-variance analysis.

### 3.7 TOOLS USED FOR THE STUDY

The following tools were used in the present investigation to verify the hypothesis.

a. Lesson plan based on Jurisprudential Inquiry Training Model
b. Lesson plan based on existing curriculum.
c. Social Competence Inventory.
d. Achievement Test
3.8 LESSON PLAN BASED ON JURISPRUDENTIAL INQUIRY TRAINING MODEL

Jurisprudential Inquiry Model is a teaching model included in the social family. Every individual is a member of a society and hence development, including cognitive growth and personal development becomes relevant only if an individual actively participates in the activities of the society. This model is mainly intended to achieve this type of social skill development.

Donald Oliver and James P. Shaver created this model with a view to help pupils think systematically about contemporary issues. Such issues are to be formulated as public policy questions and analysed in terms of alternative viewpoints. This type of experience helps pupils to rethink about their own views regarding an issue on the basis of points of view raised by other members of the society. Analyzing and debating social issues help them in redefining social values in accordance with changing societal conditions.

Theoretical Considerations

Democracy is a social set up in which people differ in their opinion regarding complicated social issues that present conflicting viewpoints. Resolving such issues is the basis of social development.

If this is to take place, the citizens should master the skill and develop the mental is required for systematically analyzing such issues and pass judgements after considering all possible arguments that emerge from different viewpoints. Here personal likes and dislikes will have to be forgotten and every view point has to be examined with a jurisprudential frame of reference, as done by a judge. Hence the model is named as Jurisprudential Inquiry Model.
DESCRIPTION OF THE MODEL

a. Syntax

Phase 1 – Orientation to the case

At this stage the materials concerning the social issue are introduced and opportunity given to review the facts.

Phase 2 – Identifying the issues

The facts gathered and reviewed are synthesised into public policy issues. These are considered one by one. The values and value conflicts associated with the underlying factual and definitional questions.

Phase 3 – Taking a position

State one’s position regarding the issue. This position has to be stated in terms of the framework of values.

Phase 4 – Exploring the stance (s)

Find out the point of the stance at which the value is violated (on the basis of factual evidence). Also thoroughly examine and substantiate the desirable or undesirable consequences of a position. Explain the value conflicts with the help of analogies and set priorities for the various values.

Phase 5 – Refining and qualifying the position

On the basis of the exploration in the fourth phase, the changed position is stated and justified on the basis of values. Also examine a number of similar stances.

Phase 6 – Testing factual assumptions behind qualified position

This is jurisprudential examination of the restated position (phase five) on the basis of factual support and the consequences. The validity of the position is examined.

In brief, phases one to three attempt to analyse the issue and the remaining three forms the argumentation stage.
b. Social System

Ranges from highly structured to low structured. To start with, it has to be high, but with experience it becomes low.

c. Principles of reaction

Teachers reactions are mostly probing. He questions the relevance, consistency, specificity etc of the students opinions and view points. He also ensures continuity of thought. The teacher has to be prepared for probing, on the basis of his understanding of the students interpretation of values

d. Support system

A comprehensive collection of source documents including all the facts and values associated with the issue is the main support. A relevant issue will all the related facts and other materials decides the success of the model

The investigator prepared lesson plan based on jurisprudential inquiry model with a view to help students think systematically about contemporary issue. Analysing and debating social issues help them in redefining social values in accordance with changing societal conditions.

The lesson plan formats of jurisprudential Inquiry model is given in appendix.

3.9 GROUP INVESTIGATION MODEL

SYNTAX

This model begins by confronting the students with a stimulating problem. The confrontation may be presented verbally or it may be an actual experience, it may arise naturally, or it may be provided by a teacher. If the students react, the teacher draws their attention to the differences in their reactions—what stances they take, what they perceive, how they organize things and what they feel. As the students become interested in their differences in reaction, the teacher draws them towards formulating and structuring the problem for themselves. Next students analyze the required roles, organize themselves,
act and report their results. Finally the group evaluates its solution in terms of its original purpose. The cycle repeats itself, either with another confrontation or with a new problem growing out of the investigation itself.

**Phase I:** Students encounter puzzling situation (planned or unplanned)

**Phase II:** Students explore reactions to the situation.

**Phase III:** Students formulate study task and organize for study.

**Phase IV:** Independent and group activity.

**Phase V:** Students analyze progress and process.

**Phase VI:** Recycle activity.

**SOCIAL SYSTEM**

The social system is democratic, governed by decisions developed from, or at least validated by, the experience of the group-within boundaries and in relation to puzzling phenomena identified by the teacher as objects to study. The activities of the group emerge with a minimal amount of external structure provided by the teacher. Students and teacher have equal status except for role differences. The atmosphere is one of reason and negotiation.

**PRINCIPLES OF REACTION**

The teachers role in group investigation is one of counselor, consultant and friendly critic. He or she must guide and reflect the group experience over three levels: the problem solving or task level, the group management level and the level of individual meaning.

**SUPPORT SYSTEM**

The support system for group investigation should be extensive and responsive to the needs of the students. The school needs to be equipped with a first class library that provides information and opinion through a wide variety of media, it should also be able
to provide access to outside resources as well. Children should be encouraged to investigate and to contact resource people beyond the school walls.

APPLICATION

Group investigation requires flexibility from the teacher and classroom organization. Although we assume that the model fits comfortably with the environment of the ‘open’ classroom, we believe it is equally compatible with more traditional classroom.

INSTRUCTIONAL AND NURTURANT EFFECTS

INSTRUCTIONAL EFFECTS

- Constructionist view of knowledge
- Disciplined inquiry
- Effective group process and governance

NURTURANT EFFECTS

- Respect for dignity of all and commitment to pluralism
- Independence as a learner
- Commitment to social inquiry
- Interpersonal warmth and affiliation

3.10 ROLE PLAYING MODEL

The essence of role playing is the involvement of participants and observers in a real problem situation and the desire for resolution and understanding that this
involvement engenders. The role playing process provides a live sample of human behavior that serves as a vehicle for students (1) to explore their feelings (2) to gain insight into their attitudes, values and perceptions. (3) to develop their problem solving skills and attitudes and (4) to explore subject matter in varied ways.

SYNTAX

Phase I: Warming up the group

- Identify or introduce problem
- Make problem explicit
- Interpret problem story, explore issues
- Explain role playing

Phase II: Select Participant

- Analyze roles
- Select role players

Phase II: Set the stage

- Set the line of action
- Restate roles
- Get inside problem situation

Phase IV: Prepare the observers

- Decide what to look for
- Assign observation task

Phase V: Enact
Begin role play
Maintain role play
Break role play

Phase VI: Discuss and evaluate
Review action of role play
Discuss major focus
Develop nest enactment

Phase VII: Reenact
Play revised roles, suggest next steps or behavioral alternatives.

Phase VIII: Discuss and evaluate
As in phase six

Phase IX: Share experiences and generalize
Relate problem situation to real experience and current problems.
Explore general principles of behavior

SOCIAL SYSTEM

The social system in this model is moderately structured. Teachers are responsible, at least initially, for starting the phases and guiding students through the activities with in each phase, however the particular content of the discussions and enactments is determined largely by the students.

SUPPORT SYSTEM

The materials for role playing are minimal but important. The major curricular tool is the problem situation. However it is sometimes helpful to construct briefing sheets for each role. These sheets describe the role or the characters feelings. Occasionally we
also develop forms for the observers that tell them what to look for and give them a place to write it down. Films, novels and short stories make excellent sources for problem situations.

**APPLICATION**

The role playing model is extremely versatile and applicable to several educational objectives. Through role playing students can increase their abilities to recognize their own and other peoples feelings, they can acquire new behaviors for handling previously difficult situation and they can improve their problem solving skills.

**INSTRUCTIONAL AND NURTURANT EFFECTS**

**INSTRUCTIONAL EFFECTS**

- Analyses of personal values and behavior
- Strategies for solving interpersonal problems
- Empathy

**NURTURANT EFFECTS**

- Facts about social problems and values
- Comfort in expressing opinions

**3.11 LESSON PLAN BASED ON EXISTING CURRICULUM**

The investigator prepared lesson plans for the XII students in Business Studies on the basis of existing curriculum (objective based instruction) for the control group.

**What is objective based instruction?**

An instructional objective is a specific and intermediate goal attainable as a result of instruction. In that respect, instructional objectives differ from educational aims. Aims such as ‘self realisation’ ‘personality development’ etc. are distant and too general. They are not fully realisable within a limited time span. But objectives can be realized. For
example the objective ‘developing understanding on a concept can be fully realized within a very limited time. Hence these are more crucial for a practicing teacher. When properly stated, instructional objectives serves as a guide for both teaching and evaluation. A clear description of the intended outcome of instruction helps the teacher in selecting relevant materials and methods of instruction, in monitoring pupils learning progress and in selecting and practicing appropriate evaluation procedures. The instruction which is aimed to obtain the pre-determined objective is known as objective based instruction.

The lesson plan format of objective based instruction is given in appendix.

3.12 SOCIAL COMPETENCE INVENTORY

The investigator prepared and standardized a Social competency inventory to determine the effectiveness of teaching based on Social Family Models of teaching and existing method, on developing social competencies among the higher secondary commerce students.

3.13 CONSTRUCTION AND STANDARDISATION OF SOCIAL COMPETENCE INVENTORY

Planning

Planning is the key to effective testing. One of the major errors when preparing tests are inadequate planning. Careful planning will remove all the deficiencies of a test. The selection of areas to be included in the social competency like empathy, leadership, communication, co-operation, collaboration, etc.

Preparation

The investigator prepared 82 items For preparing this items the investigator referred lot of books related to Social Family Models of teaching and social competency.

After the scrutiny of experts 20 items were excluded and some of them were modified.
Each test item is expressed in clear unambiguous language; students are not given any clues to the correct answer. The scoring is objective; a table of specifications has been prepared and followed.

For each of the items there were five alternative responses – strongly agree, agree, not decided, disagree and strongly disagree are given in the response sheet.

**Try out**

The draft was tried on a stratified representative sample of 100 students of standard XII. The discriminating power of each item was calculated for the analysis.

**Item discrimination**

Item discrimination refers to the degree to which an item differentiates correctly among test takers in the behavior that the test is designed to measure. It is desirable for each item to have as high an index of discrimination as possible. Ebel has suggested the following “rules of thumb” for interpreting items discrimination index for standardized test.

<table>
<thead>
<tr>
<th>D – Value</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.40 and up</td>
<td>Very good item</td>
</tr>
<tr>
<td>0.30 – 0.39</td>
<td>Reasonably good items, but possibly subject to improvement</td>
</tr>
<tr>
<td>0.20 – 0.29</td>
<td>Marginal items, usually needing and being subject to improvement</td>
</tr>
<tr>
<td>Below 0.19</td>
<td>Poor them, to be rejected or improved by revision.</td>
</tr>
</tbody>
</table>
It should be noted that items with zero or negative D-value probably were inadvertently unsuited or also are intrinsically ambiguous. These interpretations are relevant only for the ability of the item to measure individual differences.

From responses, discarded incompletely responded items and selected responses. Then scored for item analysis. The procedure suggested by Edward (1957) was used to find out the discriminating power of the item. The response sheets of 100 subjects were arranged in rank order of total scores obtained by them. The score obtained by the top 27% students and bottom 27% were taken on the high group and low group respectively.

**Why 27 percent (27%)?**

The answer is that 27% provides the best compromise between two desirable but inconsistent aims as to make the extreme groups as large possible and to make extreme groups as different as possible. (Keley, 1969).

Although upper and lower groups of 27% are best, they are not really much better than groups of 25 percent would be. If one like to work with sample fractions like one fourth or one third. Instead of an add percentage like 27% he should feel free to use upper and lower fourths or thirds. However he should grant against the intuitive feeling that 33% is better than 27% because it involves groups of larger size or that 25% is better than 27% because the difference between the groups is greater in each case the supposed advantage is slightly more than offset by the opposing disadvantage. The optimum values is 27%

Then the ‘t’ value for each item was calculated using the formula

\[
t = \frac{\bar{X}_H - \bar{X}_L}{\sqrt{\frac{\sum (X_H - \bar{X}_H)^2 + \sum (X_L - \bar{X}_L)^2}{n(n-1)}}}
\]

where,

\[\bar{X}_H =\text{Arithmetic mean of the given item for high group}\]
\[ X_L = \text{Arithmetic mean of the given item for low group} \]
\[ X_H = \text{Score of high group} \]
\[ X_L = \text{Score of low group} \]
\[ n = \text{number of subjects in the group} \]
The prepared inventory is given appendix.

3.14 VALIDITY

According to Murphy and David Shofer “If a test determining or measuring what is supposed to measure and determine whether that test can be used in making accurate discussion, such a test said to be valid”.

The degree of validity is the single most important aspect of a test. While discussing about validity, it is useful to think of two general types of aims.

(1) For making general predictions about the individual tested
(2) For describing or representing aim.

It should be evident that validity is a multifaceted concept. A test posses many validities. It may highly valid for one purpose but not for others. Hence there is no single validity index for a test.

The latest standard for educational and psychological tests and manuals of American psychological Association (APA) delimits only three kinds of validity: Content validity, criterion validity, construct validity.

The present inventory was constructed in such a way that it covers the two areas. Each item in the inventory was prepared by the components and such components proposed by Howard Gardner. So inventory possess content validity.

The criterion related validity was established using Pearson product moment correlation coefficient.
\[
r = \frac{N \sum XY - \sum X \sum Y}{\sqrt{[N \sum X^2 - (\sum X)^2] [N \sum Y^2 - (\sum Y)^2]}}
\]

Where,

- \(X\) is the score of group I
- \(Y\) is the score of group II
- \(N\) is the total number of sample

The criterion related validity was established by correlating the scores of inter and intra personal intelligence obtained from 100 pupils from standard XII and the criterion related validity was found as .682.

### 3.15 RELIABILITY

When we measure the consistency of test by determining how much variations exists in specific individuals score, such variability is intra individuals variability. It is expressed as standard error measurement. If you measure the consistency at scores of a group by determining how much variation exists between the two groups measures, such type of variability is inter-individual validity or reliability measurement.

According to Freeman (1962) “the reliability of a test is its ability to yield consistent results from one set of measures to another”.

Meheren and Lehman (1978) says “reliability can be defined as the degree of consistency between two measures of the same thing”.
Reliability coefficient  |  Interpretation
--- | ---
0.85 and above  |  High reliability
0.85 to 0.60  |  Moderate reliability
Below 0.60  |  Very low reliability.

Reliability of the inter and intrapersonal intelligence inventory was found using split half method.

Items selected through item analysis of inter and intra personal intelligence inventory were splitted into two equal halves in such a way that the scores of odd number items of the total 42 items forms the first half and the scores of the even number item out of 42 items forms the second half. The two sets of scores were asked to find out the reliability coefficient using Pearson product Moment Method (Garret 1979)

\[
r = \frac{N \sum XY - \sum X \sum Y}{\sqrt{N \sum X^2 - (\sum X)^2} \sqrt{N \sum Y^2 - (\sum Y)^2}}
\]

X = Total scores for first half items
Y = Total scores for second half items
N = number of students

From the self-correlation of the half-test, the reliability coefficient of the whole test may be estimated from Spearman-Brown prophecy and as follows :

\[
r_{xx} = \frac{2 r \frac{1}{2} \frac{1}{2}}{1 + r \frac{1}{2} \frac{1}{2}}
\]

Where,

\[r_{xx} = \text{Estimate reliability of the whole test}\]

\[r \frac{1}{2} \frac{1}{2} = \text{reliability of the half test}\]

The obtained reliability index was 0.862.
3.16 EXPERIMENTATION

The present study is basically experimental study in which quasi experimental design, pre-test post-test non-equivalent groups design was adopted for the study. To conduct the experiment the investigator selected St. John’s Higher Secondary School Parappur, in the district of Thrissur in Kerala State. One division of Class XII a was exposed to the Social Family Models of Teaching acted as experimental group, while the other class XII B which was exposed conventional objective based instruction teaching (Behaviourism) acted as a control group.

Twenty periods of forty five minutes duration were taken to both experimental and control groups. The experimental group had 55 students while the control group also had 55 students.

A pre test (Social Competency Inventory) was administered to the pupils to test their Social Competencies before the treatment, in both experimental and control groups. After teaching the two different teaching strategies in both groups, a post test (Social Competency Inventory) was administered to the pupils.

3.17 SCORING

The investigator adopted specific method for scoring the responses from the students, finally 55 samples from experimental group and 55 samples from control group were obtained. The completed answer sheets of 110 students were consolidated for further analysis and all entries were coded by daises facilitating computer feeling.

3.18 STATISTICAL TECHNIQUES USED

Suitable descriptive and inferential techniques were used in the interpretation of the data to draw out meaningful pictures of results from the collected data. In the present study, the following statistical measures were used:
1. **Mean** \( \bar{X} = A + \frac{\sum fd}{N} \times I \)

Where,
- \( A \) = Assured Mean
- \( F \) = Frequency
- \( D \) = Deviation from the assured Mean
- \( N \) = Number of observations
- \( I \) = Class interval

2. **Standard Deviation**

\[
SD = \sigma = I \sqrt{\frac{\sum fd^2}{N} - \left( \frac{\sum fd}{N} \right)^2}
\]

Where,
- \( F \) = Frequency
- \( D \) = Deviation from arithmetic Mean
- \( I \) = Class interval
- \( \sigma \) = Standard Deviation

3. **Quartile Deviation**

\[
Q_1 = L_1 + \left[ \frac{N/4 - C_1}{f_i} \right] \times I
\]

\[
Q.D = \frac{Q_3 - Q_1}{2}
\]

- \( Q.D \) = Quartile Deviation
- \( Q_1 \) = First Q.D
- \( Q_3 \) = Third Q.D
- \( L_1 \) = Lower Limit of medium class
- \( L_3 \) = Lower Limit of medium class
- \( N \) = Total Frequency
- \( C_1 \) = Cumulative frequency
- \( F_1F_2 \) = Frequency of the medium class
4. Standard Error

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

\( \sigma_1, \sigma_2 \) = Standard Deviation

\( N_1, N_2 \) = Total number of classes

5. Critical Ratio (CR) \( (CR) = \frac{M_1 - M_2}{SE} \)

\( M_1, M_2 \) = Means of two groups

6. Analysis of Variance (ANCOVA)

F ratio = \( \frac{\text{Variance between group}}{\text{Variance within group}} \)

Correlation term \( c = \frac{\left( \sum X_1 + \sum X_2 + 2 \times 3 \right)^2}{N} \)

TSS = \( X_2 - c \)

BSS = \( \left[ \sum \frac{X_1^2}{W_1} \right] + \left[ \sum \frac{X_3^2}{W_3} \right] - C \)

WSS = TSS – BSS

Where, \( X_1, X_2, X_3 \) are scores in different groups

\( C \) = Correlation term

\( \text{TSS} \) = Total Sum of squares

\( \text{BSS} \) = Sum of SQRS between groups

\( \text{WSS} \) = With in groups.

**Single Factor ANCOVA**

By the use of the single factor ANCOVA the influence of the uncontrolled variable, some times called the co-variable or concomitant variable was removed.
In the present study, initial status of the student in terms of multiple intelligence is the covariate. By the use of ANCOVA, the effect of this co-variable can be removed (Ferguson, 1971).

An application of sample of co-variance requires paired observations on ‘k’ groups of experimental subjects. The number of pairs of observation in the ‘k’ groups of experimental subjects. The number of pairs of observation in the ‘k’ groups is denoted by N₁, N₂….. Nₖ. The paired observation are assumed to the paired samples.

**SINGLE FACTOR EXPERIMENT**

Txⱼ = Sum of measurement on covariate under treatment j

Tyⱼ = Sum of measurements on variate under treatment j

Xⱼ = Mean of measurements on covariate under treatment j

Yⱼ = Mean of measurement on co-variate under treatment j

Exxⱼ = Variation on criteria under treatment j

Exyⱼ = Variation on variate under treatment j

Exx = Co-variation between variate and co-variate under treatment j

Exx = ΣExxⱼ, Eyy = ΣEyy = ΣEyy = ΣExyⱼ

Sxy = Overall Co-variation = Txy + Exy

Txx = Between treatment variation on co-variation

Tyy = Between treatment variation on variate

Txy = Between treatment co-variation

Sxx = Overall variation on co-variate = Txx + Exx

Syy = Overall variation on variate = Tyy + Eyy
To assist in the interpretation of the result, the adjusted means were calculated. There computations requires the pooled within cells regression co-efficients.

\[ B_w = \frac{E_{xy}}{E_{xx}} \]

The adjusted means for the experimental group is

\[ Y_1 \text{(adj)} = X - bw \left( X_1 - X \right) \]

The adjusted means for the control group is

\[ Y_2 \text{(adj)} = Y_2 - bw \left( X_2 - X \right) \]

While applying the ANCOVA techniques, the influence of uncontrolled variable is usually removed by simple linear regression method and the residual sums of squares are used to provide variance estimates which in turn are used to make tests of significance. In other words, Covariance analysis consists in subtracting from each individual score \( Y_i \) that portion of it \( Y_i^t \) that is predictable from uncontrolled variable \( Z_i \) and then computing the usual analysis of variance on the resulting \( Y - Y^t \) s, of course making the due adjustments to the degrees of freedom because of the fact that estimation using regression method required loss of degree of freedom.

The formulae required for the analysis of covariance and the tables of ANOVA and ANCOVA are presented below.

\[ X_1 \text{ – Pre test scores for experimental group} \]
\[ Y_1 \text{ – Post test scores for control group} \]
\[ X_2 \text{ – Pres test scores for experimental group} \]
\[ Y_2 \text{ – Post test scores for control group} \]
\[ N_1 \text{ – Sample size of experimental group} \]
N₂ – Sample size of control group

\[ \sum x = \sum x_1 + \sum x_2 \quad \sum y = \sum y_1 + \sum y_2 \]

\[ \sum x^2 = \sum x_1^2 + \sum x_2^2 \quad \sum y^2 = \sum y_1^2 + \sum y_2^2 \]

\[ \sum xy = \sum x_i y_i + \sum x_i y \quad N = N_1 + N_2 \]

Step 1 correction factor

\[ C_x = \frac{(\sum x)^2}{N} \quad C_y = \frac{(\sum y)^2}{N} \]

\[ C_{xy} = \frac{\sum x_i \cdot \sum y_i}{N} \]

Step 2 sum of squares total

\[ SS_x = \sum x^2 - C_x \]

\[ SS_y = \sum y^2 - C_y \]

\[ SS_{xy} = \sum xy^2 - C_{xy} \]

Step 3 sum of squares – Among the group

\[ SS_x = \left(\frac{\sum x_1^2}{N_1}\right) + \left(\frac{\sum x_2^2}{N_2}\right) - C_x \]

\[ SS_y = \left(\frac{\sum y_1^2}{N_1}\right) + \left(\frac{\sum y_2^2}{N_2}\right) - C_y \]

\[ SS_{xy} = \frac{\sum x_1 \cdot \sum y_1}{N_1} + \frac{\sum x_2 \cdot \sum y_2}{N_2} - C_{xy} \]

Step 4 Sum of squares – within the groups

\[ SS_x = SS_x \text{ (Total)} - SS_x \text{ (Among)} \]

\[ SS_y = SS_y \text{ (Total)} - SS_y \text{ (Among)} \]
Step 5 ANOVA Table

ANOVA was used to test the homogeneity of control group and experimental group

<table>
<thead>
<tr>
<th>Source of variation</th>
<th>df</th>
<th>SSx</th>
<th>SSy</th>
<th>MSx</th>
<th>MSy</th>
<th>F value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Among group</td>
<td>k</td>
<td></td>
<td></td>
<td>$\frac{SS_x}{df}$</td>
<td>$\frac{SS_y}{df}$</td>
<td></td>
</tr>
<tr>
<td></td>
<td>-1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Within group</td>
<td>N-k</td>
<td></td>
<td></td>
<td>$\frac{SS_x}{df}$</td>
<td>$\frac{SS_y}{df}$</td>
<td></td>
</tr>
<tr>
<td></td>
<td>k</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>N</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>-1</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

Value of F = $\frac{MS (Among the Group)}{MS (Within the Group)}$

Table values of F at 0.05 level and 0.01 level of significance for df (k-1, N-k) was calculated. Hence the homogeneity can be tested.

Step 6 Computation of Adjusted $Y$

$$\text{Total } SS_{y-x} = SS_y - \frac{(SS_y)^2}{SS_x}$$
Within $SS_{y-x} = SS_y - \frac{(SS_{xy})^2}{SS_x}$

Among $SS_{y-x} = SS_y (\text{total}) - SS_{y-x} (\text{within})$

<table>
<thead>
<tr>
<th>Source of variation</th>
<th>df</th>
<th>$SS_x$</th>
<th>$SS_y$</th>
<th>$SS_{xy}$</th>
<th>$SS_{y-x}$</th>
<th>$MS_{y-x}$</th>
<th>F value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Among group</td>
<td>k−1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Within group</td>
<td>N−k−1</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>N−2</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Value of $F = \frac{MS_{y-x} (\text{Among the Group})}{MS_{y-x} (\text{Within the Group})}$

Tabled value of $F$ at 0.05 level and 0.01 level of significance for df (k-1, N-k-1) was calculated. Hence significant difference among gain scores can be tested.
Step 7 Calculation Adjusted Means

Regression Coefficient, \( b = \frac{SS_{xy}}{SS_x} \)

Adjusted means for both control group and experimental group was calculated using the formula.

\[ M_{y-x} = M_y - b (M_x - \text{Gen.M}_x) \]

Step 8 Significance of differences among Adjusted means

Standard deviation of adjusted y’s was calculated using \( SD_{y-x} = \sqrt{V_{y-x}} ; V_{y-x} = \)

Mean square variation within the group

Standard Error between adjusted means was calculated by

\[ SE_0 = SD_{y-x} \sqrt{\frac{1}{N_1} + \frac{1}{N_2}} \]

F value is calculated using the formula

\[ F = \frac{D}{SE_0} \quad \text{Where D = difference between adjusted means} \]

Tabled value of F is taken at 0.05 and 0.01 level of significance for df (k-1, N-k-1). Compare the calculated value and table value of F. If the calculated value is greater than the tabled value at a required level, the difference is significant.

3.19 CONCLUSION

This chapter outlines the design of the present study, the procedure followed and the nature of the sample. It describes the hypotheses to be tested, the tools used and the methods of administration and scoring. Adopting the methods and procedures discussed
earlier in this chapter, tests were administered and scored. The obtained scores were analyzed, using appropriate statistical techniques described in this study for studying effectiveness of Social Family Models of teaching on developing social competencies of higher secondary commerce students.