CHAPTER IV

RESULTS AND INTERPRETATION

4.0 Introduction

The methodology is followed in conducting the present study has been given in detail in the previous chapter. In the chapter the statistical techniques used for analyzing the data have been presented objective wise. The present chapter is devoted to the presentation of results and interpretation. This has been done objective wise in the following captions.

Section I

4.1 Analysis of Basic Concept Skill, Distance Estimation, Mental Rotation & Delineation Skill

Section II

4.2 Chi-Square Analysis for Assembly Test and Rotational Displacement before and after Intervention

Section III

4.3 Influence of Gender/Grade and Type of Students and their Resultant Interaction on Spatial Ability Skill by Analysis of Covariance (ANCOVA)

Section IV

4.4 Influence of Braille Reading Skill on Spatial Ability by Analysis of Variance (ANOVA).

Section I

4.1 Analysis of Basic Concept Skill, Distance Estimation, Mental Rotation & Delineation Skill

Basic Concept Skill and Spatial Ability score among Visually Impaired Students (Experimental Group) and Blind-folded Sighted Students (Control Group) before and after Intervention. The gain score of both groups is also discussed.

4.1.1 Basic Concept Skill of Visually Impaired and Blind-Folded Sighted Students

Basic Concept Skill of two types of students viz., Visually Impaired and Blind-folded Sighted was analyzed by comparing their pre scores and post scores separately and the results are given in the following Table 4.1.

Table 4.1: Testing-wise Mean, SD, and t-value for Basic Concept Skill

Test	Type of Students	No.	Mean	SD	t-value
Pretest	Visually Impaired	60	2.37	1.47	35.26**
	Blind-folded Sighted	60	5.72	1.28	
Posttest	Visually Impaired	60	8.62	0.61	6.72**
	Blind-folded Sighted	60	7.02	1.64	

****Significant at 0.01 level***

From the table 4.1, it is evident that the ***t***-value for Basic Concept Skill for the pretest compared between Visually Impaired and Blind-folded Sighted students is 35.26 with df=59 which is significant at 0.01 level. It indicates that the pre scores of Basic Concept Skill of Visually Impaired and Blind-folded Sighted students differ significantly. It means that Blind-folded Sighted students secured higher score than the Visually Impaired students in the pretest. In the light of this, the null hypothesis stated that ***"there is no significant difference in mean Basic Concept Skill of Visually Impaired and Blind-folded Sighted students"*** **is rejected.** It may therefore be concluded that Blind-folded Sighted students showed higher score in the Basic Concept Skill than Visually Impaired students in the Pretest.

From the table 4.1, it is evident that the ***t***-value for **Basic Concept Skill** for posttest Compared between Visually Impaired and Blind-folded Sighted students is

6.72 with df=59 which is significant at 0.01 level. It indicates that the post scores of Basic Concept Skill of visually impaired and blind-folded sighted students differ significantly. In the light of this, the null hypothesis stated that ***"there is no significant differences in mean Basic Concept Skill of visually impaired and blind-folded sighted students"*** is rejected. It means that visually impaired students secured higher score than the blind-folded sighted in the posttest. It may therefore be concluded that the intervention helped improving Basic Concept Skill of visually impaired students.

4.1.2 Gain Score Analysis

Gain Score an analysis was made to find out the extent of Gain, the students achieved with the help of *t*-test. The result is given in the following table 4.2.

Table 4.2: Testing-wise Mean, SD, and t-value for Basic Concept Skill with respect to Gain Score

Score	Type of Students	No.	Mean	SD	t-value
Gain Score	Visually Impaired	60	6.25	1.37	18.86**
	Blind-folded Sighted	60	1.30	1.49	

***** Significant at 0.01 level***

From the table 4.2, it is evident that the *t*-value for **Basic Concept Skill** with respect to Gain Score is 18.86 with df=59 which is significant at 0.01 level. It indicates that the gain score of Basic Concept Skill of visually impaired students and blind-folded sighted students differ significantly. It means that the visually impaired students secured higher gain of (Mean =6.25) than the blind-folded sighted students (Mean=1.30). In the light of this, the null hypothesis stated that ***"there is no significant difference in the gain score of visually impaired and blind-folded sighted students"*** is rejected. Hence it is concluded that the visually impaired students after intervention secured higher gain than blind-folded sighted.

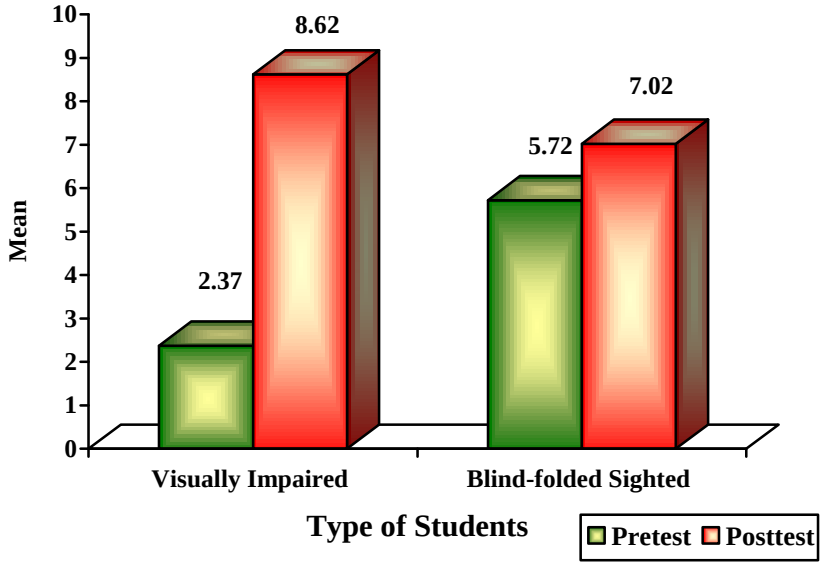

Fig 4.1a: Comparison of Basic Concept Skill

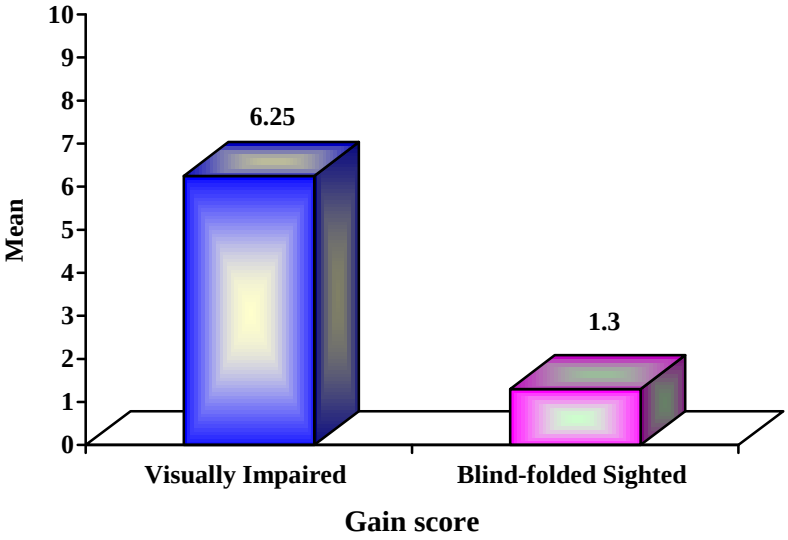

Fig 4.1b: Gain Score Comparison: Basic Concept Skill

4.1.3 Distance Estimation Skill of Visually Impaired and Blind-Folded Sighted Students

Distance Estimation of two types of student's viz., Visually Impaired and Blind-folded Sighted was analyzed by comparing their pre scores and post scores separately and the results are given in the following Table 4.3.

Table 4.3: Testing-wise Mean, SD, and t-value for Distance Estimation

Test	Type of Students	No.	Mean	SD	t-value
Pretest	Visually Impaired	60	0.73	0.97	58.19**
	Blind-folded Sighted	60	5.03	2.08	
Posttest	Visually Impaired	60	9.20	0.66	2.52**
	Blind-folded Sighted	60	5.77	2.52	

****Significant at 0.01 level***

From the table 4.3, it is evident that the ***t***-value for **Distance Estimation** for the pretest compared between Visually Impaired and Blind-folded Sighted students is 58.19 with df=59 which is significant at 0.01 level. It indicates that the pre scores of Distance Estimation of visually impaired and blind-folded sighted students differ significantly. It means that blind-folded sighted secured higher score than the visually impaired students in the pretest. In the light of this, the null hypothesis stated that ***"there is no significant difference in mean Distance Estimation of visually impaired and blind-folded sighted students"*** is rejected. It may therefore be concluded that blind-folded sighted students showed higher Distance Estimation than visually impaired students in the Pretest.

From the table 4.3, it is evident that the ***t***-value for **Distance Estimation** for posttest compared between Visually Impaired and Blind-folded Sighted students is 2.52 with df=59 which is significant at 0.01 level. It indicates that the post scores of Distance Estimation of visually impaired and blind-folded sighted students differ significantly. It means that visually impaired students secured higher score than the blind-folded sighted students in the posttest. In the light of this, the null hypothesis stated that ***"there is no significant differences in mean Distance Estimation of visually impaired and blind-folded sighted students"*** is rejected. It may therefore be

concluded that the intervention helped improving Distance Estimation of visually impaired students.

4.1.4 Gain Score Analysis

Gain Score an analysis with respect to Distance Estimation Skill. It was made to find out the extent of Gain the students achieved with the help of *t*-test. The result is given in the following table 4.4.

Table 4.4: Testing-wise Mean, SD, and t-value for Distance Estimation with respect to Gain score

Score	Type of Students	No.	Mean	SD	t-value
Gain Score	Visually Impaired	60	8.47	1.13	24.06**
	Blind-folded Sighted	60	0.73	2.25	

*****Significant at 0.01 level***

From the table 4.4, it is evident that the *t*-value for Distance Estimation for Gain Score is 24.06 with df=59 which is significant at 0.01 level. It indicates that the gain score of Distance Estimation of visually impaired students and blind-folded sighted students differ significantly. It means that the visually impaired students secured higher gain (Mean=8.47) than the blind-folded sighted (Mean=0.73). In the light of this, the null hypothesis stated that ***"there is no significant difference in the gain score of visually impaired and blind-folded sighted students"*** is rejected. Hence it is concluded that the visually impaired students after intervention secured higher gain than blind-folded sighted.

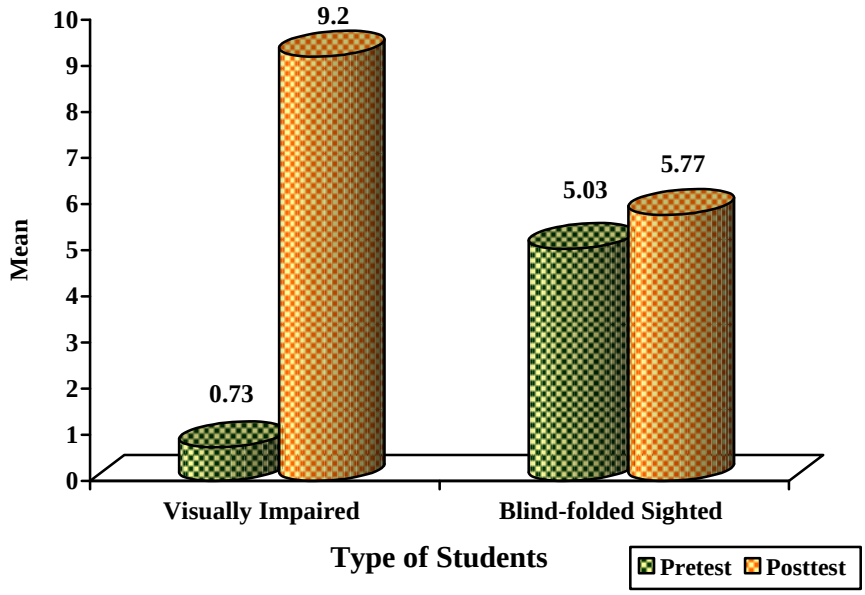

Fig 4.2a: Comparison of Distance Estimation

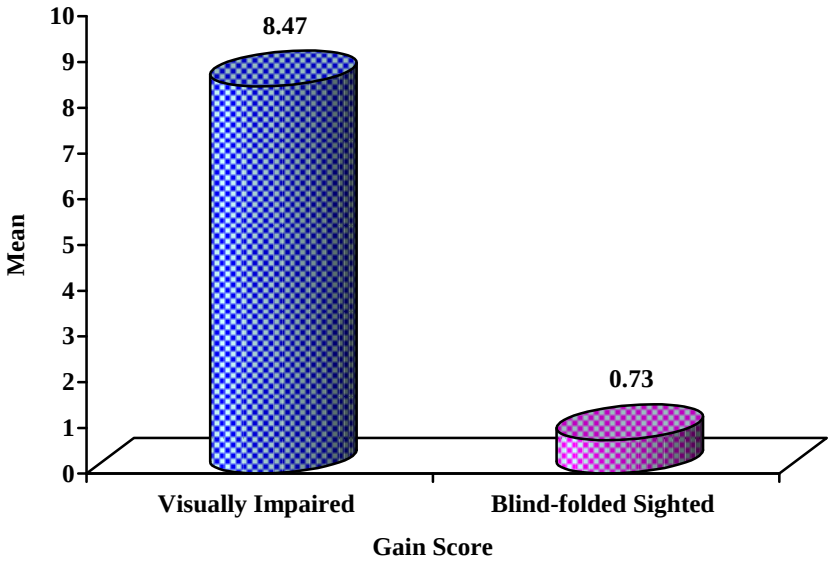

Fig 4.2b: Gain Score Comparison: Distance Estimation

4.1.5 Mental Rotation Skill of Visually Impaired and Blind-Folded Sighted Students

Mental Rotation of two types of student's viz., Visually Impaired and Blind-folded Sighted was analyzed by comparing their pre scores and post scores separately and the results are given in the following Table 4.5.

Table 4.5: Testing-wise Mean, SD, and t-value for Mental Rotation

Test	Type of Students	No.	Mean	SD	t-value
Pretest	Visually Impaired	60	1.55	1.11	59.98**
	Blind-folded Sighted	60	7.60	2.76	
Posttest	Visually Impaired	60	14.02	0.89	3.56**
	Blind-folded Sighted	60	9.08	3.48	

***Significant at 0.01 level*

From the table 4.5, it is evident that the ***t***-value for Mental Rotation for pretest compared between Visually Impaired and Blind-folded Sighted students is 59.98 with df=59 which is significant at 0.01 level. It indicates that the pre scores of Mental Rotation of visually impaired and blind-folded sighted students differ significantly. It means that blind-folded sighted students secured higher score than the visually impaired students in the pretest. In the light of this, the null hypothesis stated that ***"there is no significant difference in mean Mental Rotation of visually impaired and blind-folded sighted students"*** is rejected. It may therefore be concluded that blind-folded sighted students showed higher Mental Rotation than the visually impaired students in Pretest.

From the table 4.5, it is evident that the ***t***-value for **Mental Rotation** for posttest compared between Visually Impaired and Blind-folded Sighted students is 3.56 with df=59 which is significant at 0.01 level. It indicates that the post scores of Mental Rotation of visually impaired and blind-folded sighted students differ significantly. It means that visually impaired students secured higher score than the blind-folded sighted students in the posttest. In the light of this, the null hypothesis stated that ***"there is no significant differences in mean Mental Rotation of visually impaired and blind-folded sighted students"*** is rejected. It may therefore be

concluded that the intervention helped improving Mental Rotation of visually impaired students.

4.1.6 Gain Score Analysis

Gain Score Analysis with respect to Mental Rotation skill of Visually Impaired and Blind-folded sighted with respect to find out the extent of Gain the students achieved with the help of *t*-test. The result is given in the following table 4.6.

Table 4.6: Testing-wise Mean, SD, and t-value for Mental Rotation with respect to Gain Score

Score	Type of Students	No.	Mean	SD	t-value
Gain Score	Visually Impaired	60	12.47	1.61	22.84**
	Blind-folded Sighted	60	1.48	3.23	

***Significant at 0.01 level*

From the table 4.6, it is evident that the *t*-value for Mental Rotation for Gain Score is 22.84 with df=59 which is significant at 0.01 level. It indicates that the gain score of Mental Rotation of visually impaired students and blind-folded sighted students differ significantly. It means that the visually impaired students secured higher gain (Mean=12.47) than the blind-folded sighted (Mean=1.48). In the light of this, the null hypothesis stated that ***"there is no significant difference in the gain score of visually impaired and blind-folded sighted students"*** is rejected. Hence it is concluded that the visually impaired students after intervention secured higher gain than blind-folded sighted.

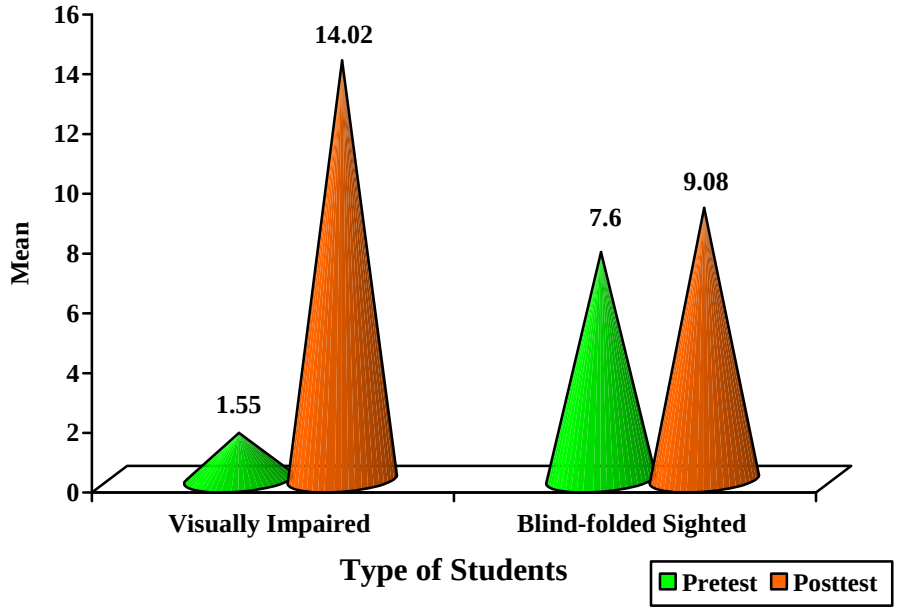

Fig 4.3a Comparison of Mental Rotation

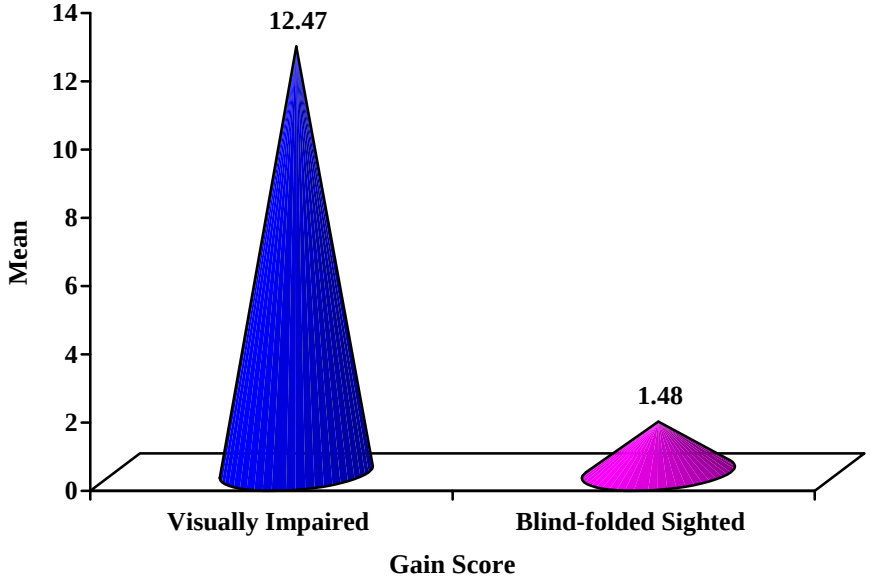

Fig 4.3b: Gain Score Comparison: Mental Rotation

4.1.7 Delineation Skill of Visually Impaired and Blind-Folded Sighted Students

Delineation skill of two types of student's viz., Visually Impaired and Blind-folded Sighted was analyzed by comparing their pre scores and post scores separately and the results are given in the following Table 4.7.

Table 4.7: Testing-wise Mean, SD, and t-value for Delineation

Test	Type of Students	No.	Mean	SD	t-value
Pretest	Visually Impaired	60	21.23	3.14	20.75**
	Blind-folded Sighted	60	21.93	2.79	
Posttest	Visually Impaired	60	32.00	2.73	3.36**
	Blind-folded Sighted	60	23.67	3.63	

***Significant at 0.01 level*

From the table 4.7, it is evident that the ***t***-value for Delineation for pretest compared between Visually Impaired and Blind-folded Sighted students is 20.75 with df=59 which is significant at 0.01 level. It indicates that the pre scores of Delineation of visually impaired and blind-folded sighted students differ significantly. It means that blind-folded sighted students secured higher score than the visually impaired students in the pretest. In the light of this, the null hypothesis stated that ***"there is no significant difference in mean Delineation of visually impaired and blind-folded sighted students"*** is rejected". It may therefore be said that blind-folded sighted students showed higher Delineation than visually impaired students in Pretest.

From the table 4.7, it is evident that the ***t***-value for **Delineation** for posttest compared between Visually Impaired and Blind-folded Sighted students is 3.36 with df=59 which is significant at 0.01 level. It indicates that the post scores of Delineation of visually impaired students and blind-folded sighted students differ significantly. It means that visually impaired students secured higher score than the blind-folded sighted students in the posttest. In the light of this, the null hypothesis stated that ***"there is no significant differences in mean Delineation skill of visually impaired and blind-folded sighted students"*** is rejected. It may therefore be said that the intervention helped improving Delineation of visually impaired students.

4.1.8 Gain Score Analysis

Gain Score Analysis with respect to skill of Delineation of Visually Impaired and Blind-folded Sighted with respect to find out the extent of Gain the students achieved with the help of *t*-test. The result is given in the following table 4.8.

Table 4.8: Testing-wise Mean, SD, and t-value for Delineation with respect to Gain Score

Score	Type of Students	No.	Mean	SD	t-value
Gain Score	Visually Impaired	60	10.77	4.02	12.73**
	Blind-folded Sighted	60	1.73	3.99	

Significant at 0.01 level

From the table 4.8, it is evident that the *t*-value for **Delineation** for Gain Score is 12.73 with df=59 which is significant at 0.01 level. It indicates that the gain score of Delineation of visually impaired students and blind-folded sighted students differ significantly. It means that the visually impaired students secured higher gain (Mean=10.77) than the blind-folded sighted (Mean=1.73). In the light of this, the null hypothesis stated that ***"there is no significant difference in the gain score of visually impaired and blind-folded sighted students"*** **i**s rejected. Hence it is concluded that the visually impaired students after intervention secured higher gain than blind-folded sighted.

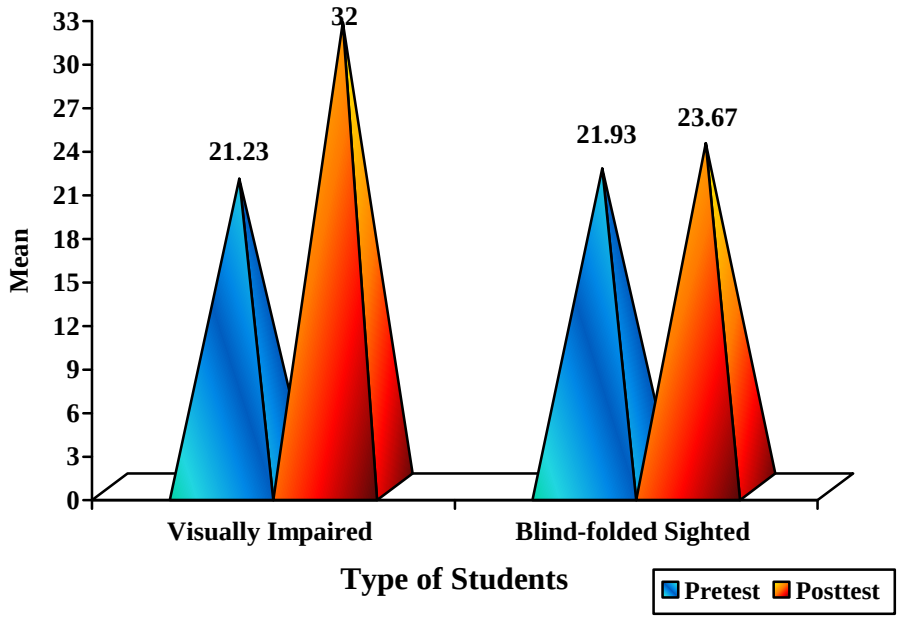

Fig 4.4a Comparison of Delineation

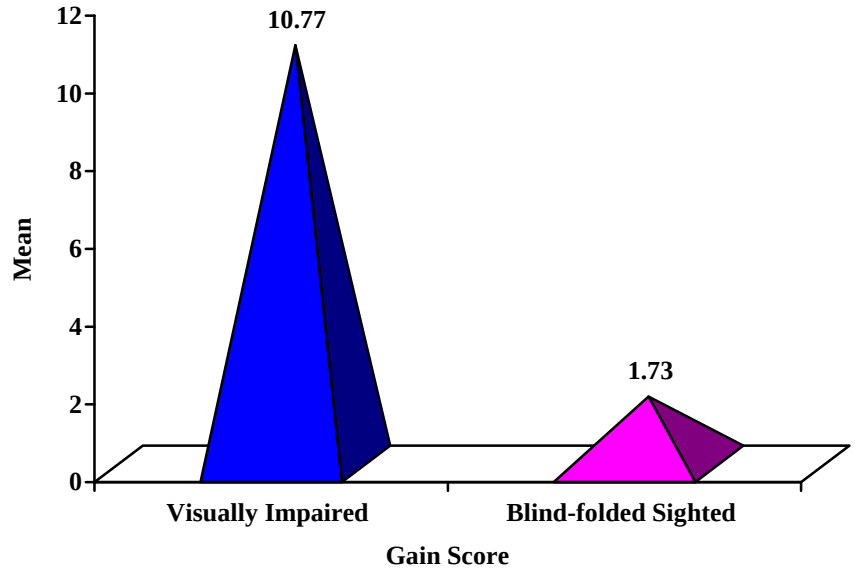

Fig 4.4b: Gain Score Comparison: Delineation

Section II

4.2 Chi-Square Analysis for Assembly Test and Rotational Displacement

The Students Assembled 6 Types of shape using two tiles for each shape. The shapes include Pentagon, Triangle, Parallelogram, Quadrilateral, Trapezoid and Parallelogram into Triangle with the help of two Tiles. The following table presents the results Chi-square testing.

Table 4.9: Chi-Square Test for Association between Type of Students and Time taken for Assembly

Type of Students	Test	<720 (sec)	>720	Total	χ^2 Value
Visually Impaired	Pretest	100 (163.5)	260(196.5)	360	90.36
Blind-folded Students	Posttest	227 (163.5)	133(196.5)	360	
	Total	327	393	720	
Visually Impaired	Pretest	360 (319.5)	0(40.5)	360	91.27
Blind-folded Students	Posttest	279 (319.5)	81(40.5)	360	
	Total	639	81	720	

From the table 4.9, it is evident that the Calculated Chi-square value is **90.36**. The table value of χ^2 for df=4 at **0.01 level is 6.64** which is less than the calculated Chi-square value. It indicates that there exists an association between Type of students and Time Taken for assembling test. Therefore it is concluded that the time taken by the visually impaired is greater than Blind-folded sighted students in the Pretest.

From the table 4.9, it is evident that the Calculated Chi-square value is **91.27**. The table value of χ^2 for df=4 at **0.01 level is 6.64** which is less than the calculated Chi-square value. It indicates that there exists an association between Type of students and Time Taken for assembling test. Therefore it is concluded that the time taken by the visually impaired is lesser than Blind-folded sighted students in the Posttest.

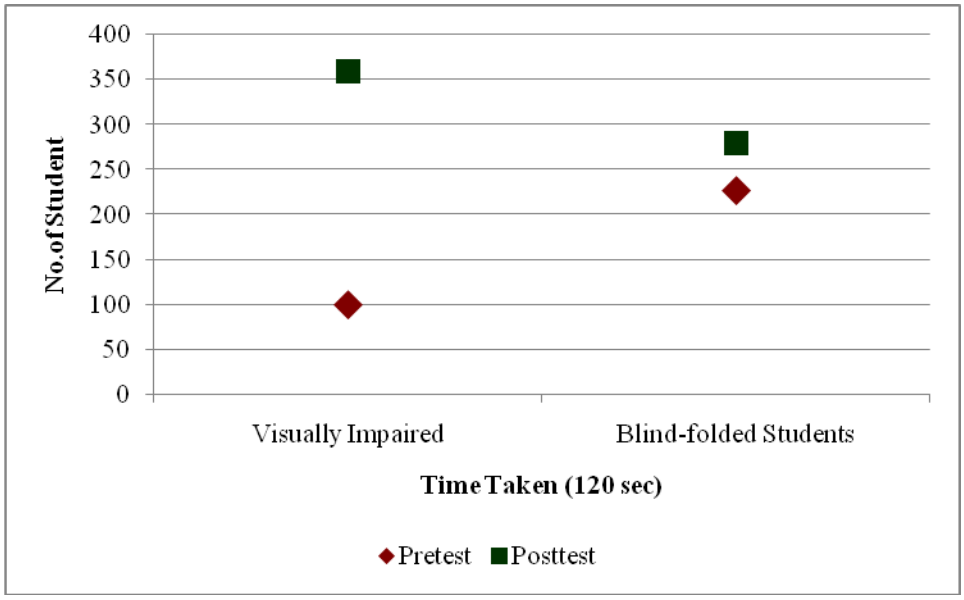

Fig 4.5: Association between Type of Students and Time Taken: Assembly Test

Table 4.10: Chi-square test for Assembly of Pentagon Shape

Students	Testing	Timing	oi	ei	oi-ei	$(oi-ei)^2$	$(oi-ei)^2$ /ei	χ 2 Value
Visually Impaired	Pretest	0-30	24	33.5	-9.5	90.25	2.69	26.58
		30-60	1	3.5	-2.5	6.25	1.79	
		60-90	3	3	0	0	0	
		90-120	7	6	1	1	0.17	
		>120	25	14	11	121	8.64	
Blind-folded Sighted		0-30	43	33.5	9.5	90.25	2.69	
		30-60	6	3.5	2.5	6.25	1.79	
		60-90	3	3	0	0	0	
		90-120	5	6	-1	1	0.17	
		>120	3	14	-11	121	8.64	
Total			120					
Visually Impaired	Posttest	0-30	46	50.5	-4.5	20.25	0.40	9.52
		30-60	4	3.5	0.5	0.25	0.071	
		60-90	4	2	2	4	2	
		90-120	6	3.5	2.5	6.25	1.79	
		>120	0	0.5	-0.5	0.25	0.5	
Blind-folded Sighted		0-30	55	50.5	4.5	20.25	0.40	
		30-60	3	3.5	-0.5	0.25	0.071	
		60-90	0	2	-2	4	2	
		90-120	1	3.5	-2.5	6.25	1.79	
		>120	1	0.5	0.5	0.25	0.5	
Total			120					

From the table 4.10, it is evident that the Calculated Chi-square value is **26.58**. The table value of χ 2 for df=4 at **0.01 level is 13.28** which is less than the calculated Chi-square value. It indicates that there exists an association between Type of students and Time Taken for Assembling Pentagon shape. Therefore it is concluded that the time taken by the visually impaired is greater than Blind-folded sighted students in the Pretest.

From the table 4.10, it is evident that the Calculated Chi-square value is **9.52**. The table value of χ 2 for df=4 at **0.05 level is 9.49** which is less than the calculated Chi-square value. It indicates that there exists an association between Type of students and Time Taken for Assembling Pentagon shape. Therefore it is concluded that the time taken by the visually impaired is lesser than Blind-folded sighted students in the Posttest.

Table 4.11: Chi-square test for Assembly of Triangle Shape

Students	Testing	Timing	oi	ei	oi-ei	$(oi-ei)^2$	$(oi-ei)^2$ /ei	χ 2 Value
Visually Impaired	Pretest	0-30	12	22.5	-10.5	110.25	4.9	19.22
		30-60	4	3	1	1	0.33	
		60-90	3	3	0	0	0	
		90-120	8	8.5	-0.5	0.25	0.029	
		>120	33	23	10	100	4.35	
Blind-folded Sighted		0-30	33	22.5	10.5	110.25	4.9	
		30-60	2	3	-1	1	0.33	
		60-90	3	3	0	0	0	
		90-120	9	8.5	0.5	0.25	0.029	
		>120	13	23	-10	100	4.35	
Total			120					
Visually Impaired	Posttest	0-30	37	36.5	0.5	0.25	0.01	5.19
		30-60	7	8	-1	1	0.13	
		60-90	3	2.5	0.5	0.25	0.1	
		90-120	13	11	2	4	0.36	
		>120	0	2	-2	4	2	
Blind-folded Sighted		0-30	36	36.5	-0.5	0.25	0.01	
		30-60	9	8	1	1	0.13	
		60-90	2	2.5	-0.5	0.25	0.1	
		90-120	9	11	-2	4	0.36	
		>120	4	2	2	4	2	
Total			120					

From the table 4.11 it is evident that the Calculated Chi-square value is **19.22**. The table value of χ 2 for df=4 at **0.01 level is 13.28** which is less than the calculated Chi-square value. It indicates that there exists an association between type of students and time taken for Assembling Triangle shape. Therefore it is concluded that the time taken by the visually impaired is greater than Blind-folded sighted students in the Pretest.

From the table 4.11 it is evident that the Calculated Chi-square value is **5.19**. The table value of χ 2 for df=4 at **0.05 level is 9.49** which is greater than the calculated Chi-square value. Therefore there exists no association between type of students and the time taken. Hence, it is concluded that the both visually impaired and blind-folded sighted students have taken time to the same extent.

Table 4.12: Chi-square test for Assembly of Parallelogram Shape

Students	Testing	Timing	oi	ei	oi-ei	$(oi-ei)^2$	$(oi-ei)^2$ /ei	χ 2 Value
Visually Impaired	Pretest	0-30	4	9	-5	25	2.78	21.52
		30-60	2	4.5	-2.5	6.25	1.39	
		60-90	1	1.5	-0.5	0.25	0.17	
		90-120	8	12.5	-4.5	20.25	1.62	
		>120	45	32.5	12.5	156.25	4.81	
Blind-folded Sighted		0-30	14	9	5	25	2.78	
		30-60	7	4.5	2.5	6.25	1.39	
		60-90	2	1.5	0.5	0.25	0.17	
		90-120	17	12.5	4.5	20.25	1.62	
		>120	20	32.5	-12.5	156.25	4.81	
Total			120					
Visually Impaired	Posttest	0-30	31	30.5	0.5	0.25	0.01	13.29
		30-60	10	9	1	1	0.11	
		60-90	9	6	3	9	1.5	
		90-120	10	9.5	0.5	0.25	0.03	
		>120	0	5	-5	25	5	
Blind-folded Sighted		0-30	30	30.5	-0.5	0.25	0.01	
		30-60	8	9	-1	1	0.11	
		60-90	3	6	-3	9	1.5	
		90-120	9	9.5	-0.5	0.25	0.03	
		>120	10	5	5	25	5	
Total			120					

From the table 4.12 it is evident that the Calculated Chi-square value is **21.52**. The table value of χ 2 for df=4 at **0.01 level is 13.28** which is less than the calculated Chi-square value. It indicates that there exists an association between Type of Students and Time Taken for Assembling Parallelogram Shape. Therefore it is concluded that the time taken by the visually impaired is greater than Blind-folded sighted students in the Pretest.

From the table 4.12 it is evident that the Calculated Chi-square value is **13.29**. The table value of $\chi 2^2$ for df=4 at **0.01 level is 13.28** which is less than the calculated Chi-square value. It indicates that there exists an association between Type of Students and Time Taken for Assembling Parallelogram shape. Therefore it is concluded that the time taken by the visually impaired is lesser than Blind-folded sighted students in the Posttest.

Table 4.13: Chi-square test for Assembly of Quadrilateral Shape

Students	Testing	Timing	oi	ei	oi-ei	$(oi-ei)^2$	$(oi-ei)^2$ /ei	χ 2 Value
Visually Impaired	Pretest	0-30	8	13	-5	25	1.92	41.05
		30-60	2	6	-4	16	2.67	
		60-90	2	1	1	1	1	
		90-120	2	10	-8	64	6.4	
		>120	46	30	16	256	8.53	
Blind-folded Sighted		0-30	18	13	5	25	1.92	
		30-60	10	6	4	16	2.67	
		60-90	0	1	-1	1	1	
		90-120	18	10	8	64	6.4	
		>120	14	30	-16	256	8.53	
Total			120					
Visually Impaired	Posttest	0-30	24	27	-3	9	0.33	16.26
		30-60	15	14.5	0.5	0.25	0.02	
		60-90	11	6	5	25	4.17	
		90-120	10	9	1	1	0.11	
		>120	0	3.5	-3.5	12.25	3.5	
Blind-folded Sighted		0-30	30	27	3	9	0.33	
		30-60	14	14.5	-0.5	0.25	0.02	
		60-90	1	6	-5	25	4.17	
		90-120	8	9	-1	1	0.11	
		>120	7	3.5	3.5	12.25	3.5	
Total			120					

From the table 4.13, it is evident that the Calculated Chi-square value is **41.05**. The table value of χ 2 for df=4 at **0.01 level is 13.28** which is less than the calculated Chi-square value. It indicates that there exists an association between Type of Students and Time Taken for Assembling Quadrilateral shape. Therefore it is concluded that the time taken by the visually impaired is greater than Blind-folded sighted students in the Pretest.

From the table 4.13, it is evident that the Calculated Chi-square value is **16.26**. The table value of χ 2 for df=4 at **0.01 level is 13.28** which is less than the calculated Chi-square value. It indicates that there exists an association between Type of Students and Time Taken for Assembling Quadrilateral shape. Therefore it is concluded that the time taken by the visually impaired is lesser than Blind-folded sighted students in the Posttest.

Table 4.14: Chi-square test for Assembly of Trapezoid Shape

Students	Testing	Timing	oi	ei	oi-ei	$(oi-ei)^2$	$(oi-ei)^2$ /ei	χ 2 Value
Visually Impaired	Pretest	0-30	3	4.5	-1.5	2.25	0.5	23.16
		30-60	0	2	-2	4	2	
		60-90	2	2.5	-0.5	0.25	0.1	
		90-120	0	6.5	-6.5	42.25	6.5	
		>120	55	44.5	10.5	110.25	2.48	
Blind-folded Sighted		0-30	6	4.5	1.5	2.25	0.5	
		30-60	4	2	2	4	2	
		60-90	3	2.5	0.5	0.25	0.1	
		90-120	13	6.5	6.5	42.25	6.5	
		>120	34	44.5	-10.5	110.25	2.48	
Total			120					
Visually Impaired	Posttest	0-30	16	13	3	9	0.69	40.88
		30-60	8	9.5	-1.5	2.25	0.24	
		60-90	10	6.5	3.5	12.25	1.88	
		90-120	26	17.5	8.5	72.25	4.13	
		>120	0	13.5	-13.5	182.25	13.5	
Blind-folded Sighted		0-30	10	13	-3	9	0.69	
		30-60	11	9.5	1.5	2.25	0.24	
		60-90	3	6.5	-3.5	12.25	1.88	
		90-120	9	17.5	-8.5	72.25	4.13	
		>120	27	13.5	13.5	182.25	13.5	
Total			120					

From the table 4.14 it is evident that the Calculated Chi-square value is **23.16**. The table value of χ 2 for df=4 at **0.01 level is 13.28** which is less than the calculated Chi-square value. It indicates that there exists an association between Type of Students and Time Taken for Assembling Trapezoid Shape. Therefore it is concluded that the time taken by the visually impaired is greater than Blind-folded sighted students in the Pretest.

From the table 4.14, it is evident that the Calculated Chi-square value is **40.88**. The table value of χ 2 for df=4 at **0.01 level is 13.28** which is less than the calculated Chi-square value. It indicates that there exists an association between Type of Students and Time Taken for Assembling Trapezoid shape. Therefore it is concluded that the time taken by the visually impaired is lesser than Blind-folded sighted students in the Posttest.

Table 4.15: Chi-square test for Assembly of Parallelogram into Triangle Shape

Students	Testing	Timing	oi	ei	oi-ei	$(oi-ei)^2$	$(oi-ei)^2$ /ei	χ 2 Value
Visually Impaired	Pretest	0-30	2	4.5	-2.5	6.25	1.39	6.58
		30-60	1	0.5	0.5	0.25	0.5	
		60-90	0	1	-1	1	1	
		90-120	1	1.5	-0.5	0.25	0.17	
		>120	56	52.5	3.5	12.25	0.23	
Blind-folded Sighted		0-30	7	4.5	2.5	6.25	1.39	
		30-60	0	0.5	-0.5	0.25	0.5	
		60-90	2	1	1	1	1	
		90-120	2	1.5	0.5	0.25	0.17	
		>120	49	52.5	-3.5	12.25	0.23	
Total			120					
Visually Impaired	Posttest	0-30	12	11	1	1	0.09	48.07
		30-60	13	7.5	5.5	30.25	4.03	
		60-90	5	4.5	0.5	0.25	0.05	
		90-120	30	21	9	81	3.85	
		>120	0	16	-16	256	16	
Blind-folded Sighted		0-30	10	11	1	1	0.09	
		30-60	2	7.5	5.5	30.25	4.03	
		60-90	4	4.5	0.5	0.25	0.05	
		90-120	12	21	9	81	3.85	
		>120	32	16	-16	256	16	
Total			120					

From the table 4.15, it is evident that the Calculated Chi-Square value is **6.58**. The table value of χ 2 for df=4 at **0.05 level is 9.49** which is greater than the calculated Chi-square value. Therefore there exists no association between Type of Students and the Time Taken. Hence, it is concluded that the both visually impaired and blind-folded sighted students have taken time to the same extent.

From the table 4.15, it is evident that the Calculated Chi-Square value is **48.07**. The table value of χ 2 for df=4 at **0.01 level is 13.28** which is less than the calculated Chi-square value. It indicates that there exists an association between Type of Students and Time Taken for Assembling Parallelogram into Triangle shape. Therefore it is concluded that the time taken by the visually impaired is lesser than Blind-folded sighted students in the Posttest.

Association between Type of Students and Time Taken with Respect to Component Shapes in Assembling

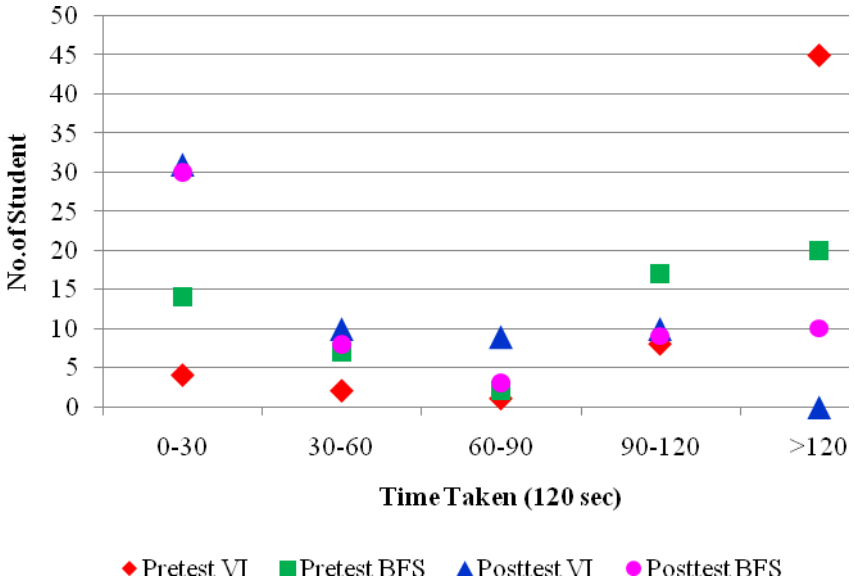

Fig 4.6 : Parallelogram

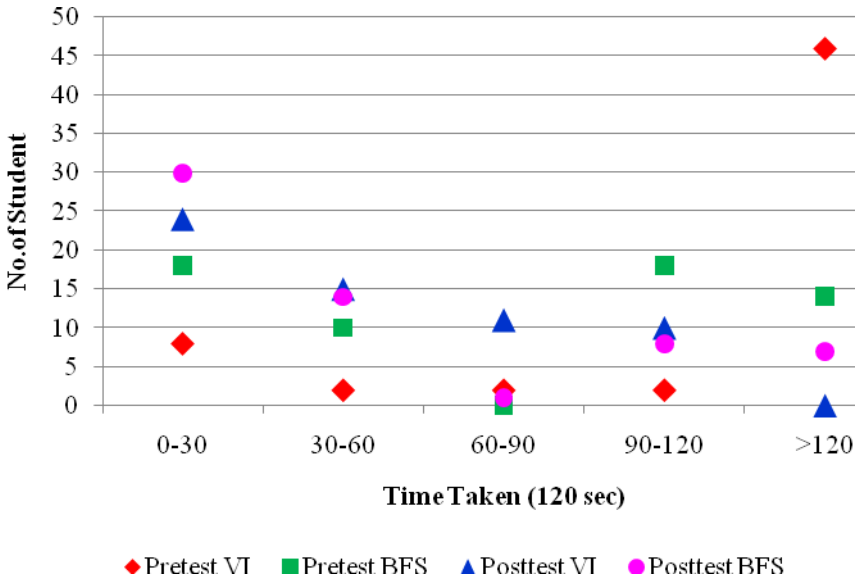

Fig 4.7: Quadrilateral

4.2.1 Chi-square Analysis for Rotational Displacement Test

The Students Performed Rotational Displacement with 5 Shapes. The Shapes include Square, Triangle, Rectangle, Rhombus and Right Triangle with the help of four Equilateral Triangle. The following table presents the results of Chi-Square Testing.

Table 4.16: Chi-square Table for Association between Type of Students and Time taken for Rotational Displacement

Type of Students	Test	<600	>600	Total	χ^2 Value
Visually Impaired	Pretest	78(115)	222(185)	300	38.61
Blind-folded Students		152(115)	148(185)	300	
Total		230	370	600	
Visually Impaired	Posttest	300(231.5)	0(68.5)	300	177.54
Blind-folded Students		163(231.5)	137(68.5)	300	
Total		300	300	600	

From the table 4.16, it is evident that the Calculated Chi-Square value is 38.61. The table value of χ 2 for df=4 at **0.01 level is 6.64** which is less than the calculated Chi-square value. It indicates that there exists an association between Type of students and Time Taken for Rotational Displacement test. Therefore it is concluded that the time taken by the visually impaired is greater than Blind-folded sighted students in the Pretest.

From the table 4.16, it is evident that the Calculated Chi-Square value is **177.54**. The table value of χ 2 for df=4 at **0.01 level is 6.64** which is less than the calculated Chi-square value. It indicates that there exists an association between Type of Students and Time Taken for Rotational Displacement test. Therefore it is concluded that the time taken by the visually impaired is lesser than Blind-folded sighted students in the Posttest.

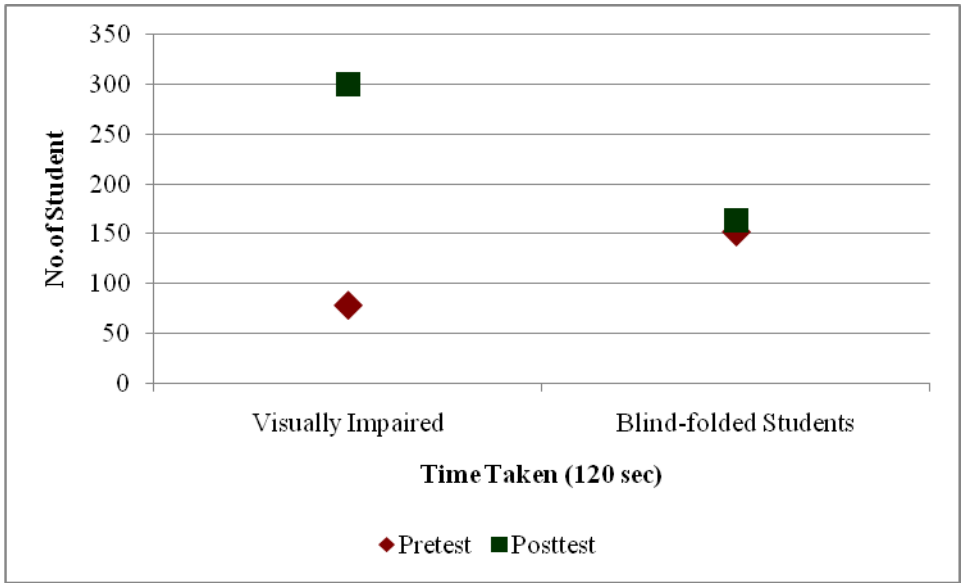

Fig 4.8: Association between Type of Students and Time Taken: Rotational Displacement

Table 4.17: Chi-square test for Rotational Displacement of Square Shape

Students	Testing	Timing	oi	ei	oi-ei	$(oi-ei)^2$	$(oi-ei)^2/ei$	$\chi 2$ Value
Visually Impaired	Pretest	0-30	29	41	-12	144	3.51	32.82
		30-60	0	1.5	-1.5	2.25	1.5	
		60-90	5	2.5	2.5	6.25	2.5	
		90-120	7	5	2	4	0.8	
		>120	19	10	9	81	8.1	
Blind-folded Sighted		0-30	53	41	12	144	3.51	
		30-60	3	1.5	1.5	2.25	1.5	
		60-90	0	2.5	-2.5	6.25	2.5	
		90-120	3	5	-2	4	0.8	
		>120	1	10	-9	81	8.1	
Total			120					
Visually Impaired	Posttest	0-30	44	50.5	-6.5	42.25	0.84	66.89
		30-60	8	4.5	3.5	12.25	2.72	
		60-90	3	1.5	1.5	2.25	1.5	
		90-120	5	3	2	4	1.33	
		>120	0	0.5	-0.5	0.25	0.5	
Blind-folded Sighted		0-30	57	50.5	-50.5	2550.25	50.5	
		30-60	1	4.5	-4.5	20.25	4.5	
		60-90	0	1.5	-1.5	2.25	1.5	
		90-120	1	3	-3	9	3	
		>120	1	0.5	-0.5	0.25	0.5	
Total			120					

From the table 4.17, it is evident that the Calculated Chi-square value is **32.82**. The table value of $\chi 2$ for df=4 at **0.01 level is 13.28** which is less than the calculated Chi-square value. It indicates that there exists an association between Type of Students and Time Taken for Rotational Displacement Square Shape. Therefore it is concluded that the time taken by the visually impaired is greater than Blind-folded sighted students in the Pretest.

From the table 4.17, it is evident that the Calculated Chi-square value is **66.89**. The table value of $\chi 2$ for df=4 at **0.01 level is 13.28** which is less than the calculated Chi-square value. It indicates that there exists an association between Type of Students and Time Taken for Rotational Displacement Square shape. Therefore it is concluded that the time taken by the visually impaired is lesser than Blind-folded sighted students in the Posttest.

Table 4.18: Chi-square test for Rotational Displacement of Triangle Shape

Students	Testing	Timing	oi	ei	oi-ei	$(oi-ei)^2$	$(oi-ei)^2$ /ei	χ 2 Value
Visually Impaired	Pretest	0-30	18	23	-5	25	1.09	11.10
		30-60	2	5.5	-3.5	12.25	2.23	
		60-90	1	1	0	0	0	
		90-120	3	2.5	0.5	0.25	0.1	
		>120	36	28	8	64	2.29	
Blind-folded Sighted		0-30	28	23	5	25	1.09	
		30-60	9	5.5	3.5	12.25	2.23	
		60-90	1	1	0	0	0	
		90-120	2	2.5	-0.5	0.25	0.1	
		>120	20	28	-8	64	2.29	
Total			120					
Visually Impaired	Posttest	0-30	45	41.5	3.5	12.25	0.29	14.22
		30-60	8	5	3	9	1.8	
		60-90	2	1.5	0.5	0.25	0.17	
		90-120	5	6.5	-1.5	2.25	0.35	
		>120	0	5.5	-5.5	30.25	5.5	
Blind-folded Sighted		0-30	38	41.5	-3.5	42.25	1.09	
		30-60	2	5	3	9	0	
		60-90	1	1.5	-0.5	0.25	0.17	
		90-120	8	6.5	1.5	2.25	0.35	
		>120	11	5.5	5.5	30.25	5.5	
Total			120					

From the table 4.18, it is evident that the Calculated Chi-square value is **11.10**. The table value of χ 2 for df=4 at **0.05 level is 9.49** which is less than the calculated Chi-square value. It indicates that there exists an association between Type of Students and Time Taken for Rotational Displacement Triangle Shape. Therefore it is concluded that the time taken by the visually impaired is greater than Blind-folded sighted students in the Pretest.

From the table 4.18, it is evident that the Calculated Chi-square value is **14.22.** The table value of χ 2 for df=4 at **0.01 level is 13.28** which is less than the calculated Chi-square value. It indicates that there exists an association between Type of Students and Time Taken for Rotational Displacement Triangle shape. Therefore it is concluded that the time taken by the visually impaired is lesser than Blind-folded sighted students in the Posttest.

Table 4.19: Chi-square test for Rotational Displacement of Rectangle Shape

Students	Testing	Timing	oi	ei	oi-ei	$(oi-ei)^2$	$(oi-ei)^2$ /ei	χ 2 Value
Visually Impaired	Pretest	0-30	6	8.5	-2.5	6.25	0.74	18.17
		30-60	0	0.5	-0.5	0.25	0.5	
		60-90	0	0.5	-0.5	0.25	0.5	
		90-120	2	8.5	-6.5	42.25	4.97	
		>120	52	42	10	100	2.38	
Blind-folded Sighted		0-30	11	8.5	2.5	6.25	0.74	
		30-60	1	0.5	0.5	0.25	0.5	
		60-90	1	0.5	0.5	0.25	0.5	
		90-120	15	8.5	6.5	42.25	4.97	
		>120	32	42	-10	100	2.38	
Total			120					
Visually Impaired	Posttest	0-30	37	26	11	121	4.65	44.31
		30-60	10	6	4	16	2.67	
		60-90	3	2	1	1	0.5	
		90-120	10	12	-2	4	0.33	
		>120	0	14	-14	196	14	
Blind-folded Sighted		0-30	15	26	-11	121	4.65	
		30-60	2	6	-4	16	2.67	
		60-90	1	2	1	1	0.5	
		90-120	14	12	2	4	0.33	
		>120	28	14	14	196	14	
Total			120					

From the table 4.19, it is evident that the Calculated Chi-square value is **18.17**. The table value of χ 2 for df=4 at **0.01 level is 13.28** which is less than the calculated Chi-square value. It indicates that there exists an association between Type of Students and Time Taken for Rotational Displacement Rectangle Shape. Therefore it is concluded that the time taken by the visually impaired is greater than Blind-folded sighted students in the Pretest.

From the table 4.19, it is evident that the Calculated Chi-square value is **44.31.** The table value of χ 2 for df=4 at **0.01 level is 13.28** which is less than the calculated Chi-square value. It indicates that there exists an association between Type of Students and Time Taken for Rotational Displacement Rectangle shape. Therefore it is concluded that the time taken by the visually impaired is lesser than Blind-folded sighted students in the Posttest.

Table 4.20: Chi-square test for Rotational Displacement of Rhombus Shape

Students	Testing	Timing	oi	ei	oi-ei	$(oi-ei)^2$	$(oi-ei)^2$ /ei	χ 2 Value
Visually Impaired	Pretest	0-30	1	1.5	-0.5	0.25	0.17	65.58
		30-60	0	1.5	-1.5	2.25	1.5	
		60-90	0	0.5	-0.5	0.25	0.5	
		90-120	1	4.5	-3.5	12.25	2.72	
		>120	58	52	6	36	0.69	
Blind-folded Sighted		0-30	2	1.5	0.5	0.25	0.17	
		30-60	3	1.5	1.5	2.25	1.5	
		60-90	1	0.5	0.5	0.25	0.5	
		90-120	8	4.5	3.5	12.25	2.72	
		>120	4	52	-6	36	0.69	
Total			120					
Visually Impaired	Posttest	0-30	21	13	8	64	4.92	49.66
		30-60	15	9.5	5.5	30.25	3.18	
		60-90	6	3	3	9	3	
		90-120	18	14	4	16	1.14	
		>120	0	20.5	-2.5	6.25	0.30	
Blind-folded Sighted		0-30	5	13	8	64	4.92	
		30-60	4	9.5	-5.5	30.25	3.18	
		60-90	0	3	3	9	3	
		90-120	10	14	-4	16	1.14	
		>120	41	20.5	20.5	420.25	0.30	
Total			120					

From the table 4.20, it is evident that the Calculated Chi-square value is **65.58**. The table value of χ 2 for df=4 at **0.01 level is 13.28** which is less than the calculated Chi-square value. It indicates that there exists an association between Type of Students and Time Taken for Rotational Displacement Rhombus Shape. Therefore it is concluded that the time taken by the visually impaired is greater than Blind-folded sighted students in the Pretest.

From the table 4.20, it is evident that the Calculated Chi-square value is **49.66.** The table value of χ 2 for df=4 at **0.01 level is 13.28** which is less than the calculated Chi-square value. It indicates that there exists an association between Type of Students and Time Taken for Rotational Displacement Rhombus shape. Therefore it is concluded that the time taken by the visually impaired is lesser than Blind-folded sighted students in the Posttest.

Table 4.21: Chi-square test for Rotational Displacement of Right Triangle Shape

Students	Testing	Timing	oi	ei	oi-ei	$(oi-ei)^2$	$(oi-ei)^2$ /ei	χ 2 Value
Visually Impaired	Pretest	0-30	1	3	-2	4	1.33	63.63
		30-60	0	1.5	-1.5	2.25	1.5	
		60-90	0	0.5	-0.5	0.25	0.5	
		90-120	2	2	0	0	0	
		>120	57	53	4	16	0.30	
Blind-folded Sighted		0-30	5	3	2	4	1.33	
		30-60	3	1.5	1.5	2.25	1.5	
		60-90	1	0.5	0.5	0.25	0.5	
		90-120	2	2	0	0	0	
		>120	49	53	-4	16	0.30	
Total			120					
Visually Impaired	Posttest	0-30	11	5.5	5.5	30.25		79.59
		30-60	18	9.5	8.5	72.25		
		60-90	6	3.5	2.5	6.25		
		90-120	25	13.5	11.5	132.25		
		>120	0	28	-3	9		
Blind-folded Sighted		0-30	0	5.5	-5.5	30.25		
		30-60	1	9.5	-9.5	90.20		
		60-90	1	3.5	-2.5	6.25		
		90-120	2	13.5	-11.5	132.25		
		>120	56	28	28	784		
Total			120					

From the table 4.21, it is evident that the Calculated Chi-square value is **63.63**. The table value of χ 2 for df=4 at **0.01 level is 13.28** which is less than the calculated Chi-square value. It indicates that there exists an association between Type of Students and Time Taken for Rotational Displacement Right Triangle shape. Therefore it is concluded that the time taken by the visually impaired is greater than Blind-folded sighted students in the Pretest.

From the table 4.21, it is evident that the Calculated Chi-square value is **79.59.** The table value of χ 2 for df=4 at **0.01 level is 13.28** which is less than the calculated Chi-square value. It indicates that there exists an association between Type of Students and Time Taken for Rotational Displacement Right Triangle shape. Therefore it is concluded that the time taken by the visually impaired is lesser than Blind-folded sighted students in the Posttest.

Association between Type of Students and Time Taken with Respect to Component Shapes in Rotational Displacement

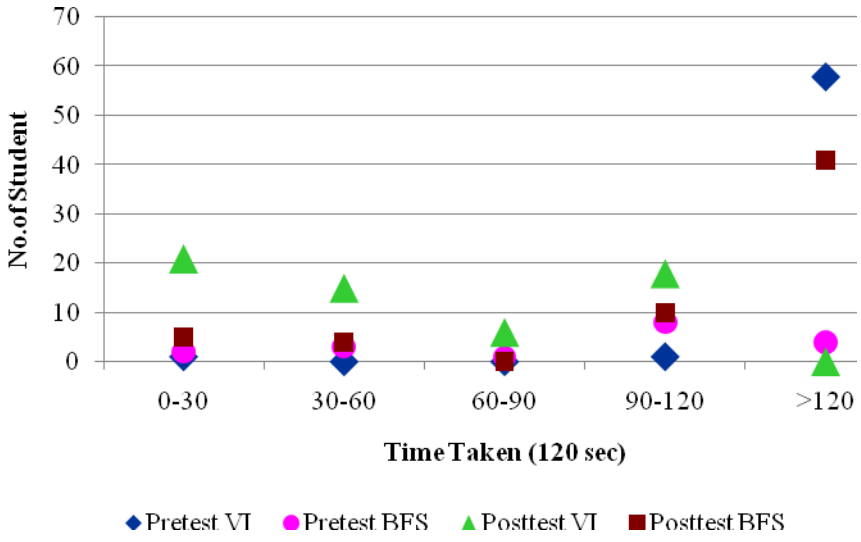

Fig 4.9: Rhombus

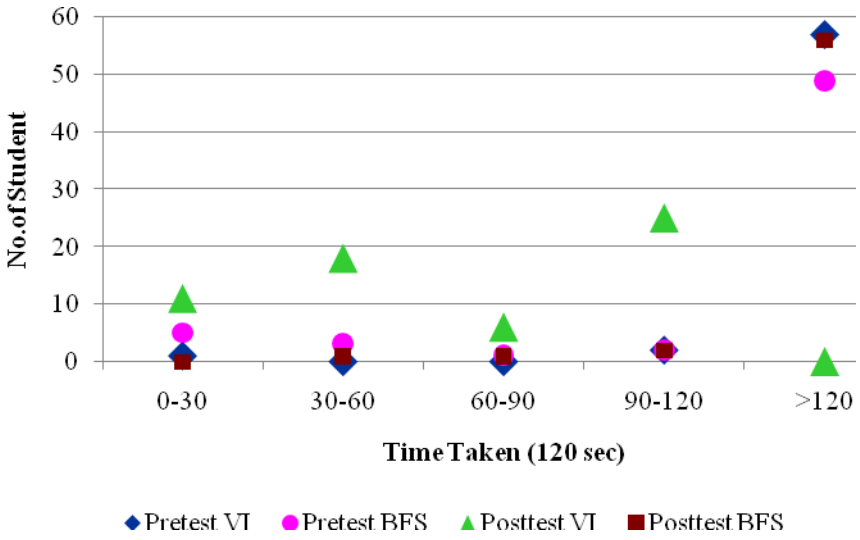

Fig 4.10: Right Triangle

Section III

4.3 Influence of Gender/Grade and Type of Students and their resultant interaction on Spatial Ability by Analysis of Covariance (ANCOVA)

4.3.1 Distance Estimation Skill with respect to Gender and Type of Students and their Resultant Interaction

2x2 Factorial Design ANCOVA was employed to find out the Influence of Gender and Type of Students and their Resultant Interaction.

Table 4.22: Mean Analysis

Group	Score - Pre									Score - Post								
	Between Gender						Total			Between Gender						Total		
	Male			Female						Male			Female					
	Mean	SD	No	Mean	SD	No	Mean	SD	No	Mean	SD	No	Mean	SD	No	Mean	SD	No
VI	0.83	.75	30	0.63	1.16	30	0.73	0.97	60	9.10	0.76	30	9.33	0.55	30	9.22	0.67	60
BFS	5.03	2.22	30	5.03	1.97	30	5.03	2.08	60	5.43	2.27	30	6.30	2.52	30	5.87	2.42	60
Total	2.93	2.68	60	2.83	2.74	60	2.88	2.70	120	7.27	2.50	60	7.82	2.37	60	7.54	2.44	120

Table 4.23: 2x2 Factorial Designs ANCOVA for Distance Estimation by Considering Pre Score as Covariate (Post score)

Source of Variance	df	SSy.x	MSS.x	F value
Gender	1	8.05	8.05	3.29 Ns
Type of Students	1	327.41	327.41	133.82**
Gender*Type of Students	1	2.13	2.13	0.87 Ns
Error	115	281.37	2.45	
Total	119	707.79		

*** Significant at 0.01 level* *Ns-Not Significant*

From the table 4.23, it is evident that the adjusted F-value for Gender is 3.29 which is not significant. It indicates that the mean scores of Distance Estimation of male and female students do not differ significantly when the pre score of Distance

Estimation was considered as covariate. In this context, the null hypothesis stated that ***"there is no significant influence of Gender on Distance Estimation Skill when the pre score of Distance Estimation Skill was considered as covariate"*** is not rejected. It may therefore be concluded that male and female students were found to have the Distance Estimation Skill to the same extent.

From the table 4.23, it is evident that the adjusted F-value for Type of Students viz. Visually Impaired and Blind-folded Sighted students is 133.82 which is significant at 0.01 level. It indicates that the mean score of Distance Estimation differ significantly between Visually Impaired and Blind-folded sighted students. In this context, the null hypothesis stated that ***"there is no significant influence with respect to when the pre score of Distance Estimation is taken Type of students as covariate"*** is rejected**.** The mean score analysis revealed that Visually Impaired students secured high score (M=9.22) in the post test than the Blind-folded Sighted (M=5.87). Hence it may be concluded that the Visually Impaired students secured high score in the Distance Estimation skill in the Posttest.

From the table 4.23, it is evident that the adjusted F-value for Distance Estimation between Gender and Type of students is 0.87 which is not significant. It indicates that there is no significant influence of Gender and Types of students on Distance Estimation when pre score of Distance Estimation was taken as covariate. In this context, the null hypothesis stated that ***"there is no significant influence of interaction between Gender and Types of students on Distance Estimation skill when considering Pre score of Distance Estimation Skill as covariate"*** is not rejected. It may therefore be concluded that Distance Estimation was found to be independent of the interaction between Gender and Type of Students when Pre score of Distance Estimation Skill was taken as covariate.

4.3.2 Skill of Mental Rotation with respect to Gender and Type of Students and their Resultant Interaction

2x2 Factorial Design ANCOVA was employed to find out the Influence of Gender and Type of Students and their Resultant Interaction on Mental Rotation.

Table 4.24: Mean Analysis

Group	Score - Pre									Score - Post								
	Between Gender						Total			Between Gender						Total		
	Male			Female						Male			Female					
	Mean	SD	No	Mean	SD	No	Mean	SD	No	Mean	SD	No	Mean	SD	No	Mean	SD	No
VI	1.73	1.05	30	1.33	1.15	30	1.53	1.11	60	13.87	0.73	30	14.17	1.02	30	14.02	0.89	60
BFS	8.10	2.81	30	7.03	2.77	30	7.57	2.82	60	8.47	3.88	30	9.73	2.99	30	9.10	3.50	60
Total	4.92	3.84	60	4.18	3.56	60	4.55	3.71	120	11.17	3.88	60	11.95	3.15	60	11.56	3.54	120

Table 4.25: 2x2 Factorial Designs ANCOVA for Mental Rotation by Considering Pre Score as Covariate (Post score)

Source of Variance	df	SSy.x	MSS.x	F value
Gender	1	7.78	7.78	1.56 Ns
Type of Students	1	665.14	665.14	133.02**
Gender* Type of Students	1	13.48	13.48	2.69 Ns
Error	115	575.03	5.00	
Total	119	1493.59		

** ***Significant at 0.01 level*** ***Ns-Not Significant***

From the table 4.25, it is evident that the adjusted F-value for Gender is 1.56 which is not significant. It indicates that the mean scores of Mental Rotation of male and female students do not differ significantly when the pre score of Mental Rotation was considered as covariate. In this context, the null hypothesis stated that ***"there is no significant influence of Gender on Mental Rotation Skill when the pre score of Mental Rotation skill was considered as covariate"*** is not rejected. It may therefore

be concluded that male and female students were found to have the Mental Rotation skill to the same extent.

From the table 4.25, it is evident that the adjusted F-value for Type of Students viz. Visually Impaired and Blind-folded sighted students is 133.02 which is significant at 0.01 level. It indicates that the mean score of Mental Rotation differ significantly between visually impaired and blind-folded sighted students. In this context, the null hypothesis stated that ***"there is no significant influence with respect to when the pre score of Mental Rotation is taken Types of students as covariate"*** is rejected. The mean score analysis revealed that Visually Impaired students secured high score (M=14.02) in the posttest than the Blind-folded Sighted (M=9.10). Hence it may be concluded that the Visually Impaired students secured higher score in the Mental Rotation skill in the Posttest.

From the table 4.25, it is evident that the adjusted F-value for Mental Rotation between Gender and Type of students is 2.69 which is not significant. It indicates that there is no significant influence of Gender and Types of students on Mental Rotation when pre score of Mental Rotation was taken as covariate. In this context, the null hypothesis stated that ***"there is no significant influence of resultant interaction between Gender and Type of students on Mental Rotation skill when considering Pre score of Mental Rotation skill as covariate"*** is not rejected. It may therefore be concluded that Mental Rotation was found to be independent of the interaction between Gender and Type of students when Pre score of Mental Rotation Skill was taken as covariate.

4.3.3 Skill of Delineation with respect to Gender and Type of Students and Resultant Interaction

2x2 Factorial Design ANCOVA was employed to find out the Influence of Gender and Type of Students and their Resultant Interaction.

Table 4.26 : Mean Analysis

Group	Score - Pre									Score - Post								
	Between Gender						Total			Between Gender						Total		
	Male			Female						Male			Female					
	Mean	SD	No	Mean	SD	No	Mean	SD	No	Mean	SD	No	Mean	SD	No	Mean	SD	No
VI	20.90	3.65	30	21.57	2.54	30	21.23	3.14	60	32.23	1.89	30	31.83	3.38	30	32.03	2.72	60
BFS	22.10	2.44	30	21.60	2.80	30	21.85	2.62	60	23.10	2.76	30	23.90	3.97	30	23.50	3.41	60
Total	21.50	3.14	60	21.58	2.65	60	21.54	2.89	120	27.67	5.17	60	27.87	5.42	60	27.77	5.27	120

Table 4.27: 2x2 Factorial Designs ANCOVA for Delineation by Considering Pre score as covariate (Post score)

Source of Variance	df	SSy.x	MSS.x	F value
Gender	1	1.18	1.18	0.13 Ns
Type of Students	1	2215.21	2215.21	236.36**
Gender* Type of Students	1	15.00	15.00	1.60 Ns
Error	115	1077.78	9.37	
Total	119	3309.47		

** ***Significant at 0.01 level*** ***Ns-Not Significant***

From the table 4.27, it is evident that the adjusted F-value for Gender is 0.13 which is not significant. It indicates that the mean score of Delineation of male and female students do not differ significantly when the pre score of Delineation was considered as covariate. In this context, the null hypothesis stated that ***"there is no significant influence of Gender on Delineation Skill when the pre score of***

***Delineation skill was considered as covariate*"** is not rejected. It may therefore be concluded that male and female students were found to have the Delineation skill to the same extent.

From the table 4.27, it is evident that the adjusted F-value for Types of Students viz. Visually Impaired and Blind-folded Sighted students is 236.36 which is significant at 0.01 level. It indicates that the mean score of Delineation differ significantly between visually impaired and blind-folded sighted students. In this context, the null hypothesis stated that ***"there is no significant influences with respect to when the pre score of Delineation is taken Types of students as covariate"*** is rejected. The mean score analysis revealed that Visually Impaired students secured higher (M=32.03) than the Blindfolded Sighted (M=23.50). Hence, it may be concluded that the Visually Impaired students secured higher score in the Delineation skill in the Posttest.

From the table 4.27, it is evident that the adjusted F-value for Delineation between Gender and Types of students is 1.60 which is not significant. It indicates that there is no significant influences of Gender and Types of students on Delineation when pre score of Delineation was taken as covariate. In this context, the null hypothesis stated that ***"there is no significant influence of interaction between Gender and Types of students on Delineation skill when considering Pre score of Delineation skill as covariate"*** is not rejected. It may therefore be concluded that Delineation was found to be independent of the interaction between Gender and Type of students when Pre score of Delineation skill was taken as covariate.

4.3.4 Distance Estimation Skill with respect to Grade and Type of Students and their Resultant Interaction

2x2 Factorial Design ANCOVA was employed to find out the Influence of Grade and Type of Students and their Resultant Interaction on Distance Estimation

Table 4.28: Mean analysis

Group	Score - Pre									Score - Post								
	Grade						Total			Grade						Total		
	V & VI			VII &VIII						V & VI			VII &VIII					
	Mean	SD	No	Mean	SD	No	Mean	SD	No	Mean	SD	No	Mean	SD	No	Mean	SD	No
VI	0.47	0.57	30	1.00	1.20	30	0.73	0.97	60	9.33	0.48	30	9.10	0.80	30	9.22	0.67	60
BFS	4.63	2.22	30	5.43	1.89	30	5.03	2.08	60	4.93	2.23	30	6.80	2.27	30	5.87	2.42	60
Total	2.55	2.65	60	3.22	2.73	60	2.88	2.70	120	7.13	2.73	60	7.95	2.05	60	7.54	2.44	120

Table 4.29: Summary of 2x2 Factorial Design ANCOVA for Distance Estimation by Considering Pre score as Covariate (Post score)

Source of Variance	df	SSy.x	MSS.x	F value
Grade	1	32.33	32.33	14.44**
Type of Students	1	299.73	299.73	133.83**
Grades* Type of Students	1	29.35	29.35	13.10**
Error	15	257.56	2.24	
Total	19	707.79		

** ***Significant at 0.01 level***

From the table 4.29, it is evident that the adjusted F-value for Grade is 14.44 which is significant at 0.0l level. It indicates that the mean score of Distance Estimation of Grade V and VI students differ significantly when the Pre score of Distance Estimation was considered as covariate. In this context, the null hypothesis stated that ***"there no significant influence of Grade on Distance Estimation skill when the Pre score of Distance Estimation Skill was considered as covariate"*** is

rejected**.** In the light of this, it may be concluded that students in higher Grade (VI-VIII) secured higher score than students in lower Grade (V-VI).

From the table 4.29, it is evident that the adjusted F-value for Types of Students viz. Visually Impaired and Blind-folded Sighted students is 133.83 which is significant at 0.01 level. It indicates that the mean score of Distance Estimation differ significantly between visually impaired and blind-folded sighted students. In this context, the null hypothesis stated that ***"there is no significant influences with respect to when pre score of Distance Estimation is taken Types of students as covariate"*** is rejected. The mean score analysis revealed that Visually Impaired students secured higher (M=9.22) than the Blind-folded Sighted (M=5.87). Hence, it may be concluded that the Visually Impaired students secured higher score in the Distance Estimation skill in the Posttest.

From the table 4.29, it is evident that the adjusted F-value for Distance Estimation between Grade and Types of Students is 13.10 which is significant at 0.01 level. It indicates that there is significant influences of Grade and Types of students on Distance Estimation when pre score of Distance Estimation was taken as covariate. In this context, the null hypothesis stated that ***"there is no significant influence of interaction between Grade and Types of students on Distance Estimation skill when considering Pre score of Distance Estimation skill as covariate"*** is rejected. Therefore it may be concluded that Grade and Type of Students have resultant interaction on Distance Estimation Skill when Pre score was considered as covariate.

4.3.5 Skill of Mental Rotation with respect to Grade and Type of Students and their Resultant Interaction

2x2 Factorial Design ANCOVA was employed to find out the Influence of Grade and Type of Students and their Resultant Interaction - Mean analysis.

Table 4.30: Mean analysis

Group	Score - Pre									Score - Post								
	Grade						Total			Grade						Total		
	V & VI			VII &VIII						V & VI			VII &VIII					
	Mean	SD	No	Mean	SD	No	Mean	SD	No	Mean	SD	No	Mean	SD	No	Mean	SD	No
VI	1.03	1.27	30	2.03	0.61	30	1.53	1.11	60	14.37	0.61	30	13.67	0.99	30	14.02	0.89	60
BFS	6.23	2.54	30	8.90	2.45	30	7.57	2.82	60	6.83	2.89	30	11.37	2.43	30	9.10	3.50	60
Total	3.63	3.29	60	5.47	3.89	60	4.55	3.71	120	10.60	4.33	60	12.52	2.17	60	11.56	3.54	120

Table 4.31: Summary of 2x2 Factorial Design ANCOVA for Mental Rotation by Considering Pre score as Covariate (Post score)

Source of Variance	df	SSy.x	MSS.x	F value
Grade	1	217.43	217.43	58.51**
Type of Students	1	450.35	450.35	121.18**
Grade* Type of Students	1	166.26	166.26	44.74**
Error	115	427.39	3.72	
Total	119	1493.59		

** ***Significant at 0.01 level***

From the table 4.31, it is evident that the adjusted F-value for Grade is 58.51 which is significant at 0.0l level. It indicates that the mean score of Mental Rotation of Grade V and VI students differ significantly when the Pre score of Mental Rotation was considered as covariate. In this context, the null hypothesis stated that ***"there is no significant influence of Grade on Mental Rotation skill when the Pre score of***

Mental Rotation skill was considered as covariate" is rejected. It may therefore be concluded that students in higher Grade (VII-VIII) secured higher score than in lower Grade (V-VI).

From the table 4.31, it is evident that the adjusted F-value for Types of Students viz. Visually Impaired and Blind-folded Sighted students is 121.18 which is significant at 0.01 level. It indicates that the mean score of Mental Rotation differ significantly between visually impaired and blind-folded sighted students. In this context, the null hypothesis stated that ***"there is no significant influences with respect to when pre score of Mental Rotation is taken Types of students as covariate"*** is rejected. The mean score analysis revealed that Visually Impaired students secured higher (M=14.02) than the Blind-folded Sighted (M=9.10). Hence, it may be concluded that the Visually Impaired students secured higher score in the Mental Rotation skill in the Posttest.

From the table 4.31, it is evident that the adjusted F-value for Mental Rotation between Grade and Types of Students is 44.74 which is significant at 0.01 level. It indicates that there is significant influences of Grade and Types of students on Mental Rotation when pre score of Mental Rotation was taken as covariate. In this context, the null hypothesis stated that ***"there is no significant influence of interaction between Grade and Types of students on Mental Rotation skill when considering Pre score of Mental Rotation skill as covariate"*** is rejected. It may therefore be concluded that Grade and Type of Students have resultant interaction on Mental Rotation when pre score was considered as covariate.

4.3.6 Skill of Delineation with respect to Grade and Type of Students and their Resultant Interaction

2x2 Factorial Design ANCOVA was employed to find out the Influence of Grade and Type of Students and their Resultant Interaction.

Table 4.32: Mean Analysis

Group	Score - Pre									Score - Post								
	Grade						Total			Grade						Total		
	V & VI			VII &VIII						V & VI			VII &VIII					
	Mean	SD	No	Mean	SD	No	Mean	SD	No	Mean	SD	No	Mean	SD	No	Mean	SD	No
VI	21.43	2.79	30	21.03	3.49	30	21.23	3.14	60	32.20	2.51	30	31.87	2.96	30	32.03	2.72	60
BFS	22.00	2.90	30	21.70	2.34	30	21.85	2.62	60	22.03	2.13	30	24.97	3.84	30	23.50	3.41	60
Total	21.72	2.83	60	21.37	2.96	60	21.54	2.89	120	27.12	5.62	60	28.42	4.86	60	27.77	5.27	120

Table 4.33: Summary of 2x2 Factorial Design ANCOVA for Delineation by Considering Pre score as Covariate (Post score)

Source of Variance	df	SSy.x	MSS.x	F value
Grade	1	51.36	51.36	6.16*
Type of Students	1	2219.88	2219.88	266.25**
Grade* Type of Students	1	79.01	79.01	9.49**
Error	115	958.83	8.34	
Total	119	3309.47		

** ***Significant at 0.01 level*** * ***Significant at 0.05 level***

From the table 4.33, it is evident that the adjusted F-value for Grade is 6.16 which is significant at 0.05 level. It indicates that the mean score of Delineation of Grade V and VI students differ significantly when the Pre score of Delineation was considered as covariate. In this context, the null hypothesis stated that ***"there is no significant influence of Grade on Delineation skill when the Pre score of***

Delineation skill was considered as covariate" is rejected. It may therefore be concluded student in higher Grade (VII-VIII) secured higher score than students in lower Grade (V-VI).

From the table 4.33, it is evident that the adjusted F-value for Types of Students viz. Visually Impaired and Blind-folded Sighted students is 266.25 which is significant at 0.01 level. It indicates that the mean score of Delineation differ significantly between visually impaired and blind-folded sighted students. In this context, the null hypothesis stated that ***"there is no significant influences with respect to when pre score of Delineation is taken Types of students as covariate"*** is rejected. The mean score analysis revealed that Visually Impaired students secured higher (M=32.03) than the Blind-folded Sighted (M=23.50). Hence, it may be concluded that the Visually Impaired students secured higher score in the Delineation skill in the Posttest.

From the table 4.33, it is evident that the adjusted F-value for Delineation between Grade and Types of Students is 9.49 which is significant at 0.01 level. It indicates that there is significant influences of Grade and Types of students on Delineation when pre score of Delineation was taken as covariate. In this context, the null hypothesis stated that ***"there is no significant influence of interaction between Grade and Types of students on Delineation skill when considering Pre score of Delineation skill as covariate"*** is rejected. It may therefore be concluded that Grade and Type of Students have resultant interaction on Delineation.

Section IV:

4.4 Influence of Braille Reading Skill on Spatial Ability by Analysis of Variance (ANOVA)

4.4.1 Influence of Braille Reading Skill on Distance Estimation, Mental Rotation and Delineation Skill among Visually Impaired Students

Table 4.34: Summary of One Way ANOVA for Distance Estimation Skill with respect to Braille Reading among Visually Impaired Students

Source of Variance	df	SSy.x	MSS.x	F value
Braille Reading	1	0.87	0.87	1.96 Ns
Error	57	25.21	0.44	
Total	59	26.18		

Ns-Not Significant

From the table 4.34, it is evident that the F-value for Distance Estimation is 1.96 which is not significant. It indicates that there is no significant influence of Braille Reading on Distance Estimation skill of Visually Impaired students. In this context, the null hypothesis stated that ***"there is no significant influence of Braille Reading on Distance Estimation Skill"*** is not rejected. Therefore, it is considered that Braille Reading has no influence on Distance Estimation skill of Visually Impaired students.

Table 4.35: Summary of One Way ANOVA for Mental Rotation Skill with respect to Braille Reading among Visually Impaired Students

Source of Variance	df	SSy.x	MSS.x	F value
Braille Reading	1	1.57	1.57	2.12 Ns
Error	57	42.11	0.74	
Total	59	46.98		

Ns-Not Significant

From the table 4.35, it is evident that the F-value for Mental Rotation is 2.12 which is not significant. It indicates that there is no significant influence of Braille Reading on Mental Rotation skill of Visually Impaired students. In this context, the null hypothesis stated that ***"there is no significant influence of Braille Reading on***

Mental Rotation Skill" is not rejected. Therefore, it is considered that Braille Reading has no influence on Mental Rotation skill of Visually Impaired students.

Table 4.36: Summary of One Way ANOVA for Delineation skill with respect to Braille Reading among Visually Impaired Students

Source of Variance	df	SSy.x	MSS.x	F value
Braille Reading	1	9.98	3.12	1.34 Ns
Error	57	424.84	9.98	
Total	59	437.93	7.45	

Ns-Not Significant

From the table 4.36, it is evident that the F-value for Delineation is 1.34 which is not significant. It indicates that there is no significant influence of Braille Reading on Delineation skill of Visually Impaired students. In this context, the null hypothesis stated that ***"there is no significant influence of Braille Reading on Delineation Skill"*** is not rejected. Therefore, it is considered that Braille Reading has no influence on Delineation skill of Visually Impaired students.