Chapter 3

Data Analysis and Interpretation

This chapter deals with the analysis and interpretation of the collected data. Appropriate statistical data analysis techniques, namely, ANOVA, ANCOVA, Correlation, Skewness, Chi-square test, Levene's Test, Frequency distribution and Cronbach's Alpha Test were employed for data analysis. The data analysis and interpretation are presented as follows:

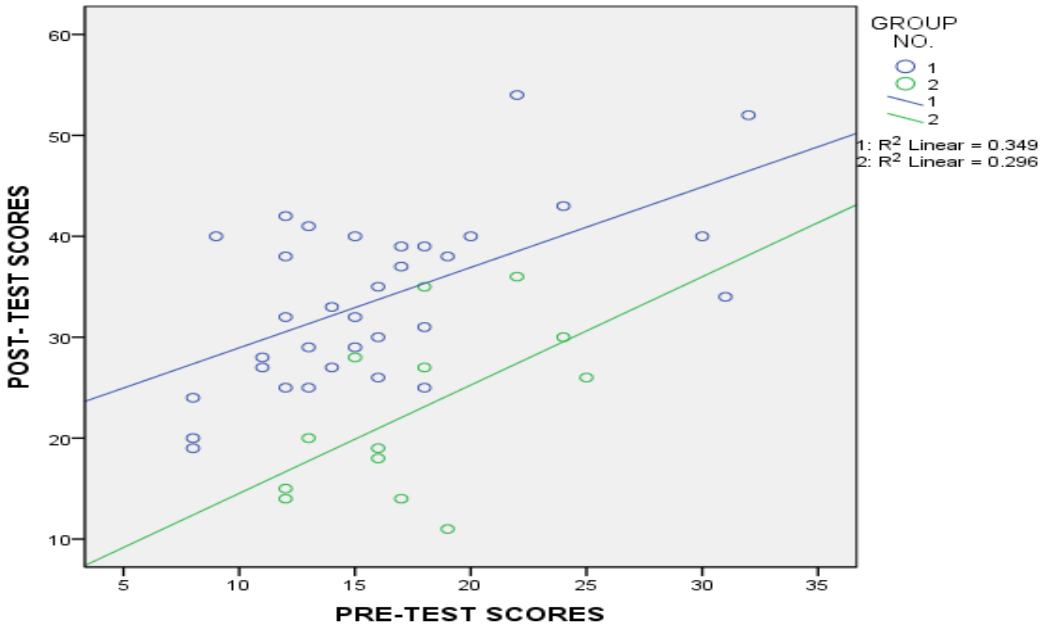
3.1 Comparison of achievement through Cooperative Learning and Conventional Method

The Null hypothesis (Ho) was "There will be no significant difference between the mean achievement scores of students who studied through cooperative learning and those with conventional method". To test this hypothesis the most suitable technique was found to be ANCOVA i.e. Analysis of Co- variance.

Prior to employing ANCOVA we must consider the covariates. Here the researcher has considered only one covariate i.e. Pre- Test scores which is the entry behaviour of the students and is measured by a multiple choice test, namely, "Entry level check on Statistical Data Analysis Techniques".

We also have to check linearity in the dependent variable (i.e. Post achievement Scores) and the covariates (i.e. Entry level check on Statistical Data Analysis Techniques) of both the groups i.e. experimental group (i.e. M.Ed. Students of Department of Education, The Maharaja Sayajirao University of Baroda, Vadodara) and the control group (i.e. M.Ed. Students of RIE – Bhopal). Following graph was plotted using SPSS software:

Graph 3.1: Scatter Plot Graph between Pre-Test Scores and Post Test Scores of Experimental Group and Control Group of Students



Here in the above graph blue and green lines are the best fitted curves for experimental and control groups respectively. Here both the curves are travelling in a general linear fashion (GLF). So, the assumption of the linear relationship has been observed.

We have also checked this assumption statistically, for that our hypothesis is that there is no significant interaction between the treatment (i.e. Post achievement scores) and the covariates (i.e. Pre test scores). Following summary was obtained:

Univariate Analysis of Variance

Between-Subjects Factors

		N
GROUP NAME	MSU	33
	RIE	13

Table 3.1: Univariate ANOVA

Tests of Between-Subjects Effects					
Dependent Variable: POST- TEST SCORES					
Source	**Type III Sum of Squares**	**Df**	**Mean Square**	**F**	**Sig.**
Corrected Model	2186.761[a]	3	728.92	15.198	0
Intercept	351.225	1	351.225	7.323	0.01
GROUPNAME	168.706	1	168.706	3.518	0.068
PRETESTSCORES	633.593	1	633.593	13.21	0.001
GROUPNAME * PRETESTSCORES	13.82	1	13.82	0.288	0.594
Error	2014.39	42	47.962		
Total	47237	46			
Corrected Total	4201.15	45			
a. R Squared = .521 (Adjusted R Squared = .486)					

We test results at 5% level of significance.

In the above table the significance value of interaction between the two groups of pre test scores is 0.594 and the rejection criteria is reject the null hypothesis (i.e. interaction is statistically significant) if sig. value < 0.05.

Here Sig. value is 0.594 which is greater than 0.05 which implies that do not reject the null hypothesis. Hence there is no significant interaction between the pre test scores of two groups. It means that we have not violated the **assumption of homogeneity of regression.** This implies that these groups are quite similar as far as their slope and trend they have.

Univariate Analysis of Variance

Between-Subjects Factors

		N
GROUP NO.	MSU	33
	RIE	13

Descriptive Statistics

Dependent Variable: POST- TEST SCORES

Table 3.2: Descriptive Statistics of Groups

GROUP NO.	Mean	Std. Deviation	N
1-MSU	33.76	8.288	33
2-RIE	22.54	8.313	13
Total	30.59	9.662	46

Mean of Post test scores of experimental group (MSU students) =33.76

Mean of Post test scores of control group (RIE students) = 22.54

Let us test **H_0: there is no significant difference in the mean scores of the post tests of experimental and control groups.**

First test the homogeneity of variances of the two groups.

Hence **H_0: there is no significant difference in the variances of the two groups.**

Table 3.3: Levene's Test of Equality of Error Variances

Dependent Variable: POST- TEST SCORES

F	df1	df2	Sig.
.015	1	44	.905

Since sig. value is 0.905 > 0.05 we do not reject our null hypothesis, which implies that we have not violated our assumption of homogeneity of variances, i.e. both the groups under the study are homogeneous in terms of variance. Now we can apply ANCOVA for testing the significant difference between the mean scores of post test achievement scores of the two groups.

Tests of Between-Subjects Effects

Dependent Variable: POST- TEST SCORES

Table 3.4: ANCOVA

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	2172.941[a]	2	1086.470	23.034	.000	.517
Intercept	889.182	1	889.182	18.851	.000	.305
PRE TEST SCORES	999.080	1	999.080	21.181	.000	.330
GROUP NO	1419.243	1	1419.243	30.089	.000	.412
Error	2028.212	43	47.168			
Total	47237.000	46				
Corrected Total	4201.152	45				

a. R Squared = .517 (Adjusted R Squared = .495)

Since sig. value of group no. is 0.00 < 0.05 which implies that both experimental and control groups are significantly different in terms of their means.

Here partial Eta squared value is 0.412 i.e. 41.2% of the variance in the post test scores is explained by the groups in individual exams.

In order to study the actual influence of the covariate, the sig. value of pre-test scores from the above table is 0.00 < 0.05 which implies that covariate is significant under the study and had significant effect on the post test scores (outcomes) and it's partial eta value is 0.33 i.e. 33.00% which is quite high. It means that 33% of variance in the post test is explained by the selected covariate. So it was a great choice to include pre-test scores as covariates in the model.

Table 3.5: To Check Reliability of Responses of Reaction Scale through Component-Wise Cronbach's Alpha Values:

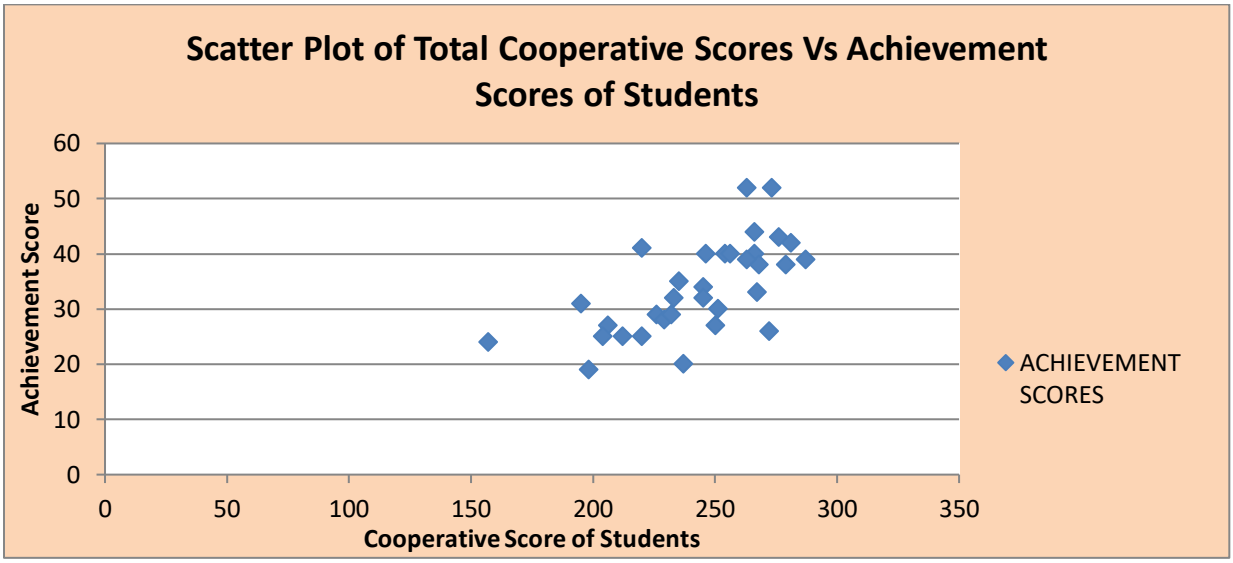
Sl. No.	Component's of Cooperative learning	Statement No.	Cronbach's alpha
1	**Positive Interdependence**	S1, S2, S3, S4, S5, S6	0.823
2	**Equal Participation**	S7, S8, S9, S10	0.586
3	**Face to Face Promotive Interaction**	S11, S12, S13, S14, S15, S16, S17, S18	0.784
4	**Individual Accountability**	S19, S20, S21, S22, S23, S24, S25, S26, S27	0.727
5	**Appropriate use of collaborative skills-** (i) Leadership	S28, S29, S30, S31, S32, S33, S34, S35, S36	0.838
6	(ii) Communication	S37, S38, S39, S40, S41	0.774
7	(iii) Trust Building	S42, S43, S44, S45, S46, S47, S48	0.837
8	(iv) Decision Making	S49, S50, S51	0.894
9	(v) Resolving Conflicts	S52, S53, S54, S55	0.747
10	**Group Processing**	S56, S57, S58, S59, S60, S61	0.887
	OVER ALL	S1 to S61	**0.959**

From the above table it can be seen that each Cronbach's alpha value is quite significant and is greater than 0.55 which means that there is consistency in the responses of the students for each statement. So we can better rely on the responses of the students collected from reaction scale.

3.2 Studying the relationship of Cooperative Scores and Achievement Scores

Cooperative Scores of Experimental group of students were calculated with the help of reactions made by the experimental group of students using Reaction scale and Achievement Scores of experimental group of students were calculated by using Post-Achievement Test on them. Following graph has shown a Scatter Plot between Cooperative Scores and Achievement Scores of the Experimental Group of Students.

Graph 3.2: Scatter Plot between Cooperative Scores and Achievement Scores



0.653804 is significantly high positive correlation between cooperative scores and achievement scores of Experimental group of students. It means that if cooperative scores increase achievement scores will also increase. And coefficient of determination $r^2 = 0.6538^2 = 0.4274$ which signifies that 42.74% of variation in achievement scores is only because of Cooperative Scores. Hence this conveys that cooperative learning is completely affecting the achievement scores in positive manner.

3.3 Analysis of Six Essential Components of Cooperative Learning:

Researcher has considered six essential components of Cooperative learning under the study. These six essential components of Cooperative Learning are Positive Interdependence, Equal Participation, Face to Face Promotive Interaction, Individual Accountability, Appropriate Use of Collaborative Skills and Group Processing. Following graphs shows the individual score of the M.Ed. students of The Maharaja Sayajirao University of Baroda, Vadodara (Experimental Group) on various components of Cooperative Learning as mentioned above:

1. Positive Interdependence

Graph 3.3: Scores of M.Ed. Students on Positive Interdependence

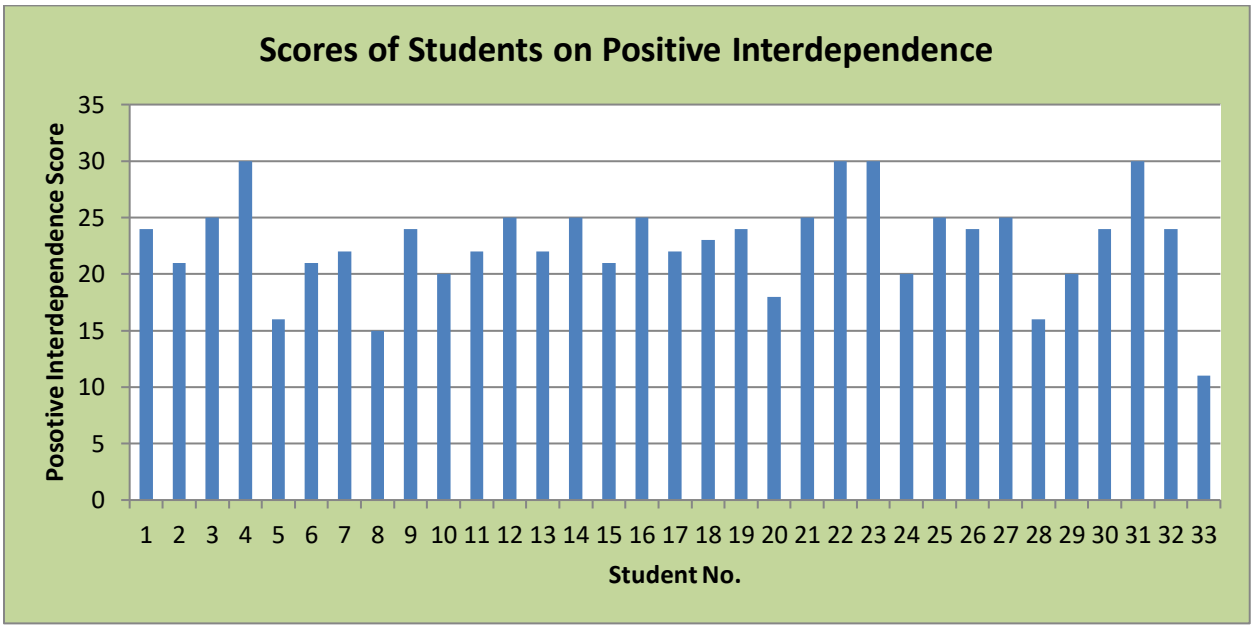


Table 3.6: Description of Positive Interdependence

Sl. No.	Descriptor	Value
1	Maximum Possible Score	30
2	Minimum Possible Score	6
3	Maximum Score Obtained	30
4	Minimum Score Obtained	11
5	Mean	22.69697
6	Med	24
7	Mode	25
8	Standard Deviation	4.333625
9	Q_1	21
10	Q_2	24
11	Q_3	25
12	Coefficient of skewness	- 0.4818

Interpretation: From the above shown graph and descriptive statistics of the component Positive Interdependence it depicts that positive interdependence was properly workout by the experimental group of students in the Cooperative Classroom. Since positive interdependence scores ranges from 11 to 30 scores where average score were 22.67 and most of the students had score of 25 as a mode score. Moreover 50% of students had scored more than 24 score with 4.3 of standard deviation. Here distribution of positive interdependence scores were negatively skewed i.e. -0.4818 which signifies that there were more number of student who had high score for positive interdependence in the classroom.

2. Equal Participation

Grap:h 3.4: Scores of M.Ed. Students on Equal Participation

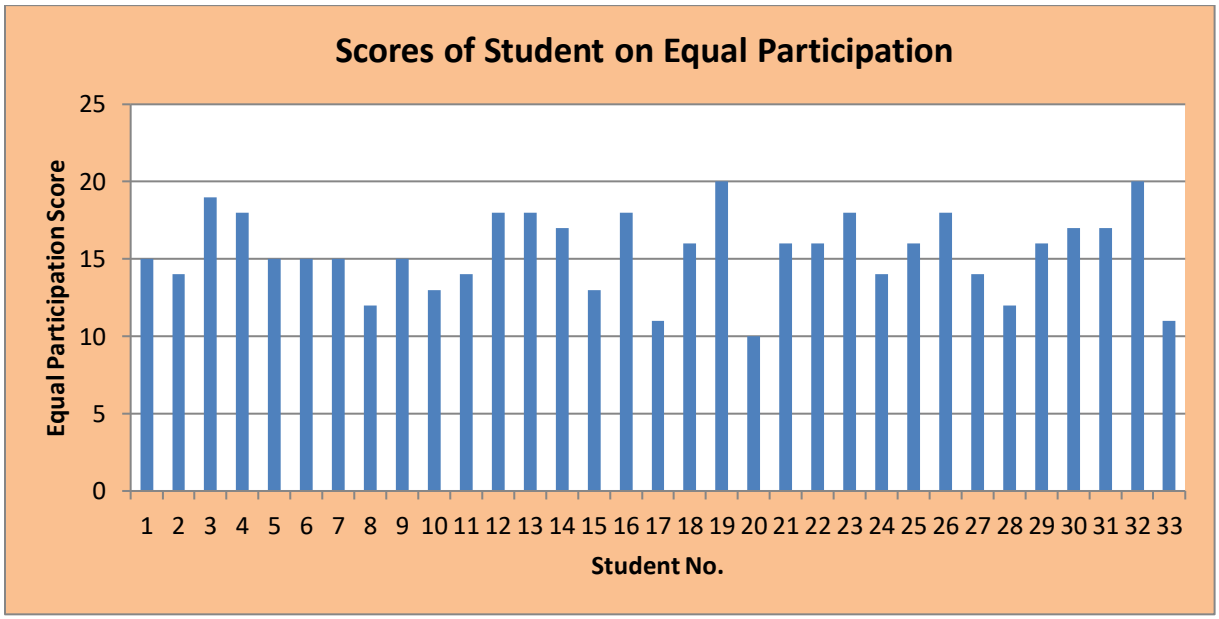


Table 3.7: Description of Equal Participation

Sl. No.	Descriptor	Value
1	Maximum Possible Score	20
2	Minimum Possible Score	4
3	Maximum Score Obtained	20
4	Minimum Score Obtained	10
5	Mean	15.48484848

6	Med	16
7	Mode	18
8	Standard Deviation	2.599533758
9	Q_1	14
10	Q_2	16
11	Q_3	18
12	Coefficient of skewness	-0.265680815

Interpretation: From the above shown graph and descriptive statistics of the component Equal Participation among the groups were genuinely practiced by the experimental group of students. As the scores of Equal Participation ranges from 10 to 20 where 20 is the maximum possible score and 4 is the minimum possible score. Here the average score of the students for this component is 15.48 with the most repeated score as 18 and 50 % of the students had score more than 16 which is a quite high score. The standard deviation of scores was 2.59 and scores were again negatively skewed which suggest that many students had high score towards Equal participation and students had a better learning environment created where each student got chance to participate in their team.

3. Face to Face Promotive Interaction

Graph 3.5: Scores of M.Ed. Students on Face to Face Promotive Interaction

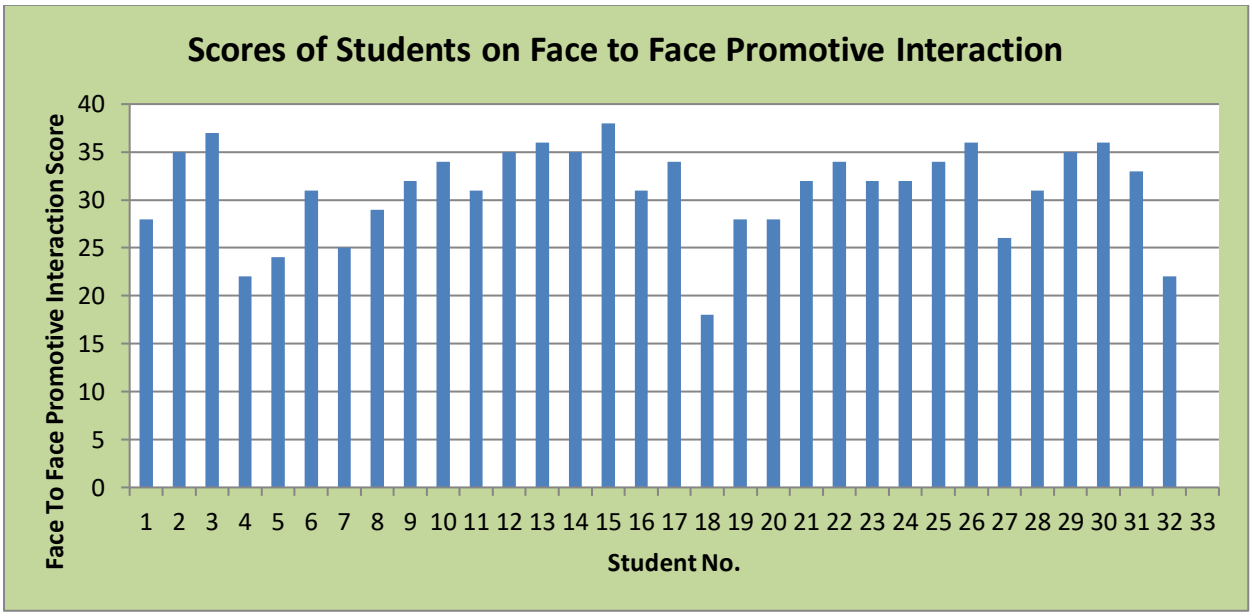


Table: 3.8 Description of Face to Face Promotive Interaction

Sl. No.	Descriptor	Value
1	Maximum Possible Score	40
2	Minimum Possible Score	8
3	Maximum Score Obtained	38
4	Minimum Score Obtained	18
5	Mean	31.0303
6	Med	32
7	Mode	35
8	Standard Deviation	4.811996
9	Q_1	28
10	Q_2	32
11	Q_3	35
12	Coefficient of skewness	-0.95131

Interpretation: From the above shown graph and descriptive statistics of the component Face to Face Promotive Interaction it is found that scores of Face to Face Promotive Interaction were ranges from 18 to 38 where minimum possible score was 8 and maximum possible score was 40. The average score was 31.03 with standard deviation of 4.81 and the most repeated score among the values were 35. Here 50% of the students had score more than 32 which is a good score. These scores were also negatively skewed i.e. -0.95 which indicates that most of the students had learned with face to face interaction mode.

4. Individual Accountability

Graph 3.6: Scores of M.Ed. Students on Individual Accountability

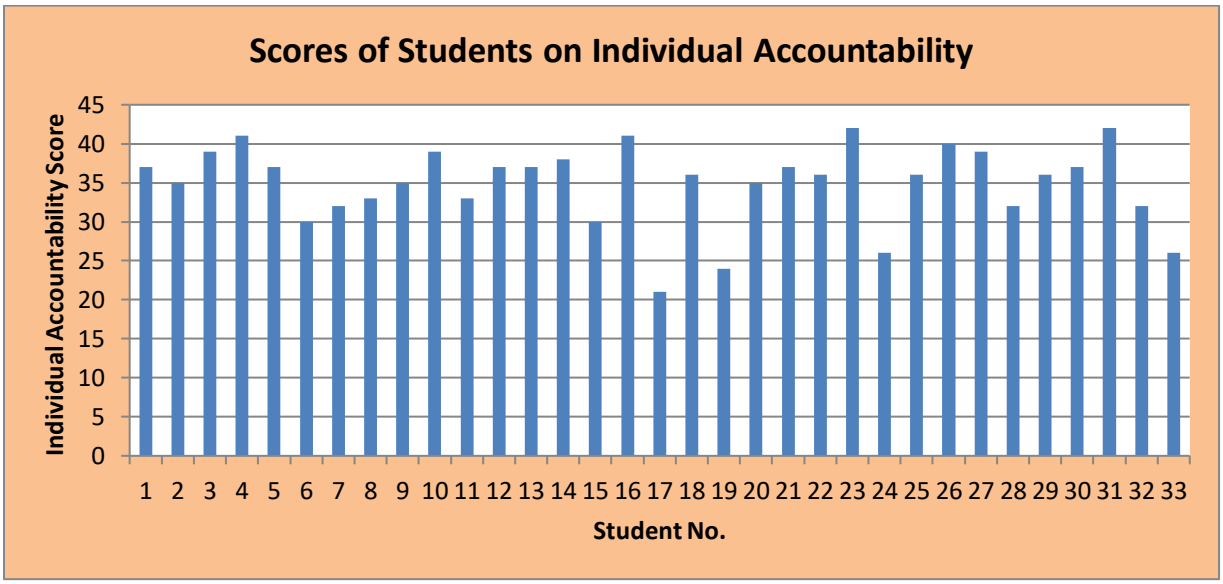


Table 3.9: Description of Individual Accountability

Sl. No.	Descriptor	Value
1	Maximum Possible Score	45
2	Minimum Possible Score	9
3	Maximum Score Obtained	42
4	Minimum Score Obtained	21
5	Mean	34.87879
6	Med	36
7	Mode	37
8	Standard Deviation	5.134184
9	Q_1	32
10	Q_2	36
11	Q_3	38
12	Coefficient of skewness	-0.99777

Interpretation: From the above shown graph and descriptive statistics of the component Individual Accountability it is found that students shared team responsibility as well as took self responsibility while learning in an effective manner. Here the scores were ranges from 21 to 42 where the maximum possible score is 45 and the minimum possible score is 9. The average score was 34.87 with standard deviation 5.13. The 50% of the students had scores more than 36 and still there was 25% of students with scores more than 38 and only 25% students were such whose score were less than 32. The coefficient of skewness was -0.9977 which indicates that score were negatively skewed and many students had gain high scores on Individual Accountability.

5. Appropriate Use of Collaborative Skills

Graph 3.7: Scores of M.Ed. Students on Appropriate Use of Collaborative Skills

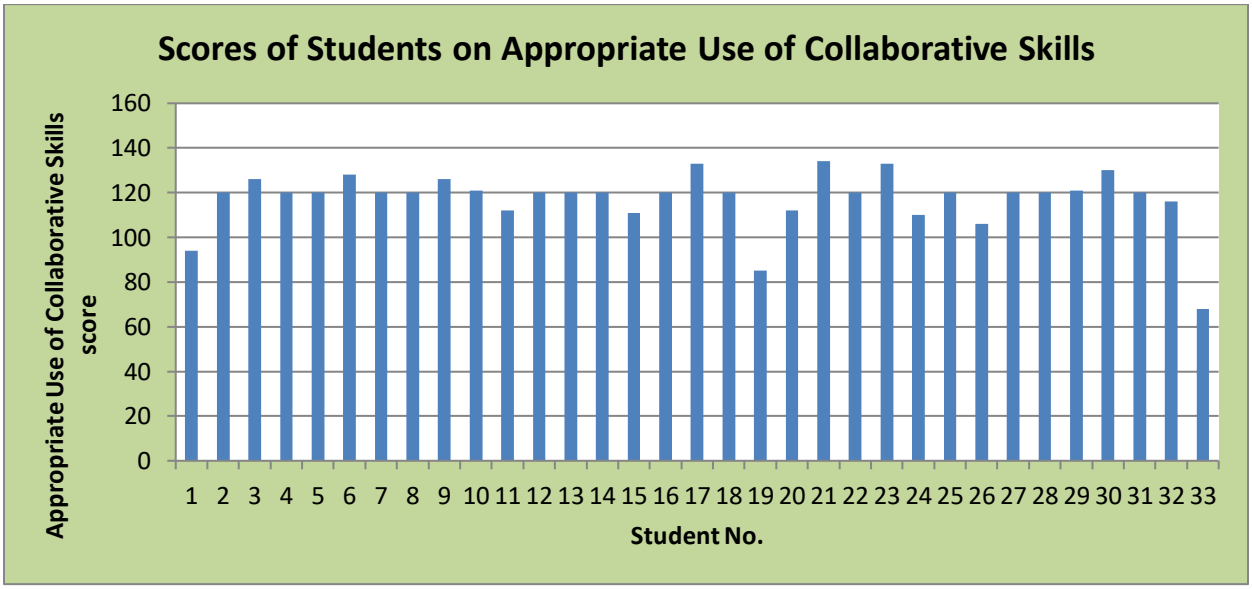


Table 3.10: Description of Appropriate Use of Collaborative Skills

Sl. No.	Descriptor	Value
1	Maximum Possible Score	140
2	Minimum Possible Score	28
3	Maximum Score Obtained	134
4	Minimum Score Obtained	68
5	Mean	117.1515152
6	Med	120

7	Mode	120
8	Standard Deviation	13.26442896
9	Q_1	116
10	Q_2	120
11	Q_3	121
12	Coefficient of skewness	-2.119003354

Interpretation: From the above shown graph and descriptive statistics of the component Appropriate Use of Collaborative Skills it is found that most of students has enhanced their Collaborative Skills while learning in Cooperative classrooms. The scores range from 68 to 134 where maximum score is 140 and minimum score is 28. The average value of scores was 117.15 with standard deviation of 13.26 and the mode and median value was 120 which states that 120 score was most often score in the entire data set and 50% of the students had scored more than 120. Even 25% of students were such who had scores more than 121. The scores of students were highly negatively skewed i.e. -2.119 which states that many students had worked and developed collaborative skills to a greater extent under Cooperative Learning classrooms.

6. Group Processing

Graph 3.8: Scores of M.Ed. Students on Group Processing

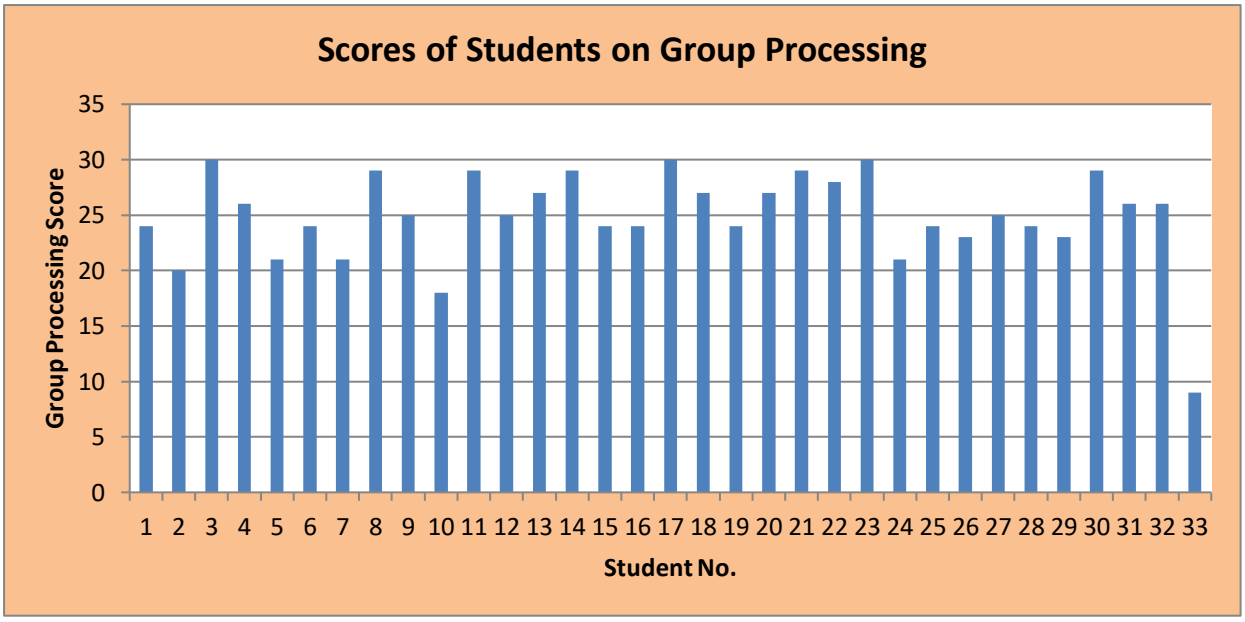


Table 3.11: Description of Group Processing

Sl. No.	Descriptor	Value
1	Maximum Possible Score	30
2	Minimum Possible Score	6
3	Maximum Score Obtained	30
4	Minimum Score Obtained	9
5	Mean	24.87878788
6	Med	25
7	Mode	24
8	Standard Deviation	4.226091396
9	Q_1	24
10	Q_2	25
11	Q_3	28
12	Coefficient of skewness	-1.684572284

Interpretation: From the above shown graph and descriptive statistics of the component Group Processing it is found that the scores on group processing were ranges from 9 to 30 where maximum possible score is 30 and minimum possible score is 6. It is more evident from the graph that there is one student who faced much adjustment difficulty in the groups. And so their reactions towards various components of cooperative learning were comparatively low. Rest all students had performed well in the groups and researcher had made special efforts to make convenient environment for that student. Like counseling of that student itself, persuading and motivating their classmates to involve her into their groups. The average of the group processing scores was 24.87 with standard deviation of 4.22. Here median is 25 which means that 50 % of students had score more than 25 score and rest 50 % of the students had score less than 25. The most repeated score in the data set is 24 i.e. mode of the distribution of data. The coefficient of skewness is -1.68 which states that there is high negative skewness in scores and further explains that most of the students have scored well in group processing scores.

7. Total Cooperative Scores of Experimental group of Students

Graph 3.9: Total Cooperative Scores of Students

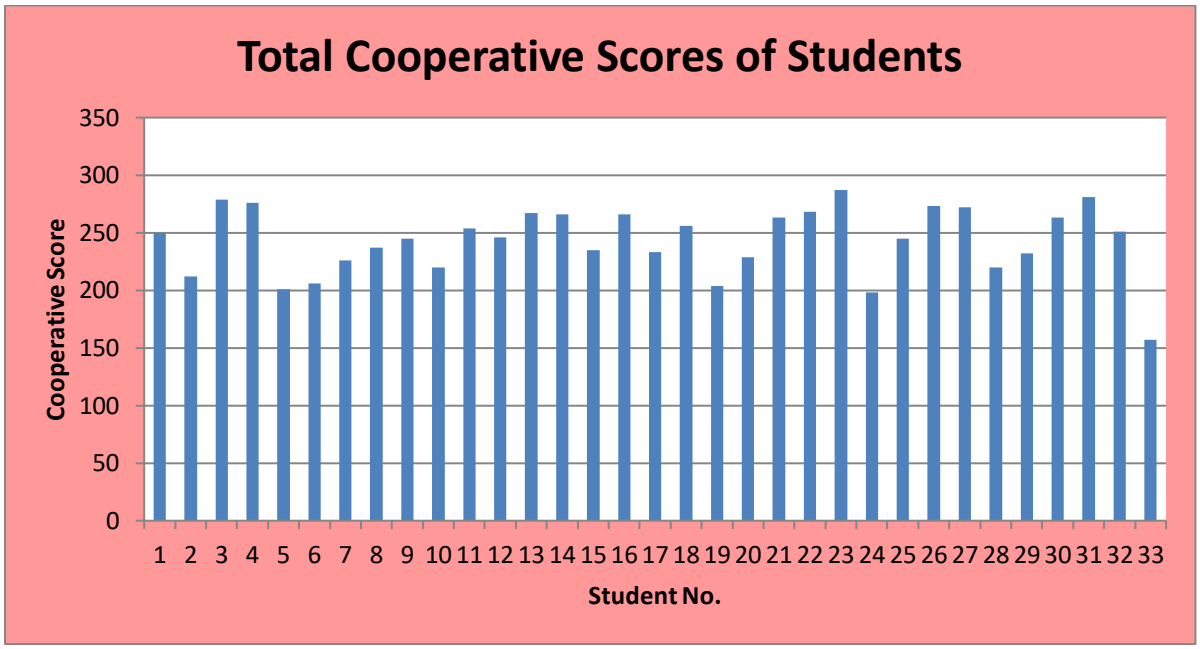
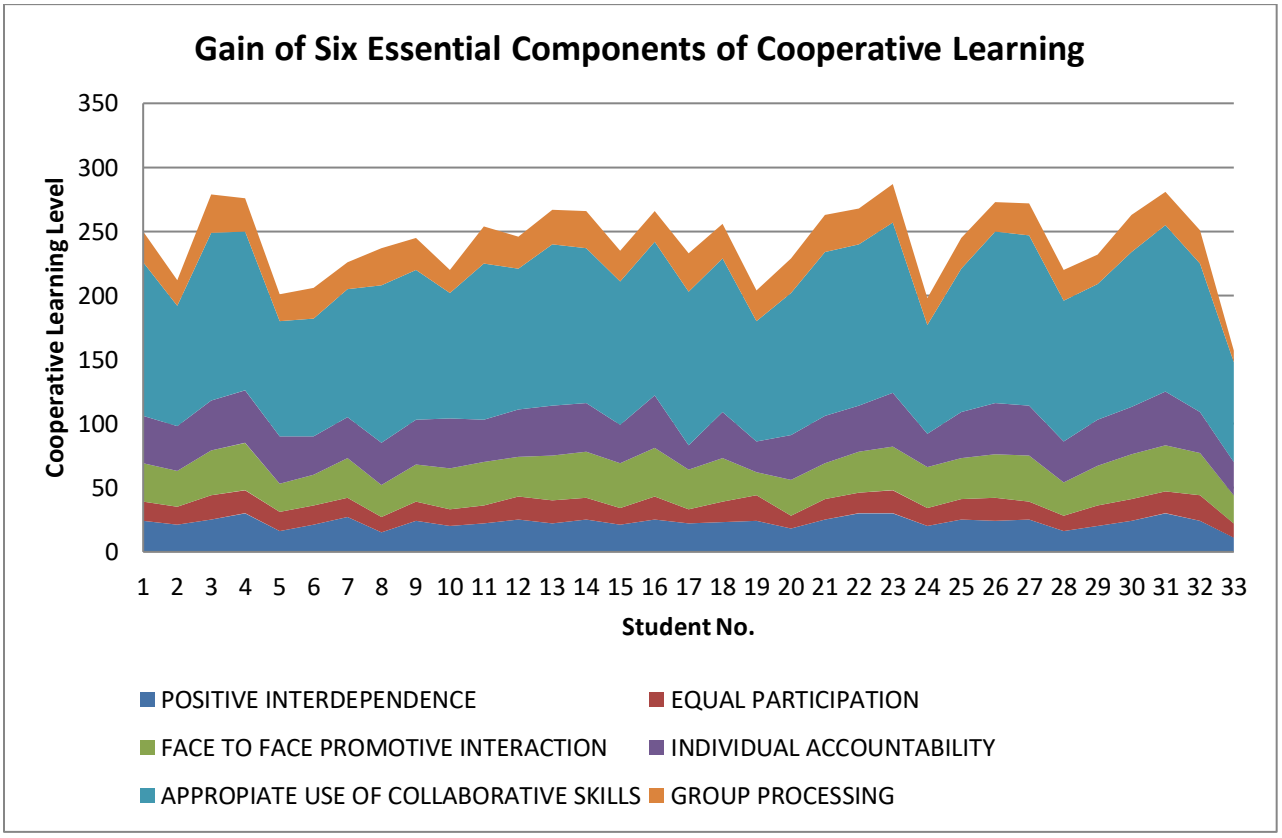


Table 3.12: Descriptions of Total Cooperative Scores of Students

Sl. No.	Descriptor	Value
1	Maximum Possible Score	305
2	Minimum Possible Score	61
3	Maximum Score Obtained	287
4	Minimum Score Obtained	157
5	Mean	242.969697
6	Med	246
7	Mode	245
8	Standard Deviation	29.51957491
9	Q_1	226
10	Q_2	246
11	Q_3	266
12	Coefficient of skewness	-0.808649644

Interpretation: From the above shown graph and descriptive statistics of the Total Cooperative Scores it is found that overall students had scored well in total cooperative scores as the average cooperative score was 242.96 with standard deviation of 29.51. The total cooperative scores were variated between 287 and 157 where the maximum possible score was 305 and the minimum possible score was 61. There were 25% of students whose scores was less than 226, there were again 25% of such students whose scores was more than 266 and there were 50% of such Students whose score were more than 246. Here the scores were negatively skewed with coefficient of skewness -0.80 which signifies that most of the students had performed well in cooperative learning classrooms.

Graph 3.10: A Graphical View of Six Essential Components of Cooperative Learning



Interpretation: From the above shown multi layered graph of the all six components of Cooperative Learning of all 33 students of experimental group it is clear that students had a good Cooperative scores and they have very positive outlook for this strategy to use in teaching learning process.

Table: 3.13 A Comprehensive View of Six Essential Components of Cooperative Learning:

Sl. No.	Components of Cooperative learning	Mean Scores	Median Scores	Mode Scores	Standard deviation	Coefficient of Skewness	Nature of distribution of data
1	Positive Interdependence	22.696	24	25	4.33	-0.481	Negatively skewed
2	Equal Participation	15.484	16	18	2.59	-0.265	Negatively skewed
3	Face to Face Promotive Interaction	31.030	32	35	4.81	-0.951	Negatively skewed
4	Individual Accountability	34.878	36	37	5.13	-0.997	Negatively skewed
5	Appropriate Use of Collaborative Skills	117.151	120	120	13.26	-2.119	Negatively skewed
6	Group Processing	24.878	25	24	4.22	-1.684	Negatively skewed
	Total Cooperative Scores	242.969	246	245	29.51	-0.812	Negatively skewed

From the above table we can infer that for each component the coefficient of skewness is significantly highly negative which indicates that most of the students have favourable or positive attitude towards learning of data analysis techniques through cooperative strategy.

Let us check it with the help of inferential statistics. So our Null hypothesis is:

Ho: There will be no significant difference in the observed frequencies and the expected equally distributed frequencies for the proposition "Every member was having positive outlook to accept the task" as asked to 33 students to express their reactions against 5 point scale.

Similarly we can write null hypothesis for each statement of the reaction scale and apply chi-square test at 5% level of significance with 4 degrees of freedom.

Following table has shown the received chi-square test statistic values for each statement of the reaction scale on application of chi-square test. Also chi-square table value is obtained from chi-square probability distribution table at 5% level of significance with 4 degrees of freedom as 9.49.

Table 3.14: Frequency Distribution of Reactions of Students, Chi-Square calculated Value and Chi- Square Table Value

Sl. No.	Components of Cooperative learning	Strongly Agree	Agree	Un-decided	Dis-agree	Strongly Disagree	chi square tab value	chi square cal value
1	**Positive Interdependence**							
i.	Every member was having positive outlook to accept the task.	7	18	4	3	1	9.49	27.45
ii.	Every member helped each other to complete the task.	10	19	1	2	1	9.49	37.76
iii.	Every member was fully involved in the task.	5	18	4	5	1	9.49	26.24
iv.	Every member respected the other ones.	5	18	7	2	1	9.49	28.06
v.	Encouragement and support were provided mutually.	8	16	6	2	1	9.49	21.7

vi.	All the members converged on the solution.	5	20	2	5	1	9.49	35.94
2	**Equal Participation**							
i.	All members were involved to achieve the task.	8	17	4	4	0	9.49	25.33
ii.	Every member was treated equally.	10	14	3	5	1	9.49	17.15
iii.	Participation in team brought self confidence and fearlessness.	9	20	3	1	0	9.49	41.39
iv.	Every member participated and presented.	8	12	8	4	1	9.49	10.79
3	**Face To Face Promotive Interaction**							
i.	Members posed questions to each other.	9	18	2	4	0	9.49	31.39
ii.	Members listened to each other.	7	19	6	1	0	9.49	34.73
iii.	All the members got chance to express their ideas to one another.	10	15	3	4	1	9.49	20.18
iv.	There was discipline during the interaction.	6	19	4	3	1	9.49	31.09
v.	Members discussed in-depth to understand thoroughly.	8	18	3	4	0	9.49	29.58
vi.	Members were probing deeply together.	6	18	5	4	0	9.49	27.76

vii.	Members were explaining thoroughly.	8	16	5	4	0	9.49	21.7
viii.	Very often interactions occurred during presentations.	5	19	4	5	0	9.49	31.7
4	**Individual Accountability**							
i.	Students were always interested in learning in cooperative setup.	13	14	2	4	0	9.49	25.33
ii.	Every member of the team was eager to complete the task.	10	16	4	2	1	9.49	24.12
iii.	Every one accepted the assigned role in the team.	8	18	1	6	0	9.49	31.39
iv.	Every one completed the accepted task.	8	18	3	4	0	9.49	29.58
v.	Every one contributed ideas, thoughts and suggestions to the team.	8	20	3	2	0	9.49	39.27
vi.	Members helped other team members if they faced difficulty.	11	13	4	5	0	9.49	17.15
vii.	Personal assignments were completed regularly.	6	15	8	2	2	9.49	17.45
viii.	Everyone got chance to represent their own team in the presentation.	10	19	1	2	1	9.49	37.76

ix.	All were regular in the class.	9	10	4	6	4	9.49	4.727
5	**Appropriate Use of Collaborative Skills**							
5.1	**Leadership**							
i.	All the team members were engaged in the completion of task.	11	19	2	1	0	9.49	40.79
ii.	The team members were treated respectfully.	9	19	3	2	0	9.49	35.94
iii.	All the team members observed high moral.	10	17	3	2	1	9.49	28.06
iv.	Tasks were distributed properly among the team members.	10	18	3	2	0	9.49	33.21
v.	Conducive environment of learning was created.	12	15	2	4	0	9.49	25.94
vi.	Time was managed properly.	7	16	5	1	4	9.49	19.58
vii.	Suggestions of all the members were considered.	8	18	3	3	1	9.49	28.67
viii.	Team members were properly instructed.	11	16	1	4	1	9.49	26.85
ix.	It was a collective learning through participatory approach.	17	14	1	1	0	9.49	40.79

5.2	**Communication**							
i.	Interactions were done in a healthy learning environment.	11	21	0	1	0	9.49	52.3
ii.	Every member was free to ask and respond to the questions.	13	17	1	1	1	9.49	36.85
iii.	Every member got chance to express the ideas.	11	18	0	3	1	9.49	35.94
iv.	Members were free to interact in different languages (Hindi, English & Guajarati).	17	14	0	2	0	9.49	41.09
v.	Members paid attention to the speaker.	13	13	3	3	1	9.49	21.09
5.3	**Trust Building**							
i.	Members were ready to work in randomly selected teams.	13	15	2	3	0	9.49	28.67
ii.	All members were allowed to express their ideas.	15	16	2	0	0	9.49	40.48
iii.	Ideas of all were used to solve a problem.	7	19	2	4	1	9.49	32.3
iv.	There was full faith in the work done by others.	9	18	3	2	1	9.49	30.48
v.	Other's explanations were relied on.	5	20	4	3	1	9.49	35.33

vi.	Team work was fully observed.	12	16	3	0	2	9.49	29.58
vii.	Credit of success/failure was attributed to all members of the team.	8	20	3	1	1	9.49	38.97
5.4	**Decision Making**							
i.	All the ideas were comprehended to arrive at a common solution.	5	24	1	3	0	9.49	59.58
ii.	Team members were directed to carry out the distributed task.	10	19	1	3	0	9.49	38.36
iii.	Results were drawn by summarizing the work of all team members.	11	16	1	4	1	9.49	26.85
5.5	**Resolving Conflicts**							
i.	All were made emotionally & mentally ready to work in a team.	10	16	4	2	1	9.49	24.12
ii.	Members were convinced logically on their arguments.	10	19	4	0	0	9.49	39.27
iii.	Necessary arrangements were made to work in a team.	10	22	1	0	0	9.49	54.09
iv.	Conflicts were resolved amicable.	6	17	7	2	1	9.49	24.42

6	**Group Processing**							
i.	New teams were constituted in the progressive class.	8	22	1	1	1	9.49	50.48
ii.	Members were selected randomly for team formation.	17	13	1	1	1	9.49	36.85
iii.	Team goals objectives were made clear to all the team members.	11	18	2	1	1	9.49	35.33
iv.	Each team work was assessed periodically by the teacher.	11	19	0	2	1	9.49	40.79
v.	Actions facilitating learning in this setup were promoted.	14	16	3	0	0	9.49	36.85
vi.	Futile actions were dropped.	9	17	4	2	1	9.49	26.24

Rejection Criteria: We reject the null hypothesis if chi-square test statistic calculated value is greater than chi-square table value at α% level of significance.

Here, we can observe that every chi-square test statistic calculated value for each statement is significantly greater than chi-square table value with 5% level of significance and 4 d.f. except in one case (4 ix), that is, against the statement "All were regular in the class". Here test statistic value is 4.72 and critical value is 9.49 which imply that do not reject the null hypothesis. From this we can infer that all students were not regular in class.