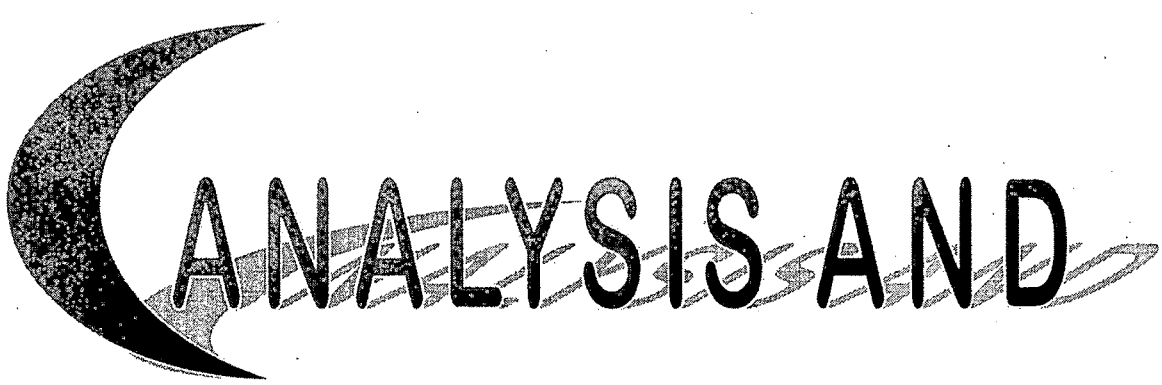
Chapter 4



ANALYSIS AND INTERPRETATION OF THE DATA

The data gathered using the tools as described in the previous chapter was analysed keeping the objectives in mind. The detailed analysis and interpretations are as follows.

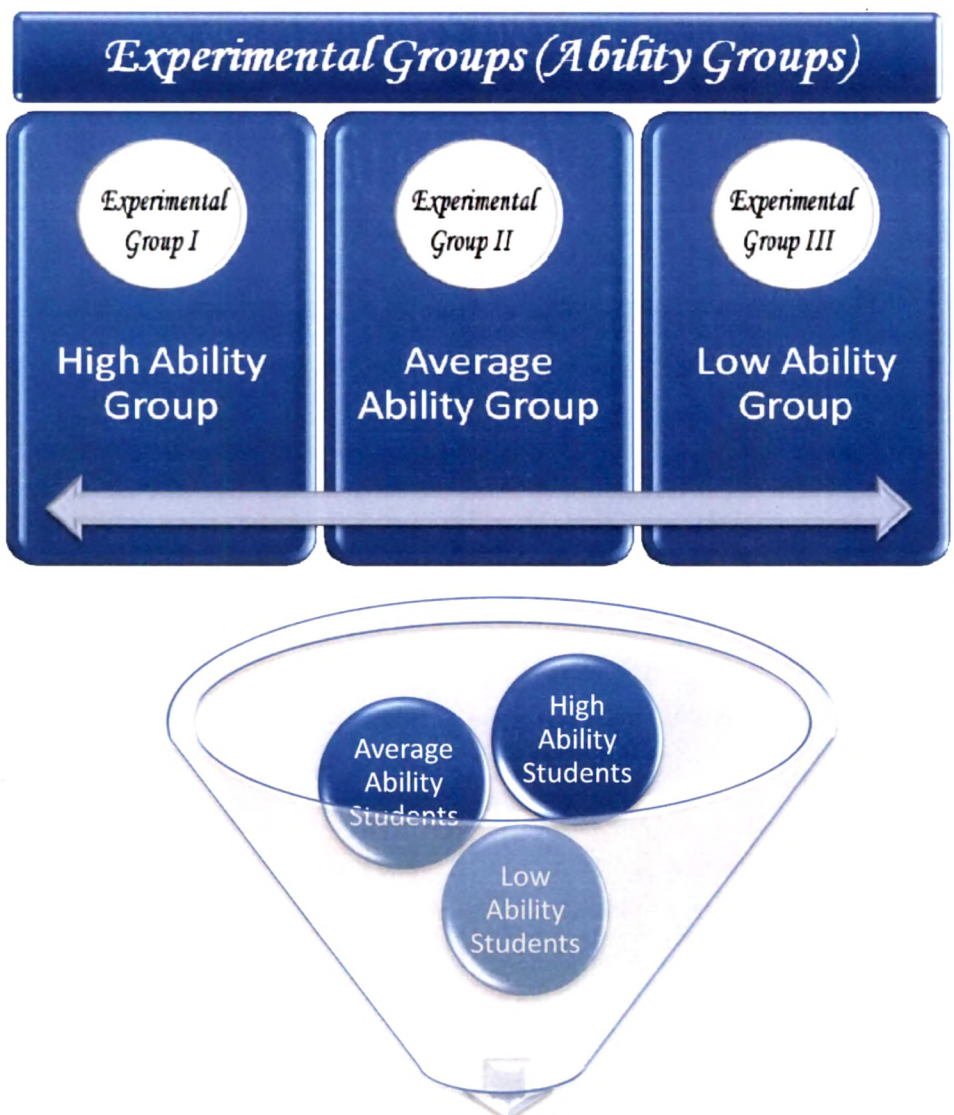
4.1 ORGANIZATION OF DATA THE OBTAINED

The researcher conducted ability test for standard VIII students in the academic year 2008-2009 in the randomly selected school for experimentation and collected their' annual examination marks for the academic year 2008-2009. Based on these two scores the students were categorized in to three groups as high ability students, average ability students and low ability students for the academic year 2009-2010. Researcher randomly assigned same number of students to experimental group and control group. The experimental group (ability groups) consists of three: high ability group, average ability group and low ability group, in which all the three groups were separately taught by differentiated instruction. For expediency, the high ability group termed as experimental group I, the average ability group termed as experimental group II and the low ability group termed as experimental group III. Experimental group I consists of 31 students, experimental group II consists of 36 students and experimental group III consists of 32 students. The control group (mixed ability group) consists of a mix of three: high ability students, average ability students and low ability students, in which all the students were taught by traditional method of instruction. For understanding the comparisons easier, the high ability students termed as control group I, average ability students termed as control Group II and low

ability students termed as control group III. Control group I consists of 31 students, control group II consists of 36 students and control group III consists of 32 students. A model of the experimental and control groups are given as figure 4.1

Figure 4.1

Model of the Experimental and Control Groups



Researcher obtained the pre-test scores by administering the achievement test and attitude test before the experimentation. Then the experimental groups were taught by differentiated instruction and the control group was taught by traditional method of instruction as explained in the previous chapter. Researcher obtained the post-test scores by administering the achievement test and attitude test after experimentation. The pre test and post test scores, achievement and attitude, of the control group were divided according to high ability, average ability and low ability group. The comparisons were made as follows:

- Effect of differentiated instruction on academic achievement in ability groups over mixed ability group.
- Effect of differentiated instruction on attitude towards mathematics in ability groups.
- Effect of differentiated instruction on attitude towards mathematics in ability groups over mixed ability group.

The academic achievement scores and attitude scores of students in ability groups and mixed ability group were subjected to analysis of covariance to determine the effect of differentiated instruction on academic achievement in ability groups over mixed ability group. The results are given below. The detailed analysis is presented below.

4.2 EFFECT OF DIFFERENTIATED INSTRUCTION ON ACADEMIC ACHIEVEMENT AMONG STUDENTS IN ABILITY GROUPS OVER MIXED ABILITY GROUP

The academic achievement scores of students in ability groups and mixed ability group were subjected to analysis of covariance to determine the effect of differentiated instruction on

academic achievement in ability groups over mixed ability group. This was done in four sections:

- Effect of differentiated instruction on academic achievement in ability groups over mixed ability group (Experimental groups × Control group).
- Effect of differentiated instruction on academic achievement among students in high ability group over high ability students in mixed ability group (Experimental group I × Control group I)
- Effect of differentiated instruction on academic achievement among students in average ability group over average ability students in mixed ability group (Experimental group II × Control group II)
- Effect of differentiated instruction on academic achievement among students in low ability group over low ability students in mixed ability group (Experimental group III × Control group III)

ANCOVA, using two groups, was used to show the effectiveness. Since the participants have been randomly assigned to ability groups and mixed ability group, ANCOVA helped the researcher to control over the extraneous variables and increased the power to make a decision to reject the null hypothesis. The detailed analysis is presented below.

4.2.1 EFFECT OF DIFFERENTIATED INSTRUCTION ON ACADEMIC ACHIEVEMENT AMONG STUDENTS IN ABILITY GROUPS OVER MIXED ABILITY GROUP (EXPERIMENTAL GROUPS × CONTROL GROUP)

The achievement test scores of 99 students in ability groups and 99 students in mixed ability group were subjected to analysis

of covariance to determine the effect of differentiated instruction on academic achievement in ability groups over mixed ability group.

F-ratios for the pre-test and post-test achievement scores of students in experimental groups and control group were computed to check whether any significant difference in pre achievement scores and in post achievement scores. Table 4.1 shows the ANOVA of achievement scores of students in experimental groups and control group.

Table 4.1

ANOVA of Achievement Scores of Students in Experimental Groups and Control Group

Sources of Variations	**df**	**SS_X**	**SS_Y**	**MS_X**	**MS_Y**	**F-ratio**
Among Groups	1	0.51	260.2	0.51	260.25	$F_X = 0.26$
With in Groups	196	384.95	9808.9	1.96	50.05	$F_Y = 5.20$
Total	197	385.46	10069.1	-	-	

The F-ratio of the two sets of scores was tested for significance. The table values of F for df = 1/196 are 3.89 at 0.05 level and 6.76 at 0.01 level. The computed value of F_X is 0.26, which is not significant even at 0.05 level and the computed value of F_Y is 5.20, which is significant at 0.05 level (F_X = 0.26; $p > 0.05$ & $F_Y = 5.20$; $p < 0.05$).

Since F_X is not significant, the null hypothesis is accepted. This implies that there is no significant difference in the pre-test achievement scores of students in experimental groups and control

group. Therefore the students were homogeneous in terms of mathematics achievement and thus randomization is justified. But F_Y is significant means the null hypothesis is rejected. So it can be inferred that there is significant difference in the post achievement scores of students in experimental groups and control group. The total sum of squares and adjusted mean square variances for post-test achievement scores were computed, and F (F_{YX}) ratio was calculated. ANCOVA of achievement scores of students in experimental groups and control group is given as table 4.2.

Table 4.2

ANCOVA of Achievement Scores of Students in Experimental Groups and Control Group

Sources of Variation	**df**	**SS_X**	**SS_Y**	**SS_{XY}**	**SS_{YX}**	**MS_{YX}**	**SD_{YX}**
Among Groups	1	0.51	260.2	11.46	258.82	258.82	7.09
Within groups	195	384.95	9808.9	18.32	9808.06	50.30	
Total	196	385.46	10069.2	29.79	10066.88	-	-
						F_{YX} = 5.15	

The table values of F for df = 1/195 are 3.89 at 0.05 level and 6.76 at 0.01 level. The computed value of F (F_{YX}) is 7.55, which is significant at 0.01 level. The significant ratio for the adjusted post-test scores shows that the final mean squares in experimental

groups and control group differ significantly after they have been adjusted for difference in pre-test scores.

The adjusted means for post-test scores of students in experimental groups and control group were computed using correlation and regression. The results are shown in table 4.3.

Table 4.3

Adjusted Means and t value of Achievement score of Students in Experimental Groups and Control Group

Groups	**N**	**M_X**	**M_Y**	**M_{XY}**	**Significance of difference among adjusted Y means**
Experimental Groups	99	2.57	28.1	28.05	SE_m = 1.01 t = 2.27
Control Group	99	2.46	25.8	25.76	
Of Total	198	2.52	26.90	-	

Adjusted means for post-test scores were tested for significance. The table values of t for df = 196 are 1.97 at 0.05 level and 2.60 at 0.01 level. The computed value of t = 2.27 is significant at 0.05 level. So the value is significant at 0.01 level ($t = 2.27$; $p < 0.05$).

The significant t value indicates that the null hypothesis is rejected. It shows that there is a significant difference in the academic achievement score of students in experimental groups and control group when taught by differentiated instruction. The mean of post achievement score of students in experimental groups (28.05) is greater than those in control group (25.75). So it can be

inferred that the mathematics achievement of students in experimental groups, which are called as ability groups, taught through differentiated instruction is significantly higher in comparison to the mathematics achievement of students in control group, which is called as mixed ability group, taught by conventional method.

The bar graph of the mean achievement scores and line graph of the achievement scores of students in experimental groups and control group are given as figure 4.2 and figure 4.3 respectively in the following pages.

Figure 4.2

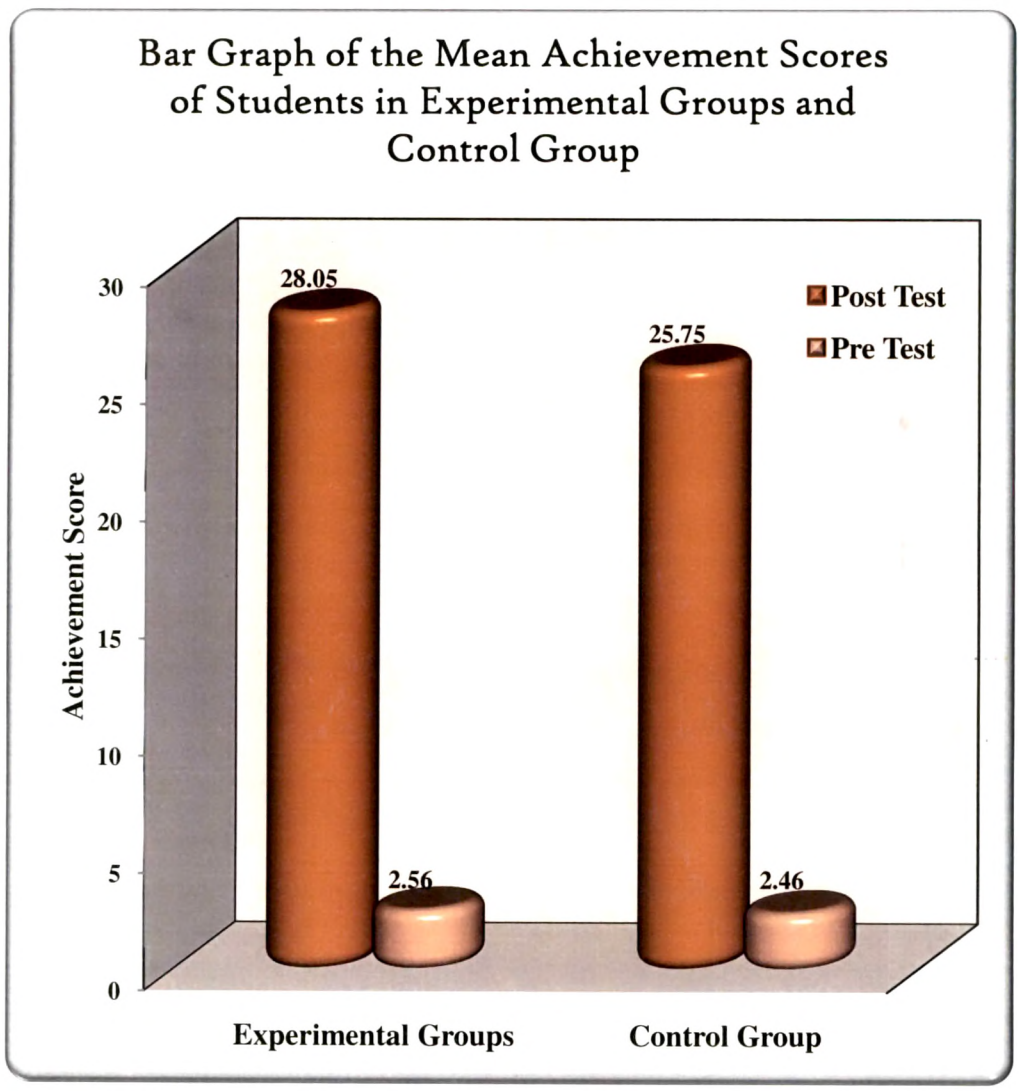
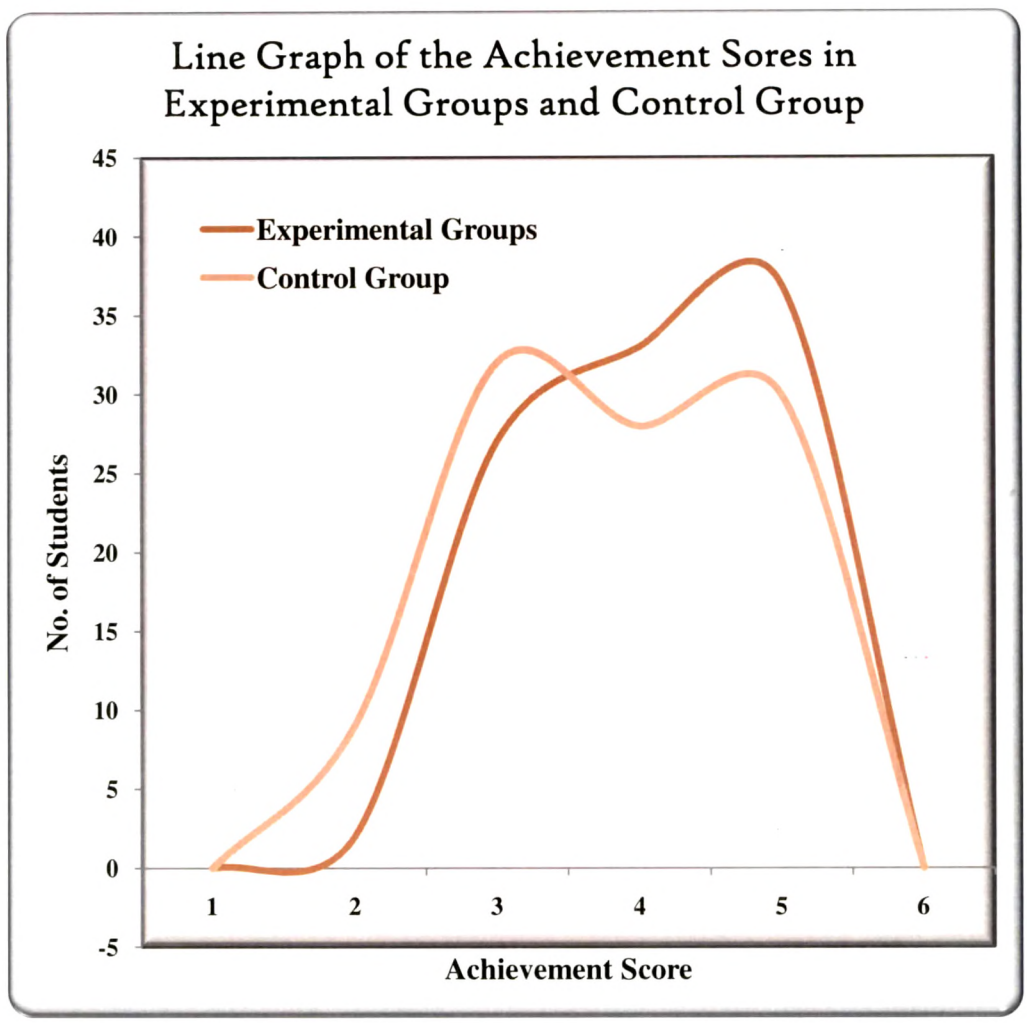

Bar Graph of the Mean Achievement Scores of Students in Experimental Groups and Control Group
Achievement Score
30
25
20
15
10
5
0
28.05
2.56
25.75
2.46
Post Test
Pre Test
Experimental Groups
Control Group

Figure 4.3


Line Graph of the Achievement Sores in Experimental Groups and Control Group
45
40
35
30
25
20
15
10
5
0
-5
No. of Students
Experimental Groups
Control Group
1
2
3
4
5
6
Achievement Score

Likewise pre- and post achievement test scores of high ability students in ability groups and in mixed ability group were compared. The analysis, in detail is given below.

4.2.2 EFFECT OF DIFFERENTIATED INSTRUCTION ON ACADEMIC ACHIEVEMENT AMONG STUDENTS IN HIGH ABILITY GROUP OVER HIGH ABILITY STUDENTS IN MIXED ABILITY GROUP (EXPERIMENTAL GROUP I × CONTROL GROUP I)

The achievement test scores of 31 students having high ability in ability groups and 31 students having high ability in mixed ability group were subjected to analysis of covariance to determine the effect of differentiated instruction on academic achievement among high ability students in ability groups over high ability students in mixed ability group.

F-ratios for the pre-test and post-test achievement scores of students in experimental group I and control group I were computed to check whether any significant difference in pre achievement scores and in post achievement scores. Table 4.4 shows the ANOVA of achievement scores of students in experimental group I and control group I.

Table 4.4

ANOVA of Achievement Scores of Students in Experimental Group I and Control Group I

Sources of Variations	**df**	**SS_X**	**SS_Y**	**MS_X**	**MS_Y**	**F-ratio**
Among Groups	1	0.58	32.7	0.58	32.66	$F_X = 0.29$
With in Groups	60	119.35	249.9	1.99	4.17	$F_Y = 7.84$
Total	61	119.93	282.6	-	-	

The F-ratio of the two sets of scores was tested for significance. The table values of F for df = 1/60 are 4.00 at 0.05 level and 7.08 at 0.01 level. The computed value of F_X is 0.29, which is not significant even at 0.05 level and the computed value of F_Y is 7.84, which is significant at 0.01 level (F_X = 0.29; $p > 0.05$ & F_Y = 7.84; $p < 0.01$).

Since F_X is not significant, the null hypothesis is accepted. This implies that there is no significant difference in the pre-test achievement scores of students in experimental group I and control group I. But F_Y is significant means the null hypothesis is rejected. So it can be inferred that there is significant difference in the post achievement scores of students in experimental group I and control group I. The total sum of squares and adjusted mean square variances for post-test achievement scores were computed, and F (F_{YX}) ratio was calculated. ANCOVA of achievement scores of students in experimental group I and control group I is given as table 4.5.

Table 4.5

ANCOVA of Achievement Scores of Students in Experimental Group I and Control Group I

Sources of Variation	**df**	**SS_X**	**SS_Y**	**SS_{XY}**	**SS_{YX}**	**MS_{YX}**	**SD_{YX}**
Among means	1	0.26	32.7	-2.90	31.57	31.57	2.05
Within groups	59	102.45	249.9	-18.03	246.76	4.18	
Total	60	102.71	282.6	-20.94	278.33	-	-
						F_{YX} = 7.55	

The table values of F for df = 1/59 are 4.00 at 0.05 level and 7.08 at 0.01 level. The computed value of F (F_{YX}) is 7.55, which is significant at 0.01 level. The significant ratio for the adjusted post-test scores shows that the final mean squares in experimental group I and control group I differ significantly after they have been adjusted for difference in pre-test scores.

The adjusted means for post-test scores of students in experimental group I and control group I were computed using correlation and regression. The results are shown in table 4.6.

Table 4.6

Adjusted Means and t value of Achievement score of Students in Experimental Group I and Control Group I

Groups	**N**	**M_X**	**M_Y**	**M_{XY}**	**Significance of difference among adjusted Y means**
Experimental Group I	31	2.55	35.6	35.63	SE_m = 0.52 t = 2.75
Control Group I	31	2.68	34.2	34.20	
Of Total	62	2.61	34.92	-	

Adjusted means for post-test scores were tested for significance. The table values of t for df = 60 are 2.00 at 0.05 level and 2.66 at 0.01 level. The computed value of t = 2.75 is significant at 0.01 level. So the value is significant at 0.01 level ($t = 2.75$; $p < 0.01$).

The significant t value indicates that the null hypothesis is to be rejected. It shows that there is a significant difference in the academic achievement score of students in experimental group I and control group I when taught by differentiated instruction. The mean of post achievement score of students in experimental group I (35.65) is greater than those in control group I (34.19). So it can be inferred that the mathematics achievement of students having high ability in ability groups taught by differentiated instruction is significantly higher in comparison to the mathematics achievement of students having high ability in mixed ability group taught by conventional method.

The bar graph of the mean achievement scores and line graph of the achievement scores of students in experimental group I and control group I are given as figure 4.4 and figure 4.5 respectively in the next pages.

Figure 4.4

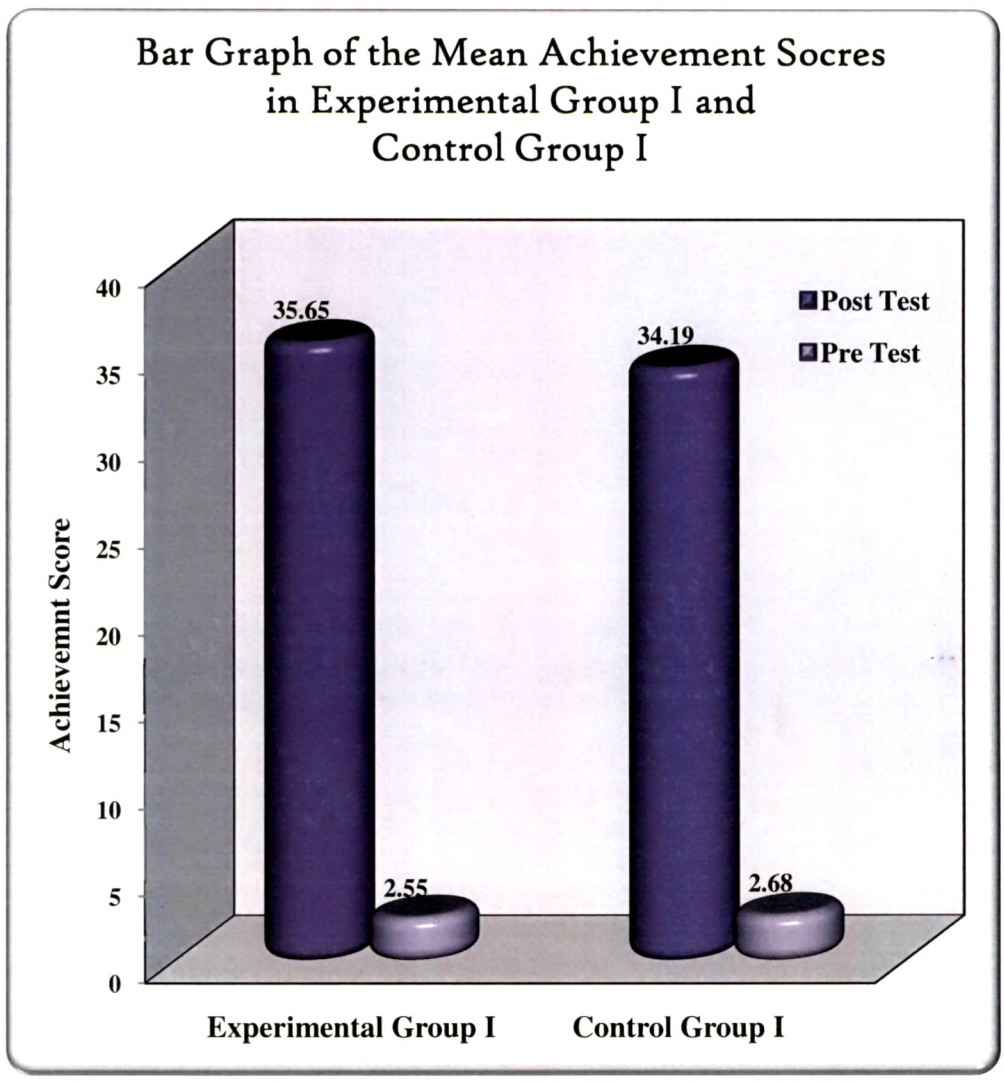
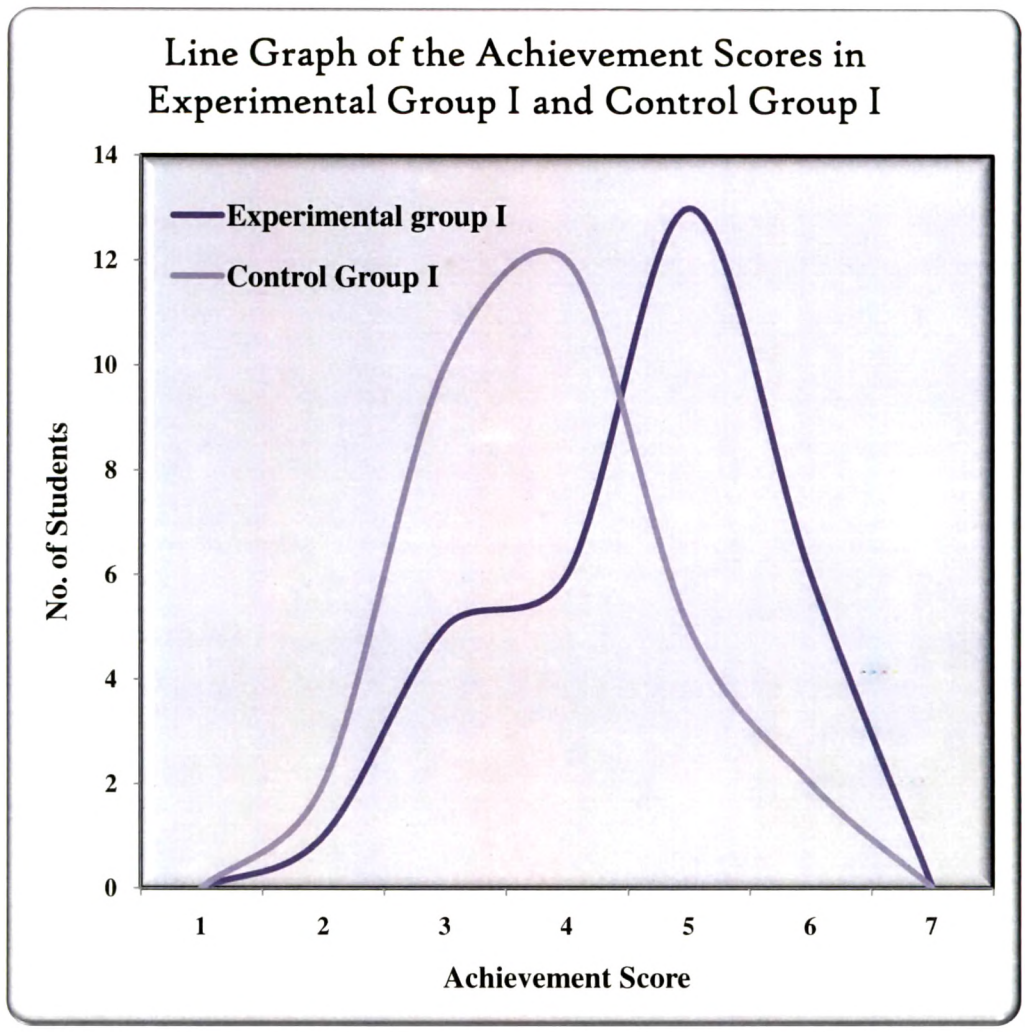

Bar Graph of the Mean Achievement Socres in Experimental Group I and Control Group I
Achievemnt Score
40
35
30
25
20
15
10
5
0
35.65
2.55
34.19
2.68
Post Test
Pre Test
Experimental Group I
Control Group I

Figure 4.5


Line Graph of the Achievement Scores in Experimental Group I and Control Group I
Experimental group I
Control Group I
No. of Students
0
2
4
6
8
10
12
14
1
2
3
4
5
6
7
Achievement Score

Similarly pre and post achievement test scores of average ability students in ability groups and in mixed ability group were compared. The detail analysis is given below.

4.2.3 EFFECT OF DIFFERENTIATED INSTRUCTION ON ACADEMIC ACHIEVEMENT AMONG STUDENTS IN AVERAGE ABILITY GROUP OVER AVERAGE ABILITY STUDENTS IN MIXED ABILITY GROUP (EXPERIMENTAL GROUP II × CONTROL GROUP II)

The achievement test scores of 36 students having average ability in ability groups and 36 students having average ability in mixed ability group were subjected to analysis of covariance to determine the effect of differentiated instruction on academic achievement among average ability students in ability groups over average ability students in mixed ability group.

F-ratios for the pre-test and post-test achievement scores of students in experimental group II and control group II were computed to check whether any significant difference in pre achievement scores and in post achievement scores. Table 4.7 shows the ANOVA of achievement scores of students in experimental group II and control group II.

Table 4.7

ANOVA of Achievement Scores of Students in Experimental Group II and Control Group II

Sources of Variations	**df**	**SS_X**	**SS_Y**	**MS_X**	**MS_Y**	**F-ratio**
Among Groups	1	0.13	66.1	0.13	66.13	$F_X = 0.07$
With in Groups	70	131.19	693.8	1.87	9.91	$F_Y = 6.67$
Total	71	131.32	759.9	-	-	

The F-ratio of the two sets of scores was tested for significance. The table values of F for df = 1/70 are 3.98 at 0.05 level and 7.01 at 0.01 level. The computed value of F_X is 0.07, which is not significant even at 0.05 level and the computed value of F_Y is 6.67, which is significant only at 0.05 level (F_X = 0.07; $p > 0.05$ & F_Y = 6.67; $p < 0.05$).

Since F_X is not significant, the null hypothesis is accepted. This implies that there is no significant difference in the pre-test achievement scores of students in experimental group II and control group II. But F_Y is significant means the null hypothesis is rejected. So it can be inferred that there is significant difference in the post achievement scores of students in experimental group II and control group II. The total sum of squares and adjusted mean square variances for post-test achievement scores were computed, and F (F_{YX}) ratio was calculated. ANCOVA of achievement scores of students in experimental group II and control group II is given as table 4.8.

Table 4.8

ANCOVA of Achievement Scores of Students in Experimental Group II and Control Group II

Sources of Variation	**df**	**SS_X**	**SS_Y**	**SS_{XY}**	**SS_{YX}**	**MS_{YX}**	**SD_{YX}**
Among means	1	0.13	66.1	-2.88	62.00	62.00	3.01
Within groups	69	131.19	693.8	-94.17	626.16	9.07	
Total	70	131.32	759.9	-97.04	688.16	-	-
						F_{YX} = 6.83	

The table values of F for df = 1/69 are 3.98 at 0.05 level and 7.01 at 0.01 level. The computed value of F (F_{YX}) is 6.83, which is significant only at 0.05 level. The significant ratio for the adjusted post-test scores shows that the final mean squares in experimental group II and control group II differ significantly after they have been adjusted for difference in pre-test scores.

The adjusted means for post-test scores of students in experimental group II and control group II were computed using correlation and regression. The results are shown in table 4.9.

Table 4.9

Adjusted Means and t value of Achievement score of Students in Experimental Group II and Control Group II

Groups	**N**	**M_X**	**M_Y**	**M_{XY}**	**Significance of difference among adjusted Y means**
Experimental Group II	36	2.36	28.2	28.14	SE_m = 0.71 t = 2.62
Control Group II	36	2.44	26.3	26.28	
Of Total	72	2.40	27.21	-	

Adjusted means for post-test scores were tested for significance. The table values of t for df = 70 are 2.00 at 0.05 level and 2.65 at 0.01 level. The computed value of t = 2.62 is significant at 0.05 level. So the value is significant at 0.01 level ($t = 2.62$; $p < 0.05$).

The significant t value indicates that the null hypothesis is rejected. It shows that there is a significant difference in the academic achievement score of students in experimental group II and control group II when taught by differentiated instruction. The mean of post achievement score of students in experimental group II (28.17) is greater than those in control group II (26.25). So it can be inferred that the mathematics achievement of students having average ability in ability groups taught by differentiated instruction is significantly higher in comparison to the mathematics achievement of students having average ability in mixed ability group taught by conventional method.

The bar graph of the mean achievement scores and line graph of the achievement scores of students in experimental group II and control group II are given in the following pages as figure 4.6 and figure 4.7 respectively.

Figure 4.6

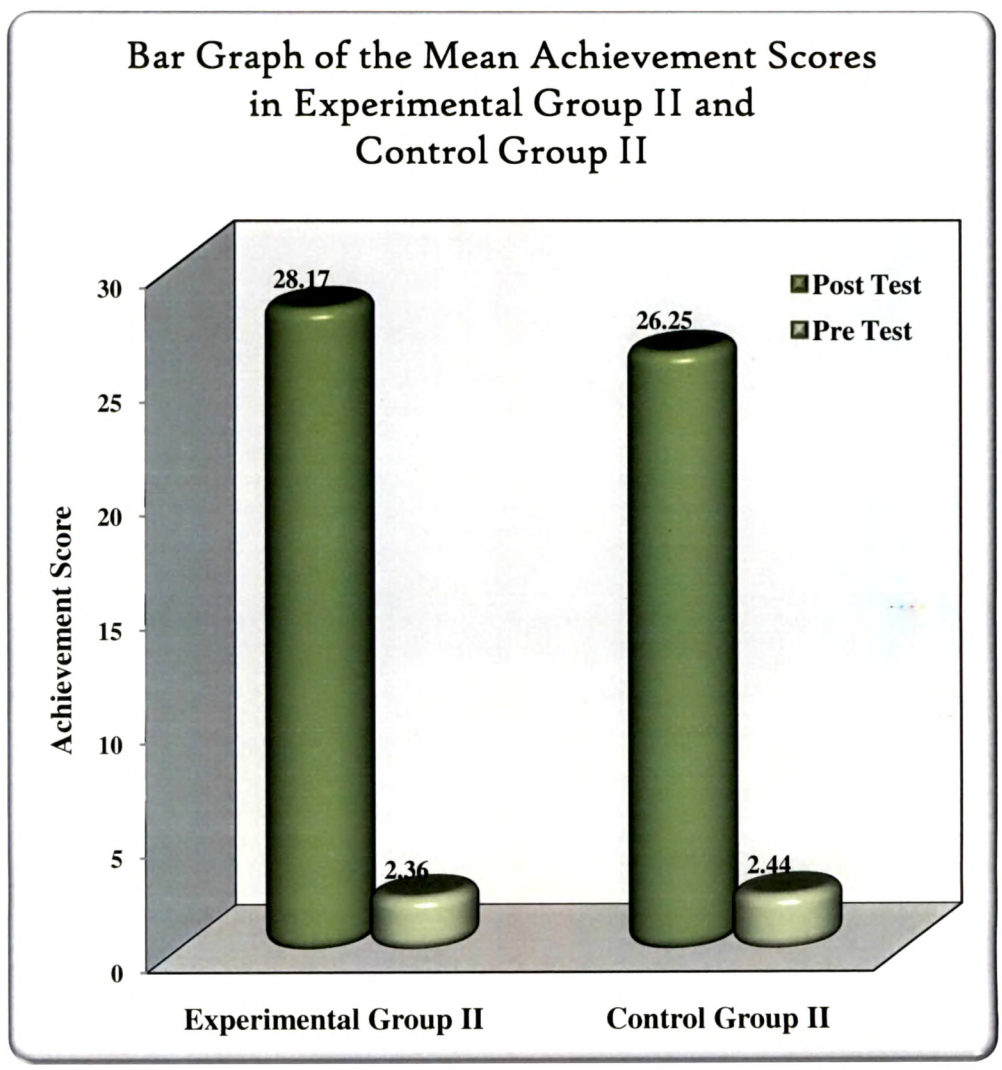
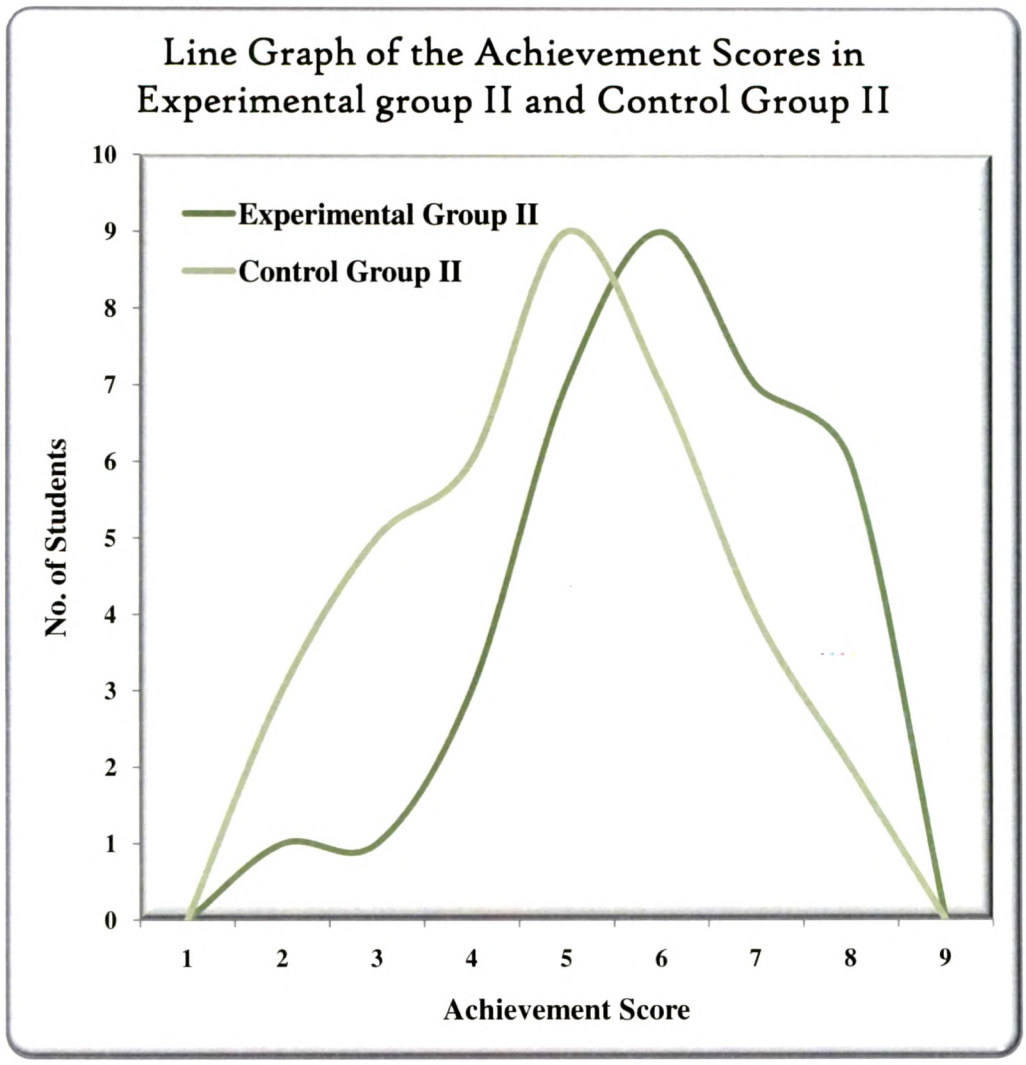

Bar Graph of the Mean Achievement Scores in Experimental Group II and Control Group II
Achievement Score
30
25
20
15
10
5
0
28.17
2.36
26.25
2.44
Post Test
Pre Test
Experimental Group II
Control Group II

Figure 4.7


Line Graph of the Achievement Scores in Experimental group II and Control Group II
Experimental Group II
Control Group II
No. of Students
Achievement Score
0
1
2
3
4
5
6
7
8
9
10

Likewise pre- and post achievement test scores of low ability students in ability groups and in mixed ability group were compared. The detail analysis is given below.

4.2.4 EFFECT OF DIFFERENTIATED INSTRUCTION ON ACADEMIC ACHIEVEMENT AMONG STUDENTS IN LOW ABILITY GROUP OVER LOW ABILITY STUDENTS IN MIXED ABILITY GROUP (EXPERIMENTAL GROUP III × CONTROL GROUP III)

The achievement test scores of 32 students having low ability in ability groups and 32 students having low ability in mixed ability group were subjected to analysis of covariance to determine the effect of differentiated instruction on academic achievement among low ability students in ability groups over low ability students in mixed ability group.

F-ratios for the pre-test and post-test achievement scores of students in experimental group III and control group III were computed to check whether any significant difference in pre achievement scores and in post achievement scores. Table 4.10 shows the ANOVA of achievement scores of students in experimental group III and control group III.

Table 4.10

ANOVA of Achievement Scores of Students in Experimental Group III and Control Group III

Sources of Variations	df	SS_X	SS_Y	MS_X	MS_Y	F-ratio
Among Groups	1	0.39	83.3	0.39	83.27	$F_X = 0.19$ $F_Y = 10.07$
With in Groups	62	129.47	512.7	2.09	8.27	
Total	63	129.86	596.0	-	-	

The F-ratio of the two sets of scores was tested for significance. The table values of F for df = 1/62 are 3.98 at 0.05 level and 7.01 at 0.01 level. The computed value of F_X is 0.19, which is not significant even at 0.05 level and the computed value of F_Y is 10.07, which is significant at 0.01 level (F_X = 0.19; $p > 0.05$ & F_Y = 10.07; $p < 0.01$).

Since F_X is not significant, the null hypothesis is accepted. This implies that there is no significant difference in the pre-test achievement scores of students in experimental group III and control group III. But F_Y is significant means the null hypothesis is rejected. So it can be inferred that there is significant difference in the post achievement scores of students in experimental group III and control group III. The total sum of squares and adjusted mean square variances for post-test achievement scores were computed, and F (F_{YX}) ratio was calculated. ANCOVA of achievement scores of students in experimental group III and control group III is given as table 4.11.

Table 4.11

ANCOVA of Achievement Scores of Students in Experimental Group III and Control Group III

Sources of Variation	**df**	**SS_X**	**SS_Y**	**SS_{XY}**	**SS_{YX}**	**MS_{YX}**	**SD_{YX}**
Among Groups	1	0.39	83.3	5.70	84.40	84.40	2.89
Within groups	61	129.47	512.7	-15.75	510.80	8.37	
Total	72	129.86	596.0	-10.05	595.21	-	-
						F_{YX} = 10.08	

The table values of F for df = 1/61 are 3.98 at 0.05 level and 7.01 at 0.01 level. The computed value of F (F_{YX}) is 10.08, which is significant at 0.01 level. The significant ratio for the adjusted post-test scores shows that the final mean squares in experimental group III and control group III differ significantly after they have been adjusted for difference in pre-test scores.

The adjusted means for post-test scores of students in experimental group III and control group III were computed using correlation and regression. The results are shown in table 4.12.

Table 4.12

Adjusted Means and t value of Achievement score of Students in Experimental Group III and Control Group III

Groups	**N**	**M_X**	**M_Y**	**M_{XY}**	**Significance of difference among adjusted Y means**
Experimental Group III	32	2.53	19.6	19.63	SE_m = 0.72 t = 3.18
Control Group III	32	2.38	17.3	17.33	
Of Total	64	2.45	18.48	-	

Adjusted means for post-test scores were tested for significance. The table values of t for df = 62 are 2.00 at 0.05 level and 2.65 at 0.01 level. The computed value of t = 3.18 is significant at 0.01 level. So the value is significant at 0.01 level (t = 3.18; $p < 0.01$).

The significant t value indicates that the null hypothesis is rejected. It shows that there is a significant difference in the academic achievement score of students in experimental group III and control group III when taught by differentiated instruction. The mean of post achievement score of students in experimental group III (19.63) is greater than those in control group III (17.34). So it can be inferred that the mathematics achievement of students having low ability in ability groups taught by differentiated instruction is significantly higher in comparison to the mathematics achievement of students having low ability in mixed ability group taught by conventional method.

The bar graph of the mean achievement scores and line graph of the achievement scores of students in experimental group III and control group III are given as figure 4.8 and figure 4.9 respectively in the next pages.

Figure 4.8

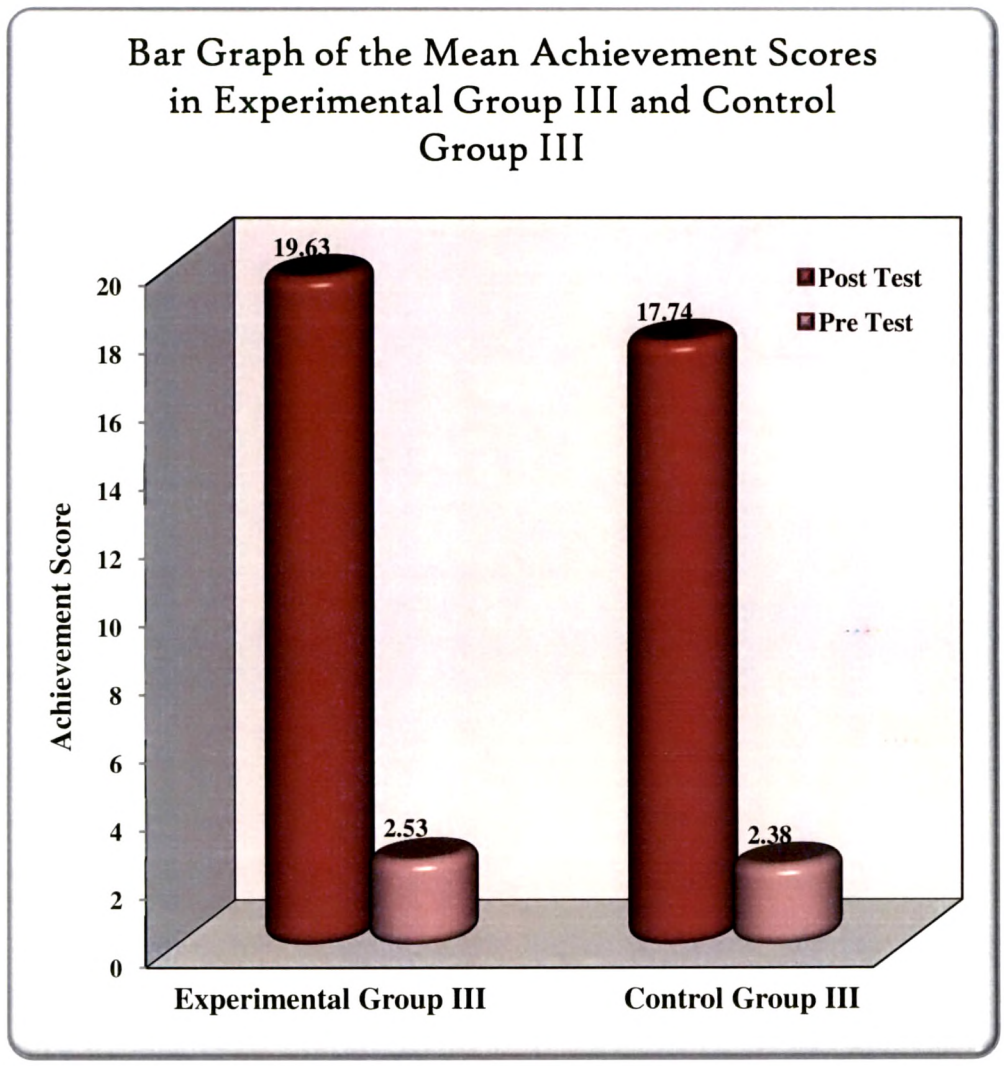
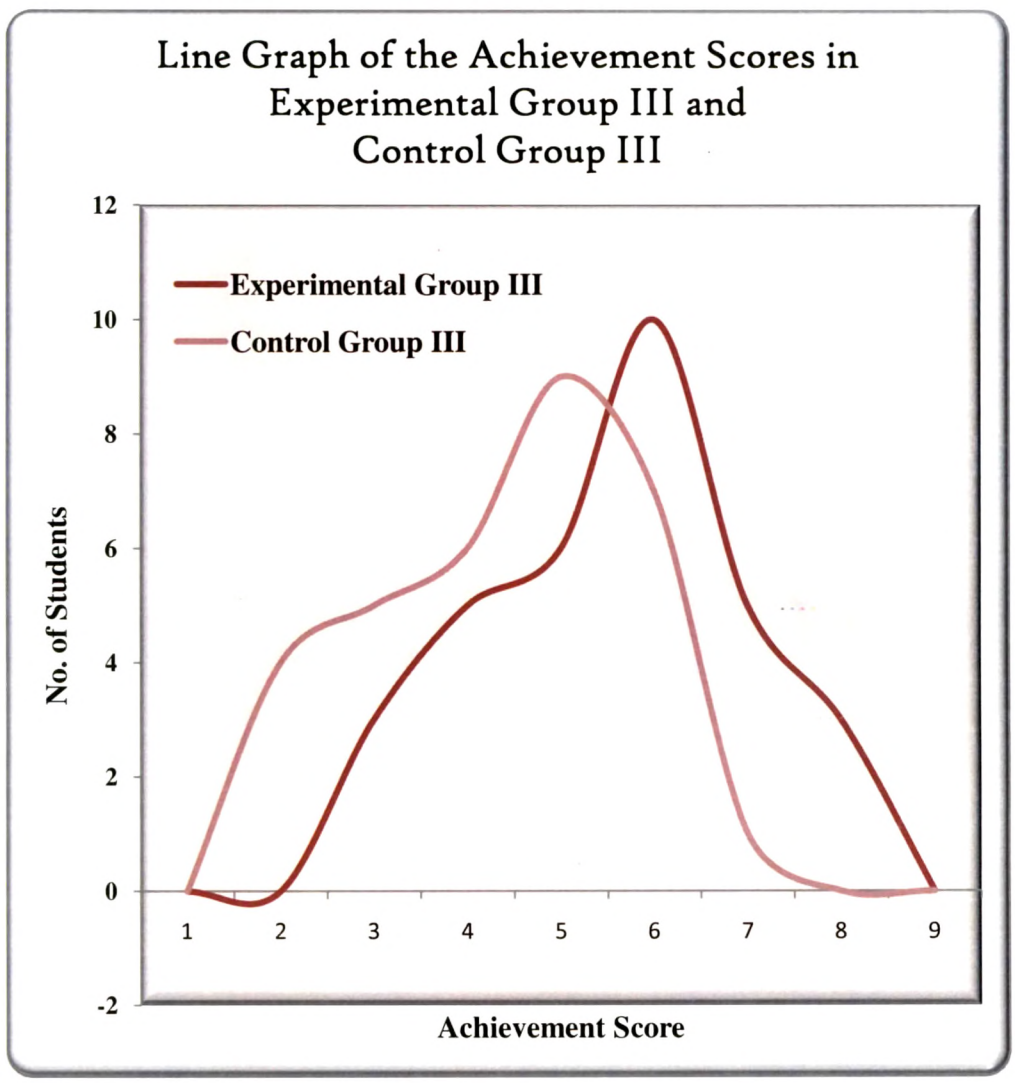

Bar Graph of the Mean Achievement Scores in Experimental Group III and Control Group III
Achievement Score
0
2
4
6
8
10
12
14
16
18
20
19.63
2.53
17.74
2.38
Post Test
Pre Test
Experimental Group III
Control Group III

Figure 4.9


Line Graph of the Achievement Scores in Experimental Group III and Control Group III
Experimental Group III
Control Group III
No. of Students
12
10
8
6
4
2
0
-2
1
2
3
4
5
6
7
8
9
Achievement Score

4.2.5 SUMMARY OF ANALYSIS OF THE ACHIEVEMENT SCORES OF STUDENTS IN ABILITY GROUPS AND IN MIXED ABILITY GROUP

The achievement scores of students between the ability groups and mixed ability group, high ability group and students of high ability in mixed ability group, average ability group and students of average ability in mixed ability group, and low ability group and students of low ability in mixed ability group were compared to check the effectiveness of differentiated instruction. The analysis of the data showed that all comparisons were significant.

The achievement scores of students between the ability groups and mixed ability group showed a 0.05 level difference ($t = 2.27$; $p < 0.05$). Also the mean of post achievement score of students in ability groups (28.05) is greater than those in mixed ability group (25.75). So the mathematics achievement of students in ability groups, taught through differentiated instruction is significantly higher in comparison to the mathematics achievement of students in mixed ability group, taught by conventional method.

The achievement scores of students between the high ability group and high ability students in mixed ability group showed a 0.01 level difference ($t = 2.75$; $p < 0.01$). Also the mean of post achievement score of students in high ability group (35.65) is greater than the high ability students in mixed ability group (34.19). So the mathematics achievement of students in high ability group, taught through differentiated instruction is significantly higher in comparison to the mathematics achievement of high ability students in mixed ability group, taught by conventional method.

The achievement scores of students between the average ability group and average ability students in mixed ability group showed a 0.01 level difference ($t = 2.62$; $p < 0.05$). Also the mean

of post achievement score of students in average ability group (28.17) is greater than the average ability students in mixed ability group (26.25). So the mathematics achievement of students in average ability group, taught through differentiated instruction is significantly higher in comparison to the mathematics achievement of average ability students in mixed ability group, taught by conventional method.

The achievement scores of students between the low ability group and low ability students in mixed ability group showed a 0.01 level difference ($t = 3.18$; $p < 0.01$). Also the mean of post achievement score of students in low ability group (19.63) is greater than the low ability students in mixed ability group (17.34). So the mathematics achievement of students in low ability group, taught through differentiated instruction is significantly higher in comparison to the mathematics achievement of low ability students in mixed ability group, taught by conventional method. The following table shows the summary of the analysis of the achievement scores of ability groups over mixed ability groups.

Table 4.13

Summary of Analysis of the Achievement Scores of Ability Groups over Mixed Ability Group

Achievement Score	N	Mean	S.D.	S.E.	t Value	Level of Significance
Ability Groups	99	28.05	6.79			
Vs				1.01	2.27	$p < 0.05$
Mixed Ability Group	99	25.75	7.30			
High Ability Group	31	35.65	2.00			
Vs				0.52	2.75	$p < 0.01$
High Ability Students in Mixed Ability Group	31	34.19	1.98			
High Ability Group	36	28.17	2.99			
Vs				0.71	2.62	$P < 0.05$
High Ability Students in Mixed Ability Group	36	26.25	3.21			
High Ability Group	32	19.63	2.87			
Vs				0.72	3.18	$P < 0.01$
High Ability Students in Mixed Ability Group	32	17.34	2.78			

Subsequently the effect of differentiated instruction on attitude towards mathematics among the students in the different ability groups were found. The detail analysis is given below.

4.3 EFFECT OF DIFFERENTIATED INSTRUCTION ON ATTITUDE TOWARDS MATHEMATICS AMONG THE ABILITY GROUPS

The attitude test scores of students in different groups in ability groups were compared in order to check whether if there is any significant affect of differentiated instruction on attitude towards mathematics in ability groups. This was done in three sections:

1. Effect of differentiated instruction on attitude towards mathematics among the high ability group.
2. Effect of differentiated instruction on attitude towards mathematics among the average ability group.
3. Effect of differentiated instruction on attitude towards mathematics among the low ability group.

The t test of significance is used for the comparisons. The detail analysis is given below.

4.3.1 EFFECT OF DIFFERENTIATED INSTRUCTION ON ATTITUDE TOWARDS MATHEMATICS AMONG THE HIGH ABILITY GROUP (EXPERIMENTAL GROUP I)

The attitude test scores of 31 students in high ability group were subjected to t-test of significance to determine the affect of differentiated instruction on attitude towards mathematics among the high ability group.

Mean and standard deviation of pre and post attitude test scores of students in experimental group I were calculated for finding the standard error. Then the test of significant of the difference between the mean scores of pre- and post attitude test scores of students in experimental group I using t-test was found and is given below in the table 4.14.

Table 4.14

Mean, Standard Deviation and t-test of significance of the Attitude Test Scores of Students in Experimental Group I

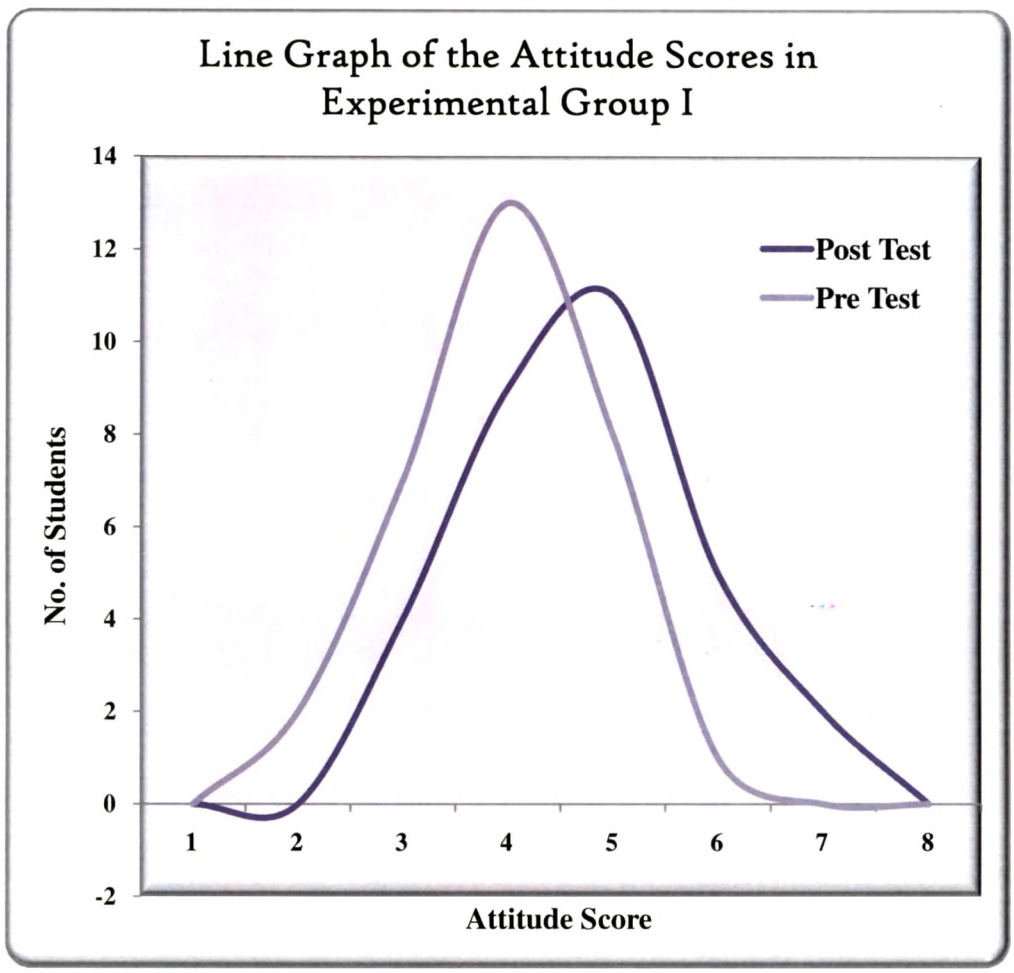
Experimental group I (Attitude)	**Mean**	**SD**	**SE_m**	**t value**	**Level of Significance**
Pre Test	264.09	8.56			
×			2.47	2.36	P < 0.05
Post Test	270.93	10.75			

Mean of pre- and post attitude test scores of students in experimental group I tested for significance. The table value of t for df = 60 are 2.00 at 0.05 level and 2.66 at 0.01 level. The computed value of t = 2.36 is significant at 0.05 level. So the value is significant at 0.01 level (t = 2.36; p < 0.05).

The significant t value indicates that the null hypothesis is rejected. It shows that there is a significant difference between the pre- and post attitude scores of students in experimental group I when taught by differentiated instruction. The mean of post attitude score of students in experimental group I (270.93) is greater than the mean of pre attitude score (264.09). So it can be inferred that there is a better affect on attitude towards mathematics among the students in experimental group I, which is called as high ability group, taught through differentiated instruction.

The line graph showing the pre and post attitude test scores of students in experimental group I is given in the next page as figure 4.10.

Figure 4.10


Line Graph of the Attitude Scores in Experimental Group I
14
12
10
8
6
4
2
0
-2
No. of Students
1
2
3
4
5
6
7
8
Attitude Score
Post Test
Pre Test

Equally the significant affect of differentiated instruction on attitude towards mathematics among the students in average ability group was found. The analysis, in detail is given below.

4.3.2 EFFECT OF DIFFERENTIATED INSTRUCTION ON ATTITUDE TOWARDS MATHEMATICS AMONG THE AVERAGE ABILITY GROUP (EXPERIMENTAL GROUP II)

The attitude test scores of 36 students in average ability group were subjected to t-test of significance to determine the affect of differentiated instruction on attitude towards mathematics among the average ability group.

Mean and standard deviation of pre- and post attitude test scores of students in experimental group II were calculated for finding the standard error. Then the test of significant of the difference between the mean scores of pre- and post attitude test scores of students in experimental group II using t-test was found and is given below in the table 4.15.

Table 4.15

Mean, Standard Deviation and t-test of significance of the Attitude Test Scores of Students in Experimental Group II

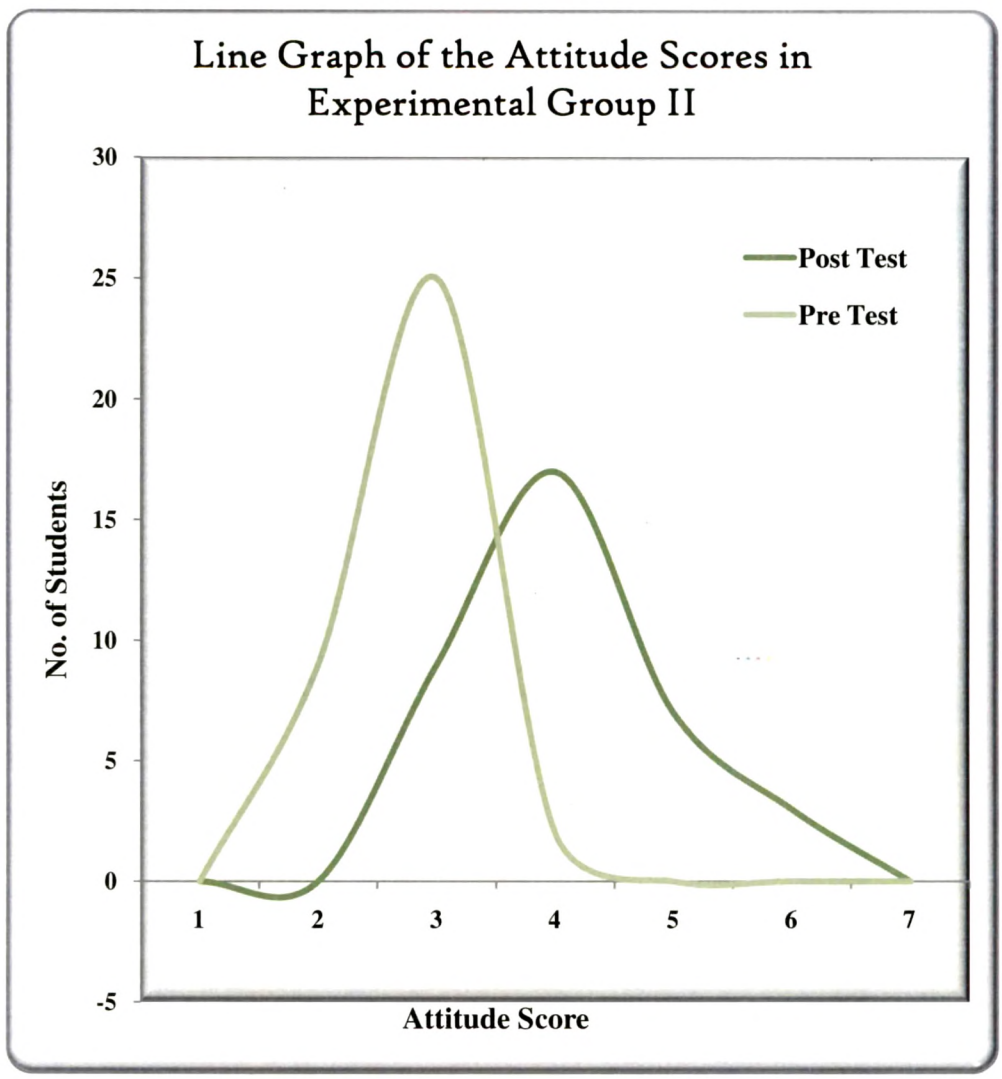
Experimental group II (Attitude)	**Mean**	**SD**	**SE_m**	**t value**	**Level of Significance**
Pre Test	216.17	11.6			
×			3.37	7.7	P < 0.01
Post Test	242.14	16.6			

Mean of pre- and post attitude test scores of students in experimental group II tested for significance. The table value of t for df = 70 are 2.00 at 0.05 level and 2.65 at 0.01 level. The computed value of t = 7.7 is significant at 0.01 level. So the value is significant at 0.01 level ($t = 7.7$; $p < 0.01$).

The significant t value indicates that the null hypothesis is rejected. It shows that there is a significant difference between the pre- and post attitude scores of students in experimental group II when taught by differentiated instruction. The mean of post attitude score of students in experimental group II (242.14) is greater than the mean of pre attitude score (216.17). So it can be inferred that there is a better affect on attitude towards mathematics among the students in experimental group II, which is called as average ability group, taught through differentiated instruction.

The line graph showing the attitude test scores of students in experimental group II is given in the next page as figure 4.11.

Figure 4.11


Line Graph of the Attitude Scores in Experimental Group II
30
25
20
15
10
5
0
-5
No. of Students
1
2
3
4
5
6
7
Attitude Score
Post Test
Pre Test

Similarly the significant affect of differentiated instruction on attitude towards mathematics among the students in low ability group was found. The detailed analysis is given below.

4.3.3 EFFECT OF DIFFERENTIATED INSTRUCTION ON ATTITUDE TOWARDS MATHEMATICS AMONG THE LOW ABILITY GROUP (EXPERIMENTAL GROUP III)

The attitude test scores of 32 students in low ability group were subjected to t-test of significance to determine the affect of differentiated instruction on attitude towards mathematics among the low ability group.

Mean and standard deviation of pre- and post attitude test scores of students in experimental group III were calculated for finding the standard error. Then the test of significant of the difference between the mean scores of pre- and post attitude test scores of students in experimental group III using t-test was found and is given below in the table 4.16.

Table 4.16

Mean, Standard Deviation and t-test of significance of the Attitude Test Scores of Students in Experimental Group III

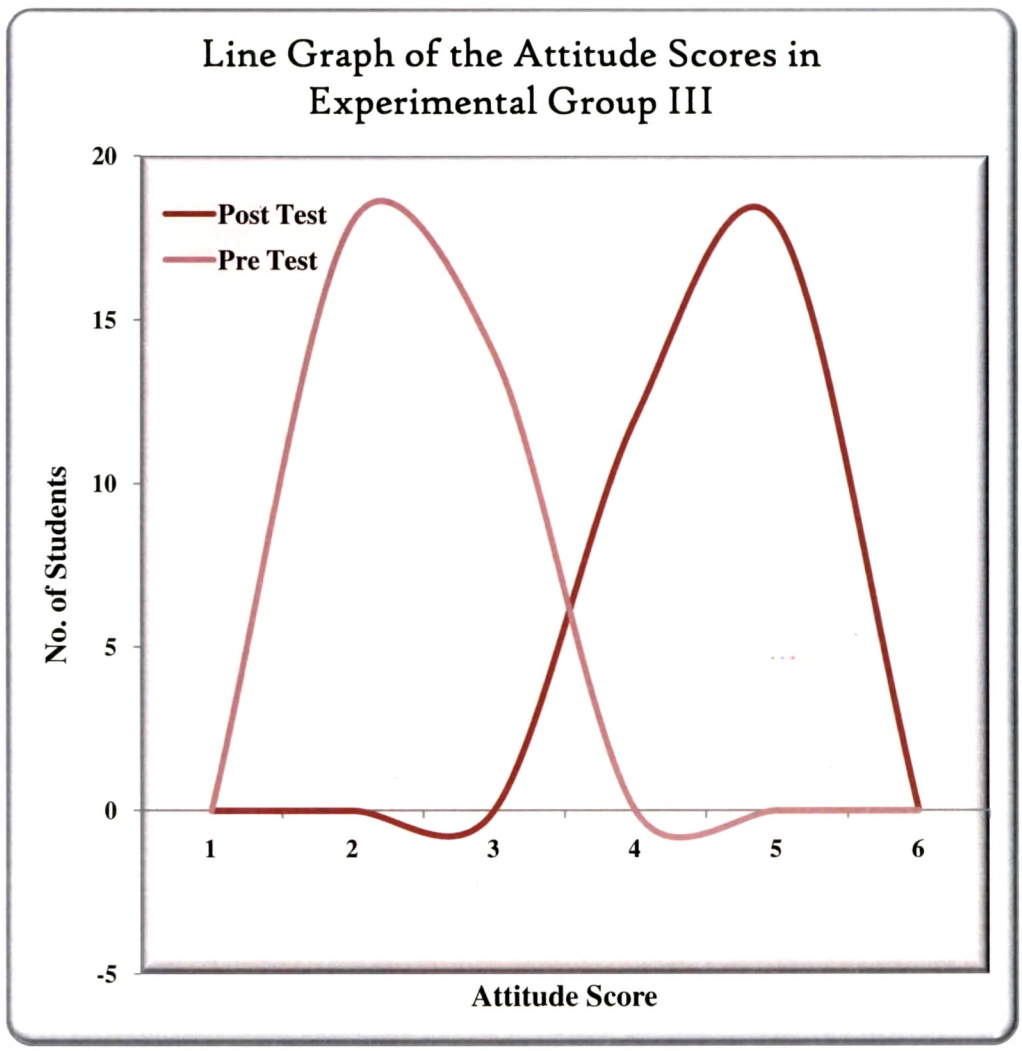
Experimental group III (Attitude Test)	**Mean**	**SD**	**SE_m**	**t value**	**Level of Significance**
Pre Test	162.46	9.66			
×			2.53	22.8	P < 0.01
Post Test	220.28	10.59			

Mean of pre- and post attitude test scores of students in experimental group II tested for significance. The table value of t for df = 62 are 2.00 at 0.05 level and 2.65 at 0.01 level. The computed value of t = 22.8 is significant at 0.01 level. So the value is significant at 0.01 level ($t = 22.8$; $p < 0.01$).

The significant t value indicates that the null hypothesis is rejected. It shows that there is a significant difference between the pre- and post attitude scores of students in experimental group III when taught by differentiated instruction. The mean of post attitude score of students in experimental group III (220.8) is greater than the mean of pre attitude score (162.46). So it can be inferred that there is a better affect on attitude towards mathematics among the students in experimental group III, which is called as low ability group, taught through differentiated instruction.

The line graph showing the attitude test scores of students in experimental group III is given in the next page as figure 4.12.

Figure 4.12


Line Graph of the Attitude Scores in Experimental Group III
Post Test
Pre Test
20
15
10
5
0
-5
No. of Students
1
2
3
4
5
6
Attitude Score

4.3.4 SUMMARY OF ANALYSIS OF THE ATTITUDE SCORES AMONG STUDENTS IN ABILITY GROUPS

The attitude test scores of students in high ability group, average ability group and low ability group were compared in order to check whether if there is any significant affect of differentiated instruction on attitude towards mathematics in ability groups. The analysis of the data showed that all comparisons were significant.

The pre- and post attitude scores of students in high ability group showed a 0.05 level of difference ($t = 2.36$; $p < 0.05$). The mean of post attitude score of students in high ability group (270.93) is greater than the mean of pre attitude score (264.09). So there is a better affect on attitude towards mathematics among the students in high ability group, taught through differentiated instruction.

The pre- and post attitude scores of students in average ability group showed a 0.01 level of difference ($t = 7.7$; $p < 0.01$). The mean of post attitude score of students in average ability group (242.14) is greater than the mean of pre attitude score (216.17). So there is a better affect on attitude towards mathematics among the students in average ability group, taught through differentiated instruction.

The pre- and post attitude scores of students in low ability group showed a 0.01 level of difference ($t = 22.8$; $p < 0.01$). The mean of post attitude score of students in low ability group (220.28) is greater than the mean of pre attitude score (162.46). So there is a better affect on attitude towards mathematics among the students in low ability group, taught through differentiated instruction.

The summary of analysis of attitude scores in ability groups is given in the table 4.17.

Table 4.17

Summary of Analysis of the Attitude Scores in Ability Groups

Attitude Score	N	Mean	S.D.	S.E.	t Value	Level of Significance
High Ability Group						
Pre Attitude Score	31	264.09	8.56			
Vs				2.47	2.36	P < 0.05
Post Attitude Score	31	270.93	10.75			
Average Ability Group						
Pre Attitude Score	36	216.17	11.6			
Vs				3.37	7.7	p < 0.01
Post Attitude Score	36	242.14	16.6			
Low Ability Group						
Pre Attitude Score	32	162.46	9.66			
Vs				2.53	22.8	P < 0.01
Post Attitude Score	32	220.28	10.59			

Subsequently the Effect of differentiated instruction on attitude towards mathematics among the students in ability groups over students in mixed ability group were found. The detailed analysis is given below.

4.4 EFFECT OF DIFFERENTIATED INSTRUCTION ON ATTITUDE TOWARDS MATHEMATICS AMONG STUDENTS IN ABILITY GROUPS OVER MIXED ABILITY GROUP

The attitude scores of students in ability groups and mixed ability group were subjected to analysis of covariance to determine the affect of differentiated instruction on attitude towards mathematics in ability groups over mixed ability group. This was done in four sections:

- Effect of differentiated instruction on attitude towards mathematics among students in ability groups over mixed ability group (Experimental groups × Control group).
- Effect of differentiated instruction on attitude towards mathematics among students in high ability group over high ability students in mixed ability group (Experimental group I × Control group I).
- Effect of differentiated instruction on attitude towards mathematics among students in average ability group over average ability students in mixed ability group (Experimental group II × Control group II).
- Effect of differentiated instruction on attitude towards mathematics among students in Low ability group over low ability students in mixed ability group (Experimental group III × Control group III).

ANCOVA, using two groups, was used to show the effectiveness. Covariance Analysis is especially useful to experimental researcher when for various reasons it is impossible or quite difficult to equate experimental groups at the start – a situation, which often obtains in actual experiments. Though covariance analysis it is able to affect adjustments in final and

terminal scores which will allow for difference in some initial variables. The detailed analysis is given below.

4.4.1 EFFECT OF DIFFERENTIATED INSTRUCTION ON ATTITUDE TOWARDS MATHEMATICS AMONG STUDENTS IN ABILITY GROUPS OVER MIXED ABILITY GROUP (EXPERIMENTAL GROUPS × CONTROL GROUP)

The attitude test scores of 99 students in ability groups and 99 students in mixed ability group were subjected to analysis of covariance to determine the affect of differentiated instruction on attitude towards mathematics in ability groups over mixed ability group.

F-ratios for the pre-test and post-test attitude scores of students in experimental groups and control group were computed to check whether any significant difference in pre attitude scores and in post attitude scores. Table 4.18 shows the ANOVA of achievement scores of students in experimental groups and control group.

Table 4.18

ANOVA of Attitude Scores of Students in Experimental Groups and Control Group

Sources of Variations	**df**	**SS_X**	**SS_Y**	**MS_X**	**MS_Y**	**F-ratio**
Among Groups	1	264.85	37972.5	264.85	37972.55	$F_X = 0.15$
With in Groups	196	344201.47	221045.8	1756.13	1127.78	$F_Y = 33.67$
Total	197	344466.33	259018.4	-	-	

The F-ratio of the two sets of scores was tested for significance. The table values of F for df = 1/196 are 3.89 at 0.05 level and 6.76 at 0.01 level. The computed value of F_X is 0.15, which is not significant even at 0.05 level and the computed value of F_Y is 33.67, which is significant at 0.01 level (F_X = 0.15; p > 0.05 & F_Y = 33.67; p < 0.01).

Since F_X is not significant, the null hypothesis is accepted. This implies that there is no significant difference in the pre-test attitude scores of students in experimental groups and control group. Therefore the students were homogeneous in terms of attitude towards mathematics and thus randomization is justified. But F_Y is significant means the null hypothesis is rejected. So it can be inferred that there is significant difference in the post attitude scores of students in experimental groups and control group. The total sum of squares and adjusted mean square variances for post-test attitude scores were computed, and F (F_{YX}) ratio was calculated. ANCOVA of attitude scores of students in experimental groups and control group is given as 4.19.

Table 4.19

ANCOVA of Attitude Scores of Students in Experimental Groups and Control Group

Sources of Variation	**df**	**SS_X**	**SS_Y**	**SS_{XY}**	**SS_{YX}**	**MS_{YX}**	**SD_{YX}**
Among Groups	1	264.85	37972.5	3171.3	33485.8	33485.8	14.3
Within groups	195	344201.5	221045.8	249652.9	39969.9	204.97	
Total	196	344466.3	259018.4	252824.2	73455.7	-	-
						F_{YX} = 163.37	

The table values of F for df = 1/195 are 3.89 at 0.05 level and 6.76 at 0.01 level. The computed value of F (F_{YX}) is 163.37, which is significant at 0.01 level. The significant ratio for the adjusted post-test scores shows that the final mean squares in experimental groups and control group differ significantly after they have been adjusted for difference in pre-test scores.

The adjusted means for post-test scores of students in experimental groups and control group were computed using correlation and regression. The results are shown in table 4.20.

Table 4.20

Adjusted Means and t value of Attitude score of Students in Experimental Groups and Control Group

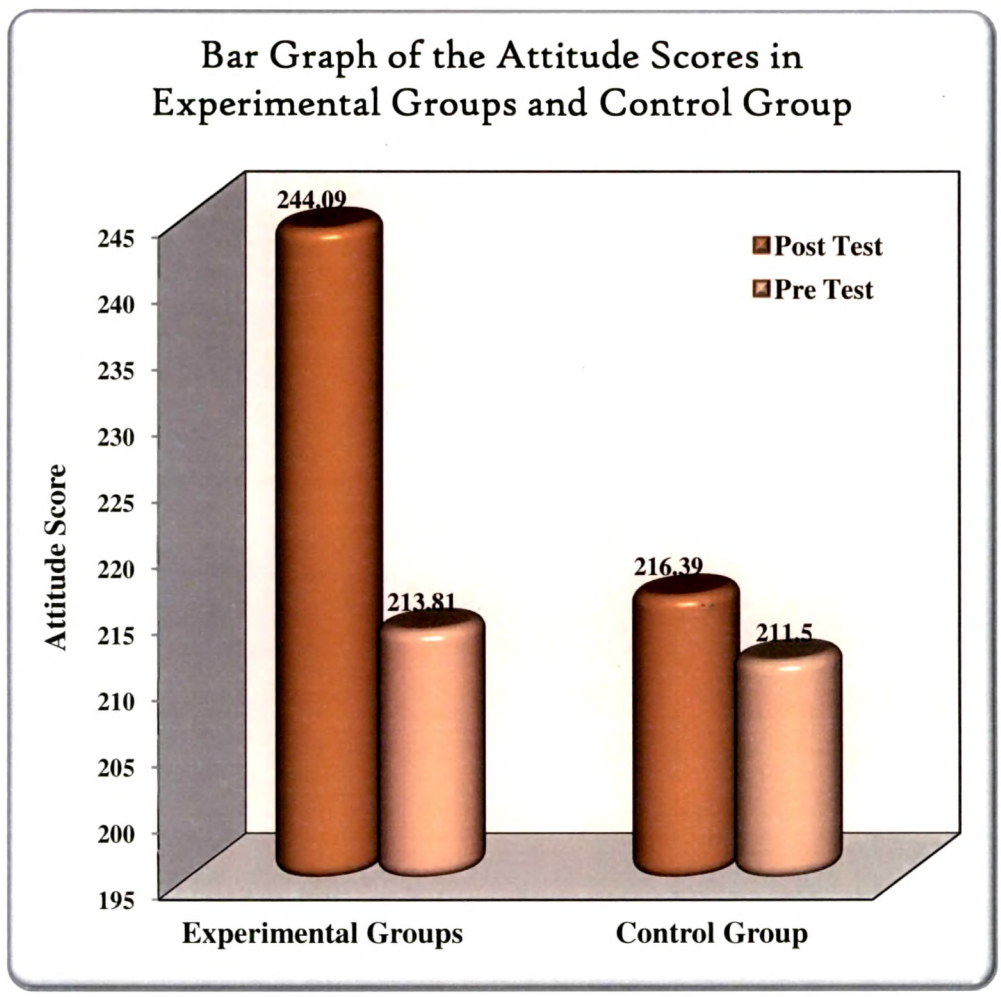
Groups	**N**	**M_X**	**M_Y**	**M_{XY}**	**Significance of difference among adjusted Y means**
Experimental Groups	99	213.82	244.1	243.25	SE_m = 2.03 t = 12.79
Control Group	99	211.51	216.4	217.23	
Of Total	198	212.66	230.24	-	

Adjusted means for post-test scores were tested for significance. The table values of t for df = 196 are 1.97 at 0.05 level and 2.60 at 0.01 level. The computed value of t = 12.79 is significant at 0.01 level. So the value is significant at 0.01 level ($t = 12.79$; $p < 0.01$).

The significant t value indicates that the null hypothesis is rejected. It shows that there is a significant difference in the attitude score of students in experimental groups and control group when taught by differentiated instruction. The mean of post attitude score of students in experimental groups (244.09) is greater than those in control group (216.39). So it can be inferred that the differentiated instruction has a better affect on attitude towards mathematics among the students in experimental groups, which is called as ability groups when compared with the students in control group, which is called as mixed ability group, taught by conventional method.

The bar graph of the mean attitude scores of students in experimental groups and control group is given in the next page as figure 4.13.

Figure 4.13


Bar Graph of the Attitude Scores in Experimental Groups and Control Group
Attitude Score
245
240
235
230
225
220
215
210
205
200
195
244.09
213.81
216.39
211.5
Post Test
Pre Test
Experimental Groups
Control Group

Likewise pre- and post attitude test scores of high ability students in ability groups and in mixed ability group were compared. The detailed analysis is given below.

4.4.2 EFFECT OF DIFFERENTIATED INSTRUCTION ON ATTITUDE TOWARDS MATHEMATICS AMONG STUDENTS IN HIGH ABILITY GROUP OVER HIGH ABILITY STUDENTS IN MIXED ABILITY GROUP (EXPERIMENTAL GROUP I × CONTROL GROUP I)

The attitude test scores of 31 students having high ability in ability groups and 31 students having high ability in mixed ability group were subjected to analysis of covariance to determine the affect of differentiated instruction on attitude towards mathematics among high ability students in ability groups over high ability students in mixed ability group.

F-ratios for the pre-test and post-test attitude scores of students in experimental group I and control group I were computed to check whether any significant difference in pre attitude scores and in post attitude scores. Table 4.21 shows the ANOVA of attitude scores of students in experimental group I and control group I.

Table 4.21

ANOVA of Attitude Scores of Students in Experimental Group I and Control Group I

Sources of Variations	df	SS_X	SS_Y	MS_X	MS_Y	F-ratio
Among Groups	1	12.65	607.0	12.65	607.03	$F_X = 0.17$ $F_Y = 6.13$
With in Groups	60	4533.55	5942.6	75.56	99.04	
Total	61	4546.19	6549.7	-	-	

The F-ratio of the two sets of scores was tested for significance. The table values of F for df = 1/60 are 4.00 at 0.05 level and 7.08 at 0.01 level. The computed value of F_X is 0.17, which is not significant even at 0.05 level and the computed value of F_Y is 6.13, which is significant at 0.05 level (F_X = 0.17; $p > 0.05$ & F_Y = 6.13; $p < 0.05$).

Since F_X is not significant, the null hypothesis is accepted. This implies that there is no significant difference in the pre-test attitude scores of students in experimental group I and control group I. But F_Y is significant means the null hypothesis is rejected. So it can be inferred that there is significant difference in the post attitude scores of students in experimental group I and control group I. The total sum of squares and adjusted mean square variances for post-test attitude scores were computed, and F (F_{YX}) ratio was calculated. ANCOVA of attitude scores of students in experimental group I and control group I is given as table 4.22.

Table 4.22

ANCOVA of Attitude Scores of Students in Experimental Group I and Control Group I

Sources of Variation	**df**	**SS_X**	**SS_Y**	**SS_{XY}**	**SS_{YX}**	**MS_{YX}**	**SD_{YX}**
Among Groups	1	12.65	607.0	87.61	453.75	453.75	5.85
Within groups	59	4533.55	5942.6	4216.13	2021.71	34.27	
Total	60	4546.19	6549.76	4303.74	2475.46	-	-
						F_{YX} = 13.24	

The table values of F for df = 1/59 are 4.00 at 0.05 level and 7.08 at 0.01 level. The computed value of F (F_{YX}) is 13.24, which is significant at 0.01 level. The significant ratio for the adjusted post-test attitude scores shows that the final mean squares in experimental group I and control group I differ significantly after they have been adjusted for difference in pre-test attitude scores.

The adjusted means for post-test attitude scores of students in experimental group I and control group I were computed using correlation and regression. The results are shown in table 4.23.

Table 4.23

Adjusted Means and t value of Attitude score of Students in Experimental Group I and Control Group I

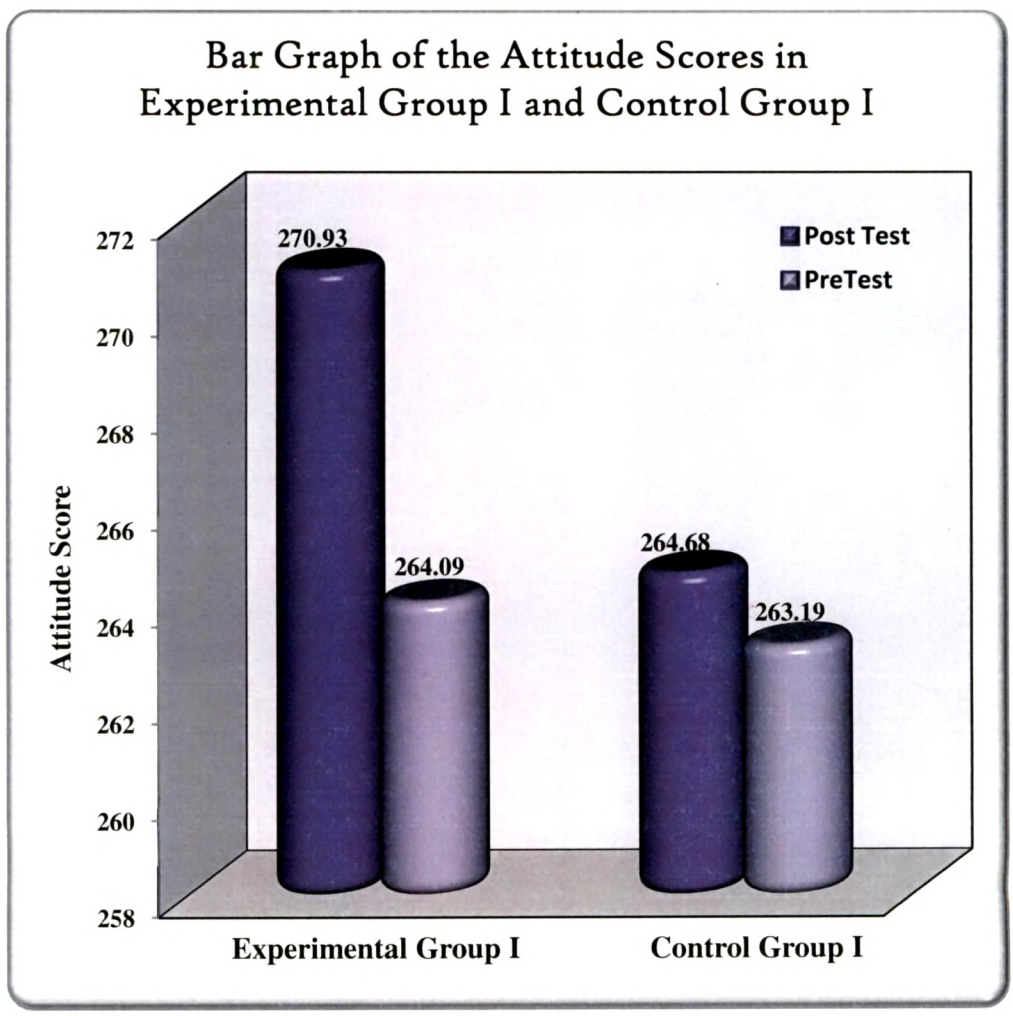
Groups	**N**	**M_X**	**M_Y**	**M_{XY}**	**Significance of difference among adjusted Y means**
Experimental Group I	31	264.10	270.9	270.52	SE_m = 1.49 t = 3.64
Control Group I	31	263.19	264.7	265.10	
Of Total	62	263.65	267.81	-	

Adjusted means for post-test attitude scores were tested for significance. The table values of t for df = 60 are 2.00 at 0.05 level and 2.66 at 0.01 level. The computed value of t = 3.64 is significant at 0.01 level. So the value is significant at 0.01 level (t = 3.64; $p < 0.01$).

The significant t value indicates that the null hypothesis is to be rejected. It shows that there is a significant difference in the attitude score of students in experimental group I and control group I when taught by differentiated instruction. The mean of post attitude score of students in experimental group I (270.93) is greater than those in control group I (264.68). So it can be inferred that differentiated instruction has a better affect on attitude towards mathematics among the high ability students in ability groups, which is called as high ability group, when compared with the high ability students in mixed ability group, taught by conventional method.

The bar graph showing the mean attitude scores of students in experimental group I and control group I is given in the next page as figure 4.14.

Figure 4.14


Bar Graph of the Attitude Scores in Experimental Group I and Control Group I
Attitude Score
272
270
268
266
264
262
260
258
270.93
264.09
264.68
263.19
Post Test
PreTest
Experimental Group I
Control Group I

Likewise post attitude test scores of students having average ability in ability group and mixed ability group were compared. The detailed analysis is given below.

4.4.3 EFFECT OF DIFFERENTIATED INSTRUCTION ON ATTITUDE TOWARDS MATHEMATICS AMONG STUDENTS IN AVERAGE ABILITY GROUP OVER AVERAGE ABILITY STUDENTS IN MIXED ABILITY GROUP (EXPERIMENTAL GROUP II × CONTROL GROUP II)

The attitude test scores of 36 students having average ability in ability groups and 36 students having average ability in mixed ability group were subjected to analysis of covariance to determine the affect of differentiated instruction on attitude towards mathematics among average ability students in ability groups over average ability students in mixed ability group.

F-ratios for the pre-test and post-test attitude scores of students in experimental group II and control group II were computed to check whether any significant difference in pre attitude scores and in post attitude scores. Table 4.24 shows the ANOVA of attitude scores of students in experimental group II and control group II.

Table 4.24

ANOVA of Attitude Scores of Students in Experimental Group II and Control Group II

Sources of Variations	df	SS_X	SS_Y	MS_X	MS_Y	F-ratio
Among Groups	1	595.13	9248.0	595.13	9248.00	$F_X = 3.83$
With in Groups	70	10885.75	14503.3	155.51	207.19	$F_Y = 44.6$
Total	71	11480.88	23751.3	-	-	

The F-ratio of the two sets of scores was tested for significance. The table values of F for df = 1/70 are 3.98 at 0.05 level and 7.01 at 0.01 level. The computed value of F_X is 3.83, which is not significant even at 0.05 level and the computed value of F_Y is 44.6, which is significant at 0.01 level (F_X = 3.83; $p > 0.05$ & $F_Y = 44.6$; $p < 0.01$).

Since F_X is not significant, the null hypothesis is accepted. This implies that there is no significant difference in the pre-test attitude scores of students in experimental group II and control group II. But F_Y is significant means the null hypothesis is rejected. So it can be inferred that there is significant difference in the post attitude scores of students in experimental group II and control group II. The total sum of squares and adjusted mean square variances for post-test attitude scores were computed, and F (F_{YX}) ratio was calculated. ANCOVA of attitude scores of students in experimental group II and control group II is given as table 4.25.

Table 4.25

ANCOVA of Attitude Scores of Students in Experimental Group II and Control Group II

Sources of Variation	**df**	**SS_X**	**SS_Y**	**SS_{XY}**	**SS_{YX}**	**MS_{YX}**	**SD_{YX}**
Among Groups	1	595.1	9348.0	2346.0	6816.5	6816.5	13.2
Within groups	69	108885.7	14503.3	5077.1	12135.3	175.9	
Total	70	114480.8	23751.3	7423.1	18951.8	-	-
						$F_{YX} = 38.76$	

The table values of F for df = 1/69 are 3.98 at 0.05 level and 7.01 at 0.01 level. The computed value of F (F_{YX}) is 38.76, which is significant at 0.01 level. The significant ratio for the adjusted post-test attitude scores shows that the final mean squares in experimental group II and control group II differ significantly after they have been adjusted for difference in pre-test attitude scores.

The adjusted means for post-test attitude scores of students in experimental group II and control group II were computed using correlation and regression. The results are shown in table 4.26.

Table 4.26

Adjusted Means and t value of Attitude score of Students in Experimental Group II and Control Group II

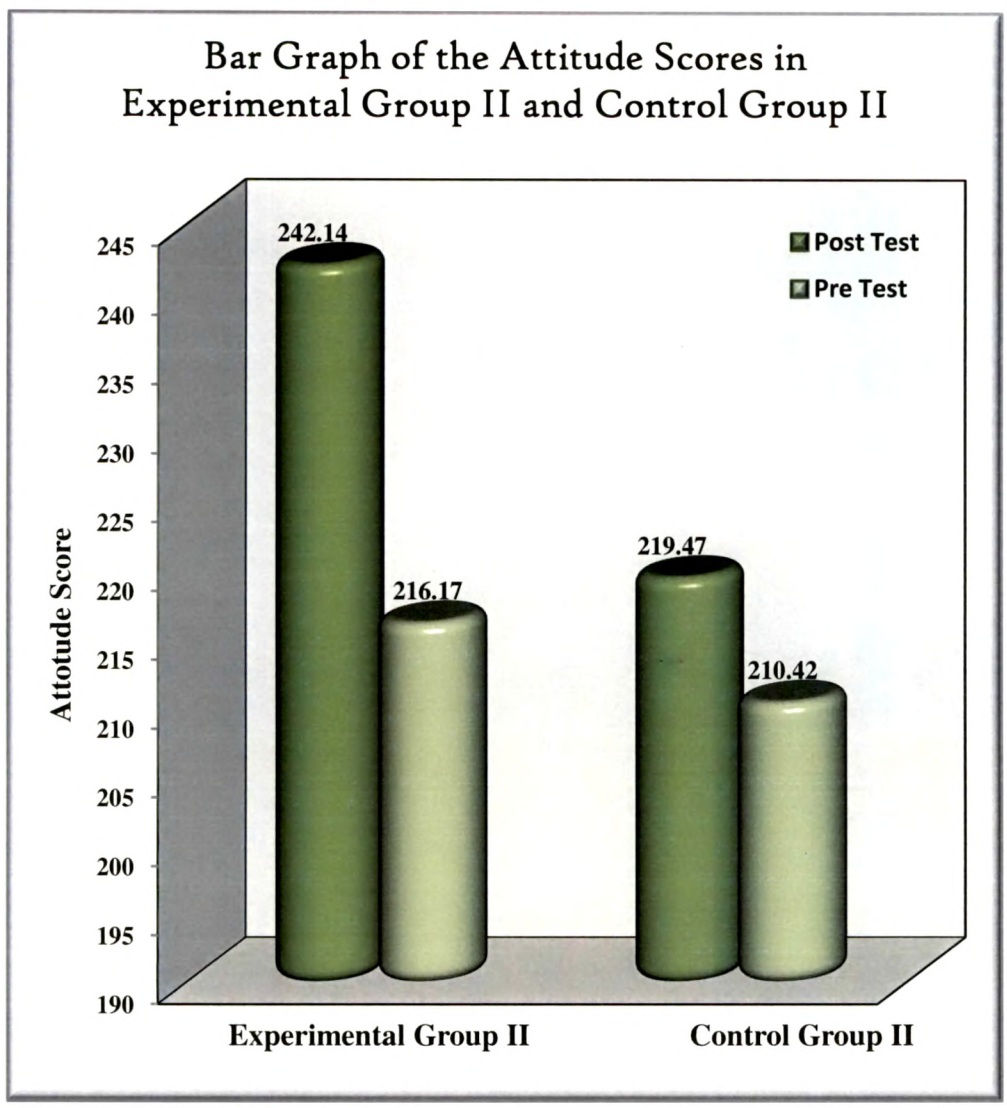
Groups	N	M_X	M_Y	M_{XY}	Significance of difference among adjusted Y means
Experimental Group II	36	216.17	242.1	240.80	SE_m = 3.13
Control Group II	36	210.42	219.5	220.81	t = 6.39
Of Total	62	213.29	230.81	-	

Adjusted means for post-test attitude scores were tested for significance. The table values of t for df = 70 are 2.00 at 0.05 level and 2.65 at 0.01 level. The computed value of t = 6.39 is significant at 0.01 level. So the value is significant at 0.01 level ($t = 6.39$; $p < 0.01$).

The significant t value indicates that the null hypothesis is rejected. It shows that there is a significant difference in the attitude score of students in experimental group II and control group II when taught by differentiated instruction. The mean of post attitude score of students in experimental group II (242.14) is greater than those in control group II (219.47). So it can be inferred that differentiated instruction has a better affect on attitude towards mathematics among the average ability students in ability groups, which is called as average ability group, when compared with the average ability students in mixed ability group, taught by conventional method.

The bar graph showing the comparison of mean scores of attitude of students in experimental group II and control group II is given in the next page as figure 4.15.

Figure 4.15


Bar Graph of the Attitude Scores in Experimental Group II and Control Group II
Attotude Score
245
240
235
230
225
220
215
210
205
200
195
190
242.14
216.17
219.47
210.42
Post Test
Pre Test
Experimental Group II
Control Group II

Similarly post attitude test scores of students having low ability in ability group and mixed ability group were compared. The results are given below.

4.4.4 EFFECT OF DIFFERENTIATED INSTRUCTION ON ATTITUDE TOWARDS MATHEMATICS AMONG STUDENTS IN LOW ABILITY GROUP OVER LOW ABILITY STUDENTS IN MIXED ABILITY GROUP (EXPERIMENTAL GROUP III × CONTROL GROUP III)

The attitude test scores of 32 students having low ability in ability groups and 32 students having low ability in mixed ability group were subjected to analysis of covariance to determine the effect of differentiated instruction on attitude towards mathematics among low ability students in ability groups over low ability students in mixed ability group.

F-ratios for the pre-test and post-test attitude scores of students in experimental group III and control group III were computed to check whether any significant difference in pre attitude scores and in post attitude scores. Table 4.27 shows the ANOVA of attitude scores of students in experimental group III and control group III.

Table 4.27

ANOVA of Attitude Scores of Students in Experimental Group III and Control Group III

Sources of Variations	df	SS_X	SS_Y	MS_X	MS_Y	F-ratio
Among Groups	1	0.56	46872.3	0.56	46872.25	$F_X = 0.01$
With in Groups	62	6617.19	6608.7	106.73	106.59	$F_Y = 439.7$
Total	63	6617.75	53480.9	-	-	

The F-ratio of the two sets of scores was tested for significance. The critical values of F for df = 1/62 are 3.98 at 0.05 level and 7.01 at 0.01 level. The obtained value of F_X is 0.01, which is not significant even at 0.05 level and the obtained value of F_Y is 439.7, which is significant at 0.01 level. (F_X = 0.01; $p > 0.05$ & F_Y = 439.7; $p < 0.01$).

Since F_X is not significant, the null hypothesis is accepted. This implies that there is no significant difference in the pre-test attitude scores of students in experimental group III and control group III. But F_Y is significant means the null hypothesis is rejected. So it can be inferred that there is significant difference in the post attitude scores of students in experimental group III and control group III. The total sum of squares and adjusted mean square variances for post-test attitude scores were computed, and F (F_{YX}) ratio was calculated. ANCOVA of attitude scores of students in experimental group III and control group III is given as table 4.28.

Table 4.28

ANCOVA of Attitude Scores of Students in Experimental Group III and Control Group III

Sources of Variation	**df**	**SS_X**	**SS_Y**	**SS_{XY}**	**SS_{YX}**	**MS_{YX}**	**SD_{YX}**
Among Groups	1	0.56	46872.3	-162.4	47054.2	47054.2	8.5
Within groups	61	6617.19	6608.7	3784.5	4444.2	72.86	
Total	62	6617.75	53480.9	3622.1	51498.4	-	-
						F_{YX} = 645.85	

The table values of F for df = 1/61 are 3.98 at 0.05 level and 7.01 at 0.01 level. The computed value of F (F_{YX}) is 645.85, which is significant at 0.01 level. The significant ratio for the adjusted post-test attitude scores shows that the final mean squares in experimental group III and control group III differ significantly after they have been adjusted for difference in pre-test attitude scores.

The adjusted means for post-test attitude scores of students in experimental group III and control group III were computed using correlation and regression. The results are shown in table 4.29.

Table 4.29

Adjusted Means and t value of Attitude score of Students in Experimental Group III and Control Group III

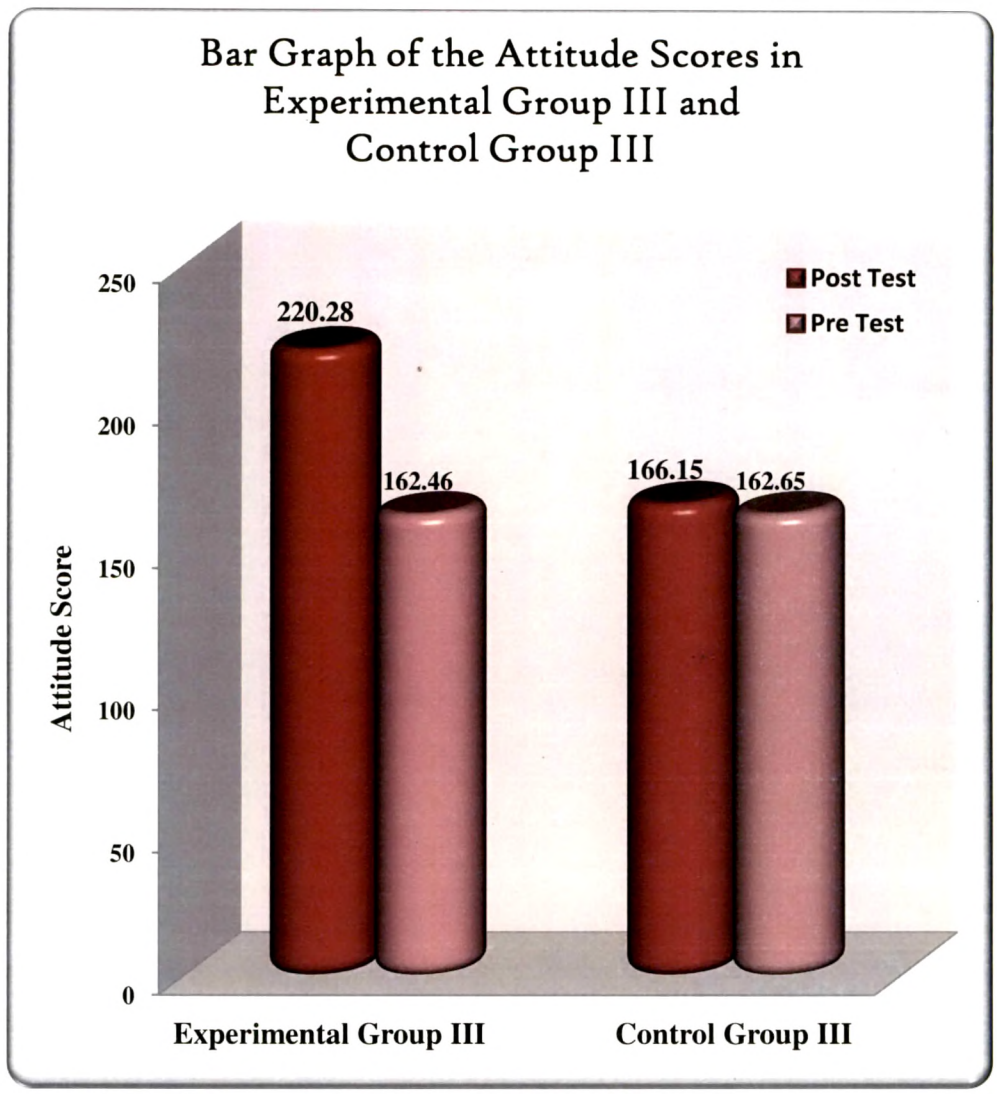
Groups	**N**	**M_X**	**M_Y**	**M_{XY}**	**Significance of difference among adjusted Y means**
Experimental Group III	32	162.47	220.3	220.33	SE_m = 2.13
Control Group III	32	162.66	166.2	166.10	t = 25.41
Of Total	64	162.56	193.22	-	

Adjusted means for post-test attitude scores were tested for significance. The table values of t for df = 62 are 2.00 at 0.05 level and 2.65 at 0.01 level. The computed value of t = 25.41 is significant at 0.01 level. So the value is significant at 0.01 level (t = 25.41; $p < 0.01$).

The significant t value indicates that the null hypothesis is rejected. It shows that there is a significant difference in the attitude score of students in experimental group III and control group III when taught by differentiated instruction. The mean of post attitude score of students in experimental group III (220.28) is greater than those in control group III (166.15). So it can be inferred that differentiated instruction has a better affect on attitude towards mathematics among the low ability students in ability groups, which is called as low ability group, when compared with the low ability students in mixed ability group, taught by conventional method.

The bar graph showing the comparison of mean scores of attitude of students in experimental group III and control group III is given as figure 4.16.

Figure 4.16


Bar Graph of the Attitude Scores in Experimental Group III and Control Group III
Post Test
Pre Test
Attitude Score
250
200
150
100
50
0
220.28
162.46
166.15
162.65
Experimental Group III
Control Group III

4.4.5 SUMMARY OF ANALYSIS OF THE ATTITUDE SCORES AMONG STUDENTS IN ABILITY GROUPS OVER MIXED ABILITY GROUP

The attitude scores of students between the ability groups and mixed ability group, high ability group and students of high ability in mixed ability group, average ability group and students of average ability in mixed ability group, and low ability group and students of low ability in mixed ability group were compared to check the affect of differentiated instruction towards mathematics. The analysis of the data showed that all comparisons were significant.

The attitude scores of students between the ability groups and mixed ability group showed a 0.01 level of difference ($t = 12.79$; $p < 0.01$). Also the mean of post attitude score of students in ability groups (244.09) is greater than those in mixed ability group (216.39). So the differentiated instruction has a better affect on attitude towards mathematics among the students in ability groups when compared with the students in mixed ability group, taught by conventional method.

The attitude scores of students between the high ability group and the high ability students in mixed ability group showed a 0.01 level of difference ($t = 3.64$; $p < 0.01$). Also the mean of post attitude score of students in high ability group (270.93) is greater than high ability students in mixed ability group (264.68). So the differentiated instruction has a better affect on attitude towards mathematics among the students in high ability group when compared with the high ability students in mixed ability group, taught by conventional method.

The attitude scores of students between the average ability group and the average ability students in mixed ability group showed a 0.01 level of difference ($t = 6.39$; $p < 0.01$). Also the mean of post attitude score of students in average ability group (242.14) is greater than average ability students in mixed ability group (219.47). So the differentiated instruction has a better affect on attitude towards mathematics among the students in average ability group when compared with the average ability students in mixed ability group, taught by conventional method.

The attitude scores of students between the low ability group and the low ability students in mixed ability group showed a 0.01 level of difference ($t = 25.41$; $p < 0.01$). Also the mean of post attitude score of students in low ability group (220.28) is greater than low ability students in mixed ability group (166.15). So the differentiated instruction has a better affect on attitude towards mathematics among the students in low ability group when compared with the low ability students in mixed ability group, taught by conventional method.

The summary of analysis of attitude scores in ability groups over mixed ability group is given as table 4.30.

Table 4.30

Summary of Analysis of Attitude Scores of Students in Ability Groups over Mixed Ability Group

Attitude Score	N	Mean	S.D.	S.E.	t Value	Level of Significance
Ability groups Vs Mixed Ability Group	99 99	244.09 216.39	24.15 40.68	2.03	12.79	$p < 0.01$
High Ability Group Vs High Ability Students in Mixed Ability Group	31 31	270.93 264.68	10.75 8.80	1.49	3.64	$p < 0.01$
High Ability Group Vs High Ability Students in Mixed Ability Group	36 36	242.14 219.47	16.60 11.16	3.13	6.39	$P < 0.01$
High Ability Group Vs High Ability Students in Mixed Ability Group	32 32	220.28 166.15	10.59 9.84	2.13	25.41	$P < 0.01$

4.5 FINDINGS AND DISCUSSION

National Curriculum Framework, 2005 recommends different strategies for different learners (high, average and slow) but not on the basis of gender, class or caste. The findings substantiated the recommendation of NCF, 2005 with differentiated instruction has a

higher significance over traditional method of instruction in academic achievement of mathematics of IX standard students in Kerala. In mixed ability classroom, while teachers teach to the average level, teachers cannot challenge the high ability students or cannot address the low ability students' needs. But differentiated instruction allowed the researcher to cater the needs of all the ability level of students to an extent. Differentiated instruction helped the researcher to give appropriate challenges, a secure environment, and an opportunity to explore ideas and have fun learning for all ability level of students. This is why; differentiated instruction had a significant effect on attitude towards mathematics too.

Differentiated instruction was found effective for enhancing the achievement of high ability students in mathematics when compared with the traditional method of instruction in mixed ability classroom. The researcher used constructivist approach as the differentiated instruction for high ability students, which proposes learning environments with multiple perspectives or interpretation of reality, knowledge construction, context-rich, experience based activities, may helped high ability students for this achievement. Also this approach helped the researcher to explore unique characteristics of high ability students. Another important thing is that differentiated instruction helped the high ability students to learn at their own pace. This benefitted in the increase in motivation. Thus attitude of high ability students towards mathematics is also changed. The analysis of the attitude scores substantiated this statement.

There is a misconception among common people that the average ability students are static in terms of achievement. Most of the educationists are also in this line. But when average ability students grouped for differentiated instruction in mathematics, it

was found effective in comparison with the traditional method of instruction. The analysis of the achievement scores of average ability students substantiated this fact. In a mixed ability classroom, the teachers normally teach to the average ability level, then also average ability students are not visibly committed to class and participate without enthusiasm. Integrated technology approach, which is used as the differentiated instruction for average ability students helped to stimulate the minds of average ability students. This made a marked change in attitude towards mathematics too. Integrated technology approach served as a bridge from concrete to abstract thinking, enable average ability students to observe and to think. The analysis of the achievement and attitude score of average ability students has a considerable potential for increasing the interest in, and improving the quality of, learning in mathematics.

Differentiated instruction was found effective for learning enhancing the achievement of low ability students as compared to the traditional method of instruction. The researcher used scaffolding approach as the differentiated instruction for low ability students, which optimized low ability students learning by providing a supportive environment. Scaffolding approach as differentiated instruction, avoided the tension and anxiety of low ability students to allow them to perform well in mathematics. Differentiated instruction allowed low ability students a slow pace to learn, which avoided the frustration that they had in mixed ability classroom. The huge change in attitude of average ability students towards mathematics underlined this fact.