CHAPTER IV

ANALYSIS AND INTERPRETATION

4.0 Introduction

The method followed in conducting the present study has been given in detail in the previous chapter. In this chapter, the statistical techniques used for analysing 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

Analysis of software component of the Computer Assisted Cartesian Plane

i. Testing of Error Free Software
ii. Testing of Time Complexity software Programme

Section II

Percentage Analysis from the response of Special Teachers and Student Teachers on a rating of Computer Assisted Cartesian Plane.

Section III

T-test Analysis on Acquisition of Graph Concepts introduced before and after the introduction of Computer Assisted Cartesian Plane among Students with Visual Impairment.

Section IV

Repeated Measures Analysis of Variance (ANOVA) for the Performance of Students in Graph Concepts.

Section V

Influence of Gender/Grade and their resultant interaction on Graph concepts by Analysis of Covariance (ANCOVA)

Section I

4.1 Analysis of Software Component of the Computer Assisted Cartesian Plane

4.1.1 Testing for Error Free Software

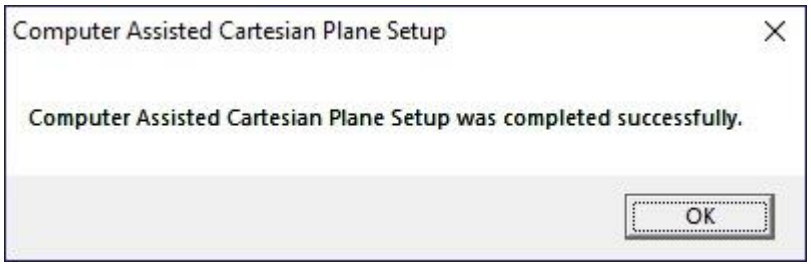


Figure 4.1: Screenshot of the Installation of software Programme

4.1.2 Testing of Time Complexity of Software Programme

Time complexity is the period of time taken by the software to perform its action. It is also called computational complexity. It is determined by counting the number of operations involved in the algorithm.

S.No	Complexity Case	Time Complexity
1.	Best case	N log N
2.	Average case	N log N
3.	Worst case	O (N^2)

Section II

4.2 Percentage Analysis from the response of Special Teachers and Student Teachers on Rating of Computer Assisted Cartesian Plane

A rating scale to examine how the special teachers and student teachers perceived the newly developed Computer Assisted Cartesian Plane was administered to 120 members who used the system to teach. Thirty-five items were pooled on various facets of the system and the responses were presented on a four-point scale. The internal consistency was measured using Cronbach Alpha which was found to be 0.88.

Table 4.1 Identification of Concepts of Cartesian Plane

Category	N	Percent
Strongly Disagree	48	40
Disagree	71	59.2
Agree	1	0.8
Total	**120**	**100**

It can be discussed from the above table that about 0.8 % (Agree) of the respondents reported that their students with visual impairment can able to identify Concepts of Cartesian Plane such as x- and y-axes, origin, positive and negative values of x- and y-axes, quadrants and form of the quadrants in Computer Assisted Cartesian Plane without the orientation to Tactile Cartesian Plane. Almost 99.2 % of the respondents that students with visual impairment have difficulty in learning the Concepts of Cartesian Plane using Computer Assisted Cartesian Plane system without the orientation to Tactile Cartesian Plane.

Table 4.2 Computer Assisted Cartesian Plane as a Self-Learning Tool

Category	N	Percentage
Strongly Agree	289	22.3
Agree	791	61
Disagree	170	13.4
Strongly Disagree	41	3.3

About 83.3% (Agree 61 %, Strongly Agree 22.3%) of the respondents reported that Computer Assisted Cartesian Plane is a self-learning tool to learn the concept of x- and y- axes, origin, positive and negative values of x-axis and y-axis, quadrants, forms of the quadrants, finding a point in respective quadrant and axis, Plotting a point in the respective quadrant and axis.

Table 4.3 Advantages of Computer Assisted Cartesian Plane

Category	N	Percentage
Strongly Agree	114	12.4
Agree	606	65.9
Disagree	161	17.5
Strongly Disagree	39	4.13

About 78.3 % (Agree 65.9% and Strongly Agree 12.4%) of the respondents expressed that Computer Assisted Cartesian Plane has many advantages in usage. They include: Learning, Practice, and Evaluation Mode; minimal keys for each operation; and accessible feature.

Table 4.4 Scope for Teaching

Category	N	Percentage
Strongly Agree	139	16.6
Agree	472	56.3
Disagree	186	22.2
Strongly Disagree	42	5.0

56.3 (Agree) and 16.6% (Strongly Agree) of the respondents reported that Computer Assisted Cartesian plane helps parents, regular teachers and sighted students for learning graphs.

Table 4.5 Challenges in using Computer Assisted Cartesian Plane

Category	N	Percentage
Strongly Agree	113	13.7
Agree	487	59.1
Disagree	173	21.0
Strongly Disagree	51	6.2

About 72.8 % (Agree 59.1 % and Strongly Agree 13.7 %) of the respondents expressed the challenges of using Computer Assisted Cartesian Plane. While using this system, the students get distracted due to its monotonous voiceover and limited interaction due to the restriction for Tactile Mode.

Section III

This section presents the comparison of Pre and Post Scores of selected students with visual impairment related to the acquisition of Concepts of Cartesian Plane and Plotting and Finding Points on Quadrants and Axes. Scores considered for these analyses are:

i. Pre Tactile Score
ii. Post Tactile Score
iii. Scores obtained in Computer Assisted Cartesian Plane

4.3 Analysis on Acquisition of Concepts of Cartesian Plane introduced Before and After Introduction of Computer Assisted Cartesian Plane among Students with Visual Impairment

The following tables analyse the performance scores pertaining to Graph concepts acquired by students with visual impairment separately before and after introduction of Computer Assisted Cartesian Plane.

Table 4.6 Testing Wise Mean, SD, DF, and t value for Graph concepts with Respect to Pre and Post Tactile

Graph Concept	Mode	Test	N	df	Mean	SD	t-Value
* Concepts of Cartesian Plane *Plotting and Finding Points on Quadrants and Axes	Tactile	Pre	42	41	4.76	2.91	61.03**
		Post	42	41	23.05	2.76	

***Significant at 0.01 level*

From table 4.6, it is evident that the t-value for Graph Concepts is **61.03** with df = 41 which is significant at 0.01 level. It indicates that pre and post tactile scores of Graph Concepts using Tactile Cartesian Plane differ significantly. In the light of this, the null hypothesis that ***"there is no significant difference in the mean scores of Graph concepts before and after the introduction of Computer Assisted Cartesian Plane"*** is rejected. It may therefore be said that the Computer Assisted Cartesian Plane helped in improving the Learning of Graph Concepts among Students with Visual Impairment.

Table 4.7 Testing Wise Mean, SD, df and t value for Graph Concepts with Respect to Pre Tactile and Computer Assisted

Graph Concept	Mode	Test	N	df	Mean	SD	t-value
* Concepts of Cartesian Plane *Plotting and Finding Points on Quadrants and Axes	Tactile	Pre	42	41	4.76	2.91	69.69**
	Computer	-	42	41	23.05	2.65	

***Significant at 0.01 level*

From table 4.7, it is evident that the t-value for Graph Concepts is **69.69** with df = 41 which is significant at 0.01 level. It indicates that Pre Tactile and a Computer Assisted score of Graph Concepts differ significantly. In the light of this, the null hypothesis that ***"there is no significant difference in the mean scores of Graph Concepts before and after the introduction of Computer Assisted Cartesian Plane"*** is rejected. It may therefore be said that the Computer Assisted Cartesian Plane helped in improving the Learning of Graph Concepts among Students with Visual Impairment.

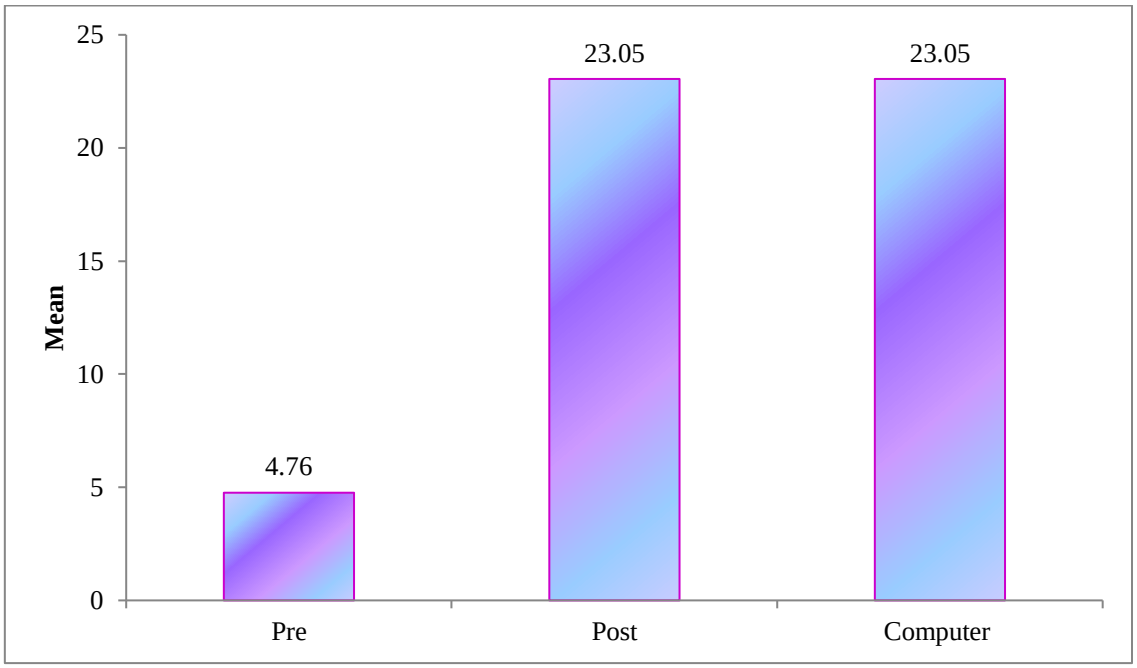


Figure 4.2: Testing Wise Mean, SD, df, and t value for Graph Concepts with Respect to Pre & Post Tactile and Computer Assisted

Table 4.8 Testing Wise Mean, SD, df and t Value for Graph Concepts with Respect to Post Tactile and Computer Assisted

Graph Concept	Mode	Test	N	df	Mean	SD	t-value
* Concepts of Cartesian Plane	Tactile	Post	42	41	23.05	2.76	0.00^{NS}
*Plotting and Finding Points on Quadrants and Axes	Computer	-	42	41	23.05	2.65	

NS- Not Significant

From table 4.8, it is evident that the t-value for Graph Concepts is **0.00** with df = 41 which is not significant. It indicates that Post Tactile and Computer Assisted score of Graph concepts does not differ significantly. In the light of this, the null hypothesis that ***"there is no significant difference in the mean scores of Graph Concepts before and after introduction of Computer Assisted Cartesian Plane"*** is not rejected. Therefore it is concluded that the scores between Post tactile and Computer Assisted score for Graph concepts were found to be at the same level.

Table 4.9 Testing wise Mean, SD, df and t value for Concepts of Cartesian Plane with Respect to Pre and Post Tactile

Graph Concept	Mode	Test	N	df	Mean	SD	t-value
Concepts of Cartesian Plane	Tactile	Pre	42	41	3.29	2.06	29.88**
		Post	42	41	12.40	1.58	

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

From table 4.9, it is evident that the t-value for Concepts of Cartesian Plane is **29.88** with df = 41 which is significant at 0.01 level. It indicates that Pre and Post Tactile scores of Concepts of Cartesian Plane differ significantly. In the light of this, the null hypothesis that ***"there is no significant difference in mean scores of Concepts of Cartesian Plane before and after the introduction of Computer Assisted Cartesian Plane"*** is rejected. It may therefore be said that the Computer Assisted Cartesian Plane helped in improving the Learning of Concepts of Cartesian Plane among Students with Visual Impairment.

Table 4.10 Testing Wise Mean, SD, df and t Value for Concepts of Cartesian Plane with Respect to Pre Tactile and Computer Assisted

Graph Concept	Mode	Test	N	df	Mean	SD	t-value
Concepts of Cartesian Plane	Tactile	Pre	42	41	3.29	2.06	29.34**
	Computer	-	42	41	12.29	1.57	

***Significant at 0.01 level*

From table 4.10, it is evident that the t-value for Concepts of Cartesian Plane is **29.34** with df = 41 which is significant at 0.01 level. It indicates that Pre Tactile and Computer Assisted score of Concepts of Cartesian Plane differ significantly. In the light of this, the null hypothesis that ***"there is no significant difference in mean scores of Concepts of Cartesian Plane before and after the introduction of Computer Assisted Cartesian Plane"*** is rejected. It may therefore be said that the Computer Assisted Cartesian Plane helped in improving the Learning of Concepts of Cartesian Plane among Students with Visual Impairment.

Table 4.11 Testing wise Mean, SD, df and t value for Concepts of Cartesian Plane with respect to Computer Assisted and Post Tactile

Graph concept	Mode	Test	N	df	Mean	SD	t-value
Concepts of Cartesian Plane	Computer	-	42	41	12.29	1.57	2.35*
	Tactile	Post	42	41	12.40	1.58	

***Significant at 0.05 level*

From table 4.11, it is evident that the t-value for Concepts of Cartesian Plane is **2.35** with df = 41 which is significant at 0.05 level. It indicates that the Computer Assisted and Post Tactile score of Concept of Axes, Origin, and Quadrants differ significantly. In the light of this, the null hypothesis that ***"there is no significant difference in mean scores of Concepts of Cartesian Plane before and after the introduction of Computer Assisted Cartesian Plane"*** is rejected. It may therefore be said that the Computer Assisted Cartesian Plane helped in improving the Learning of Concepts of Cartesian Plane among Students with Visual Impairment.

Table 4.12 Testing wise Mean, SD, df, and t value for Plotting Points on Quadrants with respect to Pre and Post Tactile

Graph concept	Mode	Test	N	df	Mean	SD	t-value
Plotting Points on Quadrants	Tactile	Pre	42	41	0.76	0.73	12.34**
		Post	42	41	2.86	1.00	

***Significant at 0.01 level*

From the table 4.12, it is evident that the t-value for Plotting Points on Quadrants is **12.34** with df = 41 which is significant at 0.01 level. It indicates that Pre Tactile and Post Tactile scores of Plotting Points on Quadrants differ significantly. In the light of this, the null hypothesis stated that ***"there is no significant difference in mean scores of Plotting Points on Quadrants before and after introduction of Computer Assisted Cartesian Plane"*** is rejected. It may therefore be said that the Computer Assisted Cartesian Plane helped in improving the Learning of Plotting Points on Quadrants among Students with Visual Impairment.

Table 4.13 Testing wise Mean, SD, df and t value for Plotting Points on Quadrants with Respect to Pre Tactile and Computer Assisted

Graph concept	Mode	Test	N	df	Mean	SD	t-value
Plotting Points on Quadrants	Tactile	Pre	42	41	0.76	0.73	15.76**
	Computer	-	42	41	3.07	0.78	

***Significant at 0.01 level*

From the table 4.13, it is evident that the t-value for Plotting Points on Quadrants is **15.76** with df = 41 which is significant at 0.01 level. It indicates that Pre tactile and Computer Assisted scores of Plotting Points on Quadrants differ significantly. In the light of this, the null hypothesis stated that ***"there is no significant difference in mean scores of Plotting Points on Quadrants before and after the introduction of Computer Assisted Cartesian Plane"*** is rejected. It may therefore be said that the Computer Assisted Cartesian Plane helped in improving the Learning of Plotting Points on Quadrants among Students with Visual Impairment.

Table 4.14 Testing wise Mean, SD, df, and t value for Plotting Points on Quadrants with Respect to Computer Assisted and Post Tactile

Graph Concept	Mode	Test	N	df	Mean	SD	t-value
Plotting points on Quadrants	Computer	-	42	41	3.07	0.78	2.95*
	Tactile	Post	42	41	2.86	1.00	

***Significant at 0.05 level*

From the table 4.14, it is evident that the t-value for Plotting Points on Quadrants is **2.95** with df = 41 which is significant at 0.05 level. It indicates that Computer Assisted and Post Tactile scores of Plotting Points on Quadrants differ significantly. In the light of this, the null hypothesis that ***"there is no significant difference in mean Plotting Points on Quadrants before and after the introduction of Computer Assisted Cartesian Plane"*** is rejected. It may therefore be said that the Computer Assisted Cartesian Plane helped in improving the Learning of Plotting Points on Quadrants among Students with Visual Impairment.

Table 4.15 Testing wise Mean, SD, df, and t value for Plotting Points on Axes with Respect to Pre and Post Tactile

Graph Concept	Mode	Test	N	df	Mean	SD	t-value
Plotting points on Axes	Tactile	Pre	42	41	0.05	0.31	18.67**
		Post	42	41	2.67	0.87	

***Significant at 0.01 level*

From the table 4.15, it is evident that the t-value for the Plotting Points on Axes is **18.67** with df = 41 which is significant at 0.01 level. It indicates that Pre Tactile and Post Tactile scores of Plotting Points on Axes differ significantly. In the light of this, the null hypothesis stated that ***"there is no significant difference in mean scores of Plotting Points on the axes before and after the introduction of Computer Assisted Cartesian Plane"*** is rejected. It may therefore be said that the Computer Assisted Cartesian Plane helped in improving the Learning of Plotting Points on Axes among Students with Visual Impairment.

Table 4.16 Testing wise Mean, SD, df, and t value for Plotting Points on Axes with respect to Pre Tactile and Computer Assisted

Graph Concept	Mode	Test	N	df	Mean	SD	t-value
Plotting Points on Axes	Tactile	Pre	42	41	0.05	0.31	18.44**
	Computer	-	42	41	2.64	0.88	

****Significant at 0.01 level***

From the table 4.16, it is evident that the t-value for Plotting Points on Axes is **18.44** with df = 41 which is significant at 0.01 level. It indicates that Pre Tactile and Computer Assisted scores of Plotting Points on the Axes differ significantly. In the light of this, the null hypothesis stated that ***"there is no significant difference in mean scores of Plotting Points on the Axes before and after the introduction of Computer Assisted Cartesian Plane"*** is rejected. It may therefore be said that the Computer Assisted Cartesian Plane helped in improving the Learning of Plotting Points on Axes among Students with Visual Impairment.

Table 4.17 Testing wise Mean, SD, df, and t value for Plotting Points on Axes with respect to Post Tactile and Computer Assisted

Graph Concept	Mode	Test	N	df	Mean	SD	t-value
Plotting Points on Axes	Tactile	Post	42	41	2.67	0.87	0.57^{NS}
	Computer	-	42	41	2.64	0.88	

NS- Not Significant

From the table 4.17, it is evident that the t-value for Plotting Points on Axes is **0.57** with df = 41 which is not significant. It indicates that Post Tactile and Computer Assisted score of Plotting Points on Axes is not differ significantly. In the light of this, the null hypothesis that ***"there is no significant difference in mean scores of Plotting Points on Axes before and after the introduction of Computer Assisted Cartesian Plane"*** is not rejected. Therefore it is concluded that the scores between Post Tactile and Computer Assisted score for Plotting Points on Axes were found to be at the same level.

Table 4.18 Testing wise Mean, SD, df, and t value for Finding Points on Quadrants with respect to Pre Tactile and Post Tactile

Graph Concept	Mode	Test	N	df	Mean	SD	t-value
Finding Points on Quadrants	Tactile	Pre	42	41	0.60	0.77	10.41**
	Tactile	Post	42	41	2.50	1.04	

****Significant at 0.01 level***

From the table 4.18, it is evident that the t-value for Finding Points on quadrants is **10.41** with df = 41 which is significant at 0.01 level. It indicates that Pre Tactile and Post Tactile scores of Finding Points on Quadrants differ significantly. In the light of this, the null hypothesis stated that ***"there is no significant difference in mean scores of Finding Points on Quadrants before and after the introduction of Computer Assisted Cartesian Plane"*** is rejected. It may therefore be said that the Computer Assisted Cartesian Plane helped in improving the Learning of Finding Points on Quadrants among Students with Visual Impairment.

Table 4.19 Testing wise Mean, SD, df, and t value for Finding Points on Quadrants with respect to Pre Tactile and Computer Assisted

Graph Concept	Mode	Test	N	df	Mean	SD	t-value
Finding Points on Quadrants	Tactile	Pre	42	41	0.60	0.77	13.58**
	Computer	-	42	41	2.76	0.91	

****Significant at 0.01 level***

From the table 4.19, it is evident that the t-value for finding points on quadrants is **13.58** with df = 41 which is significant at 0.01 level. It indicates that Pre Tactile and Computer Assisted scores of Finding Points on Quadrants differ significantly. In the light of this, the null hypothesis stated that ***"there is no significant difference in mean scores of Finding Points on Quadrants before and after the introduction of Computer Assisted Cartesian Plane"*** is rejected. It may therefore be said that the Computer Assisted Cartesian Plane helped in improving the Learning of Finding Points on Quadrants among Students with Visual Impairment.

Table 4.20 Testing wise Mean, SD, df, and t value for Finding Points on Quadrants with respect to Post Tactile and Computer Assisted

Graph Concept	Mode	Test	N	df	Mean	SD	t-value
Finding Points on Quadrants	Tactile	Post	42	41	2.50	1.04	3.42**
	Computer	-	42	41	2.76	0.91	

***Significant at 0.01level*

From the table 4.20, it is evident that the t-value for Finding Points on Quadrants is **3.42** with df = 41 which is significant at 0.01 level. It indicates that Post Tactile and Computer Assisted scores of Finding Points on Quadrants differ significantly. In the light of this, the null hypothesis that ***"there is no significant difference in mean scores of Finding Points on the Quadrants before and after the introduction of Computer Assisted Cartesian Plane"*** is rejected. It may therefore be said that the Computer Assisted Cartesian Plane helped in improving the Learning of Finding Points on Quadrants among Students with Visual Impairment.

Table 4.21 Testing wise Mean, SD, df, and t value for Finding points on Axes with respect to Tactile Pre and Post

Graph Concept	Mode	Test	N	df	Mean	SD	t-value
Finding Points on Axes	Tactile	Pre	42	41	0.07	0.34	14.60**
	Tactile	Post	42	41	2.62	1.13	

***Significant at 0.01 level*

From the table 4.21, it is evident that the t-value for Finding Points on Axes is **14.60** with df = 41 which is significant at 0.01 level. It indicates that Pre Tactile and Post Tactile scores of Finding Points on Axes differ significantly. In the light of this, the null hypothesis stated that ***"there is no significant difference in mean scores of Finding Points on Axes before and after the introduction of Computer Assisted Cartesian Plane"*** is rejected. It may therefore be said that the Computer Assisted Cartesian Plane helped in improving the Learning of Finding Points on Quadrants among Students with Visual Impairment.

Table 4.22 Testing wise Mean, SD, df, and t value for Finding Points on Axes of Students with respect to Pre Tactile and Computer Assisted

Graph Concept	Mode	Test	N	df	Mean	SD	t-value
Finding Points on Axes	Tactile	Pre	42	41	0.07	0.34	13.12**
	Computer	-	42	41	2.29	1.11	

***Significant at 0.01 level*

From the table 4.22, it is evident that the t-value for Finding Points on Axes is **13.12** with df = 41 which is significant at 0.01 level. It indicates that Pre Tactile and Computer Assisted scores of Finding Points on Axes differ significantly. In the light of this, the null hypothesis stated that ***"there is no significant difference in mean scores of Finding Points on Axes before and after introduction of Computer Assisted Cartesian Plane"*** is rejected. It may therefore be said that the Computer Assisted Cartesian Plane helped in improving the Learning of Finding Points on Axes among Students with Visual Impairment.

Table 4.23 Testing wise Mean, SD, df, and t value for Finding Points on Axes with respect to Post Tactile and Computer Assisted

Graph Concept	Mode	Test	N	df	Mean	SD	t-value
Finding Points on Axes	Tactile	Post	42	41	2.62	1.13	3.79**
	Computer	-	42	41	2.29	1.11	

***Significant at 0.01 level*

From the table 4.23, it is evident that the t-value for Finding Points on Axes is **3.79** with df = 41 which is significant at 0.01 level. It indicates that Post Tactile and Computer Assisted scores of Finding Points on Axes differ significantly. In the light of this, the null hypothesis that ***"there is no significant difference in mean Finding Points on Axes before and after introduction of Computer Assisted Cartesian Plane"*** is rejected. It may therefore be said that the Computer Assisted Cartesian Plane helped in improving the Learning of Finding Points on Axes among Students with Visual Impairment.

SECTION IV

4.4 Analysis of Performance in Computer Assisted Cartesian Plane

Section III analyses the scores obtained in Concepts of Cartesian Plane, Plotting Points on Quadrants, Plotting Points on Axes, Finding Points on Quadrants, Finding Points on Axes for students with visual impairment were included and scores analysed.

The repeated measures ANOVA was employed to determine whether the performance score in the graph concepts differ significantly in the Pre Tactile , Post Tactile, and Computer Assisted score applying statistical methods such as Sphericity Assumed, Greenhouse-Geisser, Huynh-Feldt, and Lower-bound. The results are given in the following tables

Table 4.24 Summary of Repeated Measures ANOVA for Concepts of Cartesian Plane

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Concepts of Cartesian Plane	Sphericity Assumed	2298.40	2	1149.20	865.04	0.00**	0.955
	Greenhouse-Geisser	**2298.40**	**1.04**	**2207.42**	**865.04**	**0.00****	**0.955**
	Huynh-Feldt	2298.40	1.04	2200.79	865.04	0.00**	0.955
	Lower-bound	2298.40	1	2298.40	865.04	0.00**	0.955
Error	Sphericity Assumed	108.94	82	1.33			
	Greenhouse-Geisser	108.94	42.69	2.55			
	Huynh-Feldt	108.94	42.82	2.54			
	Lower-bound	108.94	41	2.66			

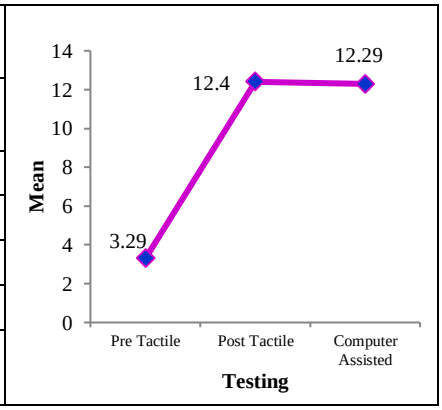
***** Significant at 0.01 level***

From the table 4.24, it is evident that the F value for Concepts of Cartesian Plane is (2, 1.04) = 865.04, $p<0.01$). This shows that the Mean scores of Concepts of Cartesian Plane in the Pre Tactile, Computer Assisted, and Post Tactile test differ significantly. The effect size $\eta 2 = 0.955$ was found to be significant in making changes

as the result of the intervention. In the context, the null hypothesis stated that ***"there is no significant difference within Pre Tactile, Computer Assisted, and Post Tactile Scores"*** is rejected. To investigate as to which pairs of Means differed significantly, Post - Hoc was further employed. The results of the analysis are given in the following table.

Table 4.25 Sidak Post- Hoc test of Concepts of Cartesian Plane

Testing		Mean	MD	Std. Error	Sig.
Pre Tactile	Computer Assisted	12.29	9.00	0.31	0.00**
	Post Tactile	12.40	9.12	0.31	0.00**
Computer Assisted	Pre tactile	3.29	9.00	0.31	0.00**
	Post Tactile	12.40	0.12	0.05	0.07
Post Tactile	Pre tactile	3.29	9.12	0.31	0.00**
	Computer Assisted	12.29	0.12	0.05	0.07



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

From the above table 4.25, it is evident that the significant difference is resulted between: Pre Tactile and Computer Assisted (9), Pre Tactile and Post Tactile (9.12), Computer Assisted and Post Tactile (0.12). These results indicate that the students have shown improvement in Concepts of Cartesian Plane after the introduction of the Computer Assisted Cartesian Plane. The scores between Computer Assisted and Post Tactile were found to be at the same level.

Table 4.26 Summary of Repeated measures ANOVA for Plotting Points on Quadrants

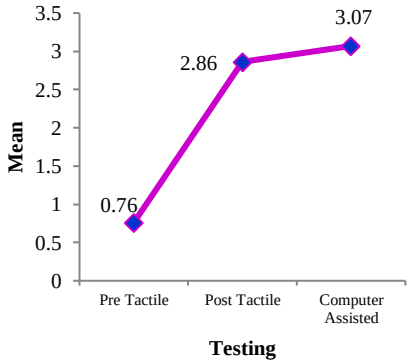
Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Plotting points on Quadrants	Sphericity Assumed	136.78	2	68.39	175.86	0.00**	0.811
	Greenhouse-Geisser	**136.78**	**1.28**	**106.99**	**175.86**	**0.00****	**0.811**
	Huynh-Feldt	136.78	1.30	105.10	175.86	0.00**	0.811
	Lower-bound	136.78	1.00	136.78	175.86	0.00**	0.811
Error	Sphericity Assumed	31.89	82	0.39			
	Greenhouse-Geisser	31.89	52.42	0.61			
	Huynh-Feldt	31.89	53.36	0.60			
	Lower-bound	31.89	41.00	0.78			

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

From the table 4.26, it is evident that the F value for Plotting Points on Quadrants is (2, 1.28) = 175.86, p<0.01). This shows that the Mean of Plotting Points on Quadrants in the Pre Tactile, Computer Assisted, and Post Tactile test differs significantly. The effect size η2 =0.811 was found to be significant in making changes as the result of the intervention. In the context, the null hypothesis stated that ***"there is no significant difference within Pre Tactile, Computer, and Post Tactile test scores"*** is rejected. To investigate as to which pairs of Means differed significantly, Post Hoc was further employed. The results of the analysis are given in the following table.

Table 4.27 Sidak Post Hoc test of Plotting Points on Quadrants

Testing		Mean	MD	Std. Error	Sig.
Pre Tactile	Post Tactile	2.86	2.10	0.17	0.00**
	Computer Assisted	3.07	2.31	0.15	0.00**
Post Tactile	Pre Tactile	0.76	2.10	0.17	0.00**
	Computer Assisted	3.07	0.21	0.07	0.02
Computer Assisted	Pre Tactile	0.76	2.31	0.15	0.00**
	Post Tactile	2.86	0.21	0.07	0.02



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

From the above table 4.27, it is evident that the significant difference is resulted between: Pre Tactile and Computer Assisted(2.31), Pre Tactile and Post Tactile (2.10), Computer Assisted and Post Tactile (0.21). These results indicate that the students have shown improvement in Plotting Points on Quadrants after the introduction of Computer Assisted Cartesian Plane. The scores between Computer Assisted and Post Tactile were found to be at the same level.

Table 4.28 Summary of Repeated measures ANOVA for Plotting Points on Axes

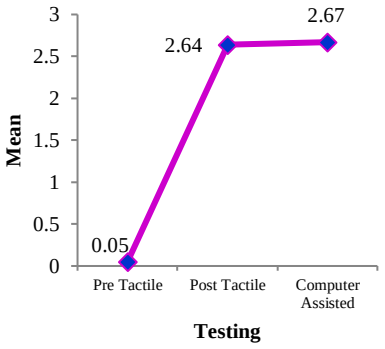
Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Plotting Points on Axes	Sphericity Assumed	190.33	2	95.17	329.73	0.00**	0.889
	Greenhouse-Geisser	**190.33**	**1.13**	**167.91**	**329.73**	**0.00****	**0.889**
	Huynh-Feldt	190.33	1.14	166.37	329.73	0.00**	0.889
	Lower-bound	190.33	1.00	190.33	329.73	0.00**	0.889
Error	Sphericity Assumed	23.67	82	0.29			
	Greenhouse-Geisser	23.67	46.48	0.51			
	Huynh-Feldt	23.67	46.91	0.51			
	Lower-bound	23.67	41.00	0.58			

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

From the table 4.28, it is evident that the F value for Plotting Points on Axes is (2, 1.13) = 329.73, $p<0.01$). This shows that the Mean of Plotting Points on Axes in the Pre Tactile, Computer Assisted, and Post Tactile test differs significantly. The effect size $\eta 2 = 0.889$ was found to be significant in making changes as the result of the intervention. In the context, the null hypothesis stated that ***"there is no significant difference within Pre Tactile, Computer Assisted, and Post Tactile test scores"*** is rejected. To investigate as to which pairs of Means differed significantly, Post Hoc was further employed. The results of the analysis are given in the following table.

Table 4.29 Sidak Post Hoc test of Plotting Points on Axes

Testing		Mean	MD	Std. Error	Sig.
Pre Tactile	Computer Assisted	2.67	2.60	0.14	0.00**
	Post Tactile	2.64	2.62	0.14	0.00**
Computer Assisted	Pre tactile	0.05	2.60	0.14	0.00**
	Post Tactile	2.64	0.02	0.04	0.92
Post Tactile	Pre Tactile	0.05	2.62	0.14	0.00**
	Computer Assisted	2.67	0.02	0.04	0.92



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

From the above table 4.29, it is evident that the significant difference is resulted between: Pre Tactile and Computer Assisted (2.60), Pre Tactile and Post Tactile (2.62), Computer Assisted and Post Tactile (0.02). These results indicate that the students have shown improvement in Plotting Points on Axes after the introduction of the Computer Assisted Cartesian Plane. The scores between Computer Assisted and Post Tactile were found to be at the same level.

Table 4.30 Summary of Repeated Measures ANOVA for Finding Points on Quadrants

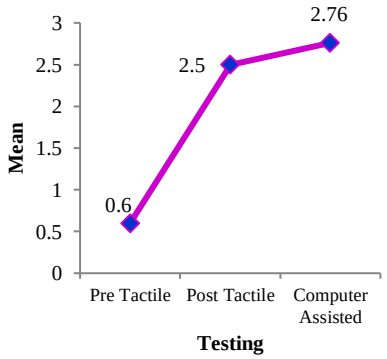
Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Finding Points on Quadrants	Sphericity Assumed	117.476	2	58.74	129.51	0.00**	0.760
	Greenhouse-Geisser	**117.476**	**1.27**	**92.55**	**129.51**	**0.00****	**0.760**
	Huynh-Feldt	117.476	1.29	90.96	129.51	0.00**	0.760
	Lower-bound	117.476	1.00	117.48	129.51	0.00**	0.760
Error	Sphericity Assumed	37.190	82	0.45			
	Greenhouse-Geisser	37.190	52.04	0.72			
	Huynh-Feldt	37.190	52.95	0.70			
	Lower-bound	37.190	41.00	0.91			

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

From the table 4.30, it is evident that the F value for Finding Points on Quadrants is (2, 1.27) = 129.51, p<0.01). This shows that the Mean of Finding Points on Axes in the Pre tactile, Computer Assisted, and Post Tactile test differs significantly. The effect size η2 =0.760 was found to be significant in making changes as the result of the intervention. In the context, the null hypothesis stated that ***"there is no significant difference within Pre Tactile, Computer Assisted, and Post Tactile test scores"*** is rejected. To investigate as to which pairs of Means differed significantly, Post Hoc was further employed. The results of the analysis are given in the following table.

Table 4.31 Sidak Post Hoc Test of Finding Points on Quadrants

Testing		Mean	MD	Std. Error	Sig.
Pre Tactile	Computer Assisted	2.76	2.17	0.16	0.00**
	Post Tactile	2.50	1.91	0.18	0.00**
Computer Assisted	Pre Tactile	0.60	2.17	0.16	0.00**
	Post Tactile	2.50	0.26	0.08	0.00**
Post Tactile	Pre Tactile	0.60	1.91	0.18	0.00**
	Computer Assisted	2.76	0.26	0.08	0.00**



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

From the above table 4.31, it is evident that the significant differences are resulted between: Pre Tactile and Computer Assisted (2.17), Pre Tactile and Post Tactile (1.91), Computer Assisted and Post Tactile (0.26). These results indicate that the students have shown improvement in Finding Points on Quadrants after the introduction of Computer Assisted Cartesian Plane.

Table 4.32 Summary of Repeated measures ANOVA for Finding Points on Axes

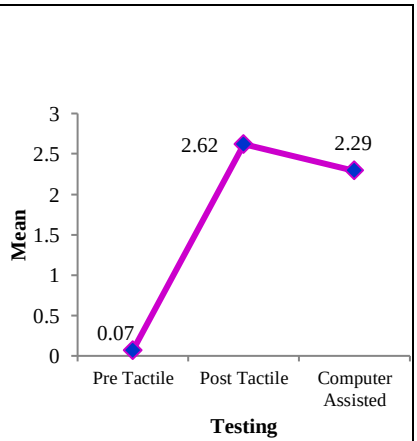
Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Finding Points on axes	Sphericity Assumed	161.06	2	80.53	172.55	0.00**	0.808
	Greenhouse-Geisser	**161.06**	**1.40**	**114.93**	**172.55**	**0.00****	**0.808**
	Huynh-Feldt	161.06	1.44	112.17	172.55	0.00**	0.808
	Lower-bound	161.06	1.00	161.06	172.55	0.00**	0.808
Error	Sphericity Assumed	38.27	82	0.47			
	Greenhouse-Geisser	38.27	57.46	0.67			
	Huynh-Feldt	38.27	58.87	0.65			
	Lower-bound	38.27	41.00	0.93			

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

From the table 4.32, it is evident that the F value for Finding Points on Axes is (2, 1.40) = 172.55, p<0.01). This shows that the Mean of Finding Points on Axes in the Pre Tactile, Computer Assisted, and Post Tactile test differs significantly. The effect size η2 =0.808 was found to be significant in making changes as the result of the intervention.In the context, the null hypothesis stated that ***"there is no significant difference within Pre Tactile, Computer Assisted, and Post Tactile test scores"*** is rejected. To investigate as to which pairs of Means differed significantly, Post Hoc was further employed. The results of the analysis are given in the following table.

Table 4.33 Sidak Post Hoc test of Finding Points on Axes

Testing		Mean	MD	Std. Error	Sig.
Pre Tactile	Computer Assisted	2.29	2.21	0.17	0.00**
	Post Tactile	2.62	2.55	0.17	0.00**
Computer Assisted	Pre Tactile	0.07	2.21	0.17	0.00**
	Post Tactile	2.62	0.33	0.09	0.00**
Post Tactile	Pre Tactile	0.07	2.55	0.17	0.00**
	Computer Assisted	2.29	0.33	0.09	0.00**



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

From the above table 4.33, it is evident that the significant differences are resulted between: Pre Tactile and Computer Assisted (2.21), Pre Tactile and Post Tactile (2.55), Computer Assisted and Post Tactile (0.33). These results indicate that the students have shown improvement in Finding Points on Axes after the introduction of the Computer Assisted Cartesian Plane.

Table 4.34 Summary of Repeated Measures ANOVA for Overall Performance

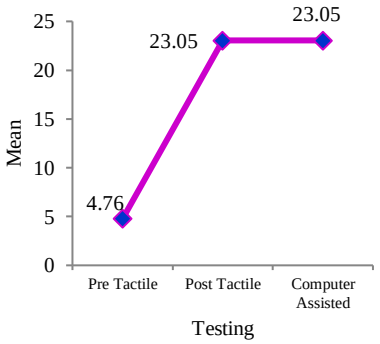
Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Finding points in the axes	Sphericity Assumed	9362.29	2	4681.14	3.75	0.00**	0.989
	Greenhouse-Geisser	**9362.29**	**1.35**	**6962.33**	**3.75**	**0.00****	**0.989**
	Huynh-Feldt	9362.29	1.37	6814.98	3.75	0.00**	0.989
	Lower-bound	9362.29	1.00	9362.29	3.75	0.00**	0.989
Error	Sphericity Assumed	102.38	82	1.25			
	Greenhouse-Geisser	102.38	55.13	1.86			
	Huynh-Feldt	102.38	56.33	1.82			
	Lower-bound	102.38	41.00	2.50			

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

From table 4.34 it is evident that the F value for overall performance is (2, 1.35) = 3.75, $p<0.01$). This shows that Mean of overall in the Pre tactile, Computer, and post tactile test differs significantly. The effect size $\eta 2 = 0.989$ was found to be significant in making changes as the result of the intervention. In the context the null hypothesis stated as that ***"there is no significant difference within Pre tactile, Computer Assisted and post Tactile test scores"*** is rejected. To investigate as to which pairs of Means differed significantly, Post - Hoc was further employed. The results of the analysis are given in the following table.

Table 4.35 Sidak Post Hoc test of Overall Performance

Testing		Mean	MD	Std. Error	Sig.
Pre Tactile	Computer Assisted	23.05	18.29	0.26	0.00**
	Post Tactile	23.05	18.29	0.30	0.00**
Computer Assisted	Pre Tactile	4.76	18.29	0.26	0.00**
	Post Tactile	23.05	0.00	0.14	1.00
Post Tactile	Pre Tactile	4.76	18.29	0.30	0.00**
	Computer Assisted	23.05	0.00	0.14	1.00



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

From the above table 4.35, it is evident that the significant difference is resulted between: Pre Tactile and Computer Assisted (18.29), Pre Tactile and Post Tactile (18.29), Computer Assisted and Post Tactile (0.00). These results indicate that the students have shown improvement in overall performance after the introduction of the Computer Assisted Cartesian Plane. The scores between Computer Assisted and post Tactile were found to be at the same level.

SECTION V

4.5 Influence of Gender/Grade and their resultant interaction on Graph Concepts by Analysis of Covariance (ANCOVA)

The following tables from 4.31 to 4.42 analyze the performance scores pertaining to the graph concepts namely concepts of Cartesian Plane, Plotting Points on Quadrants, Plotting Points on Axes, Finding Points on Quadrants and Finding Points on Axes in both Computer Assisted and Post Tactile Scores by considering pre tactile score as covariate.

Table 4.36 Summary of 2 × 2 Factorial Design ANCOVA for Computer Assisted Cartesian Plane by Considering Pre Tactile Score as Covariate

Source of Variance	df	$SS_{y.x}$	$MSS_{y.x}$	$F_{y.x}$
Gender	1	4.776	4.776	2.05 NS
Grade	1	5.885	5.885	2.53 NS
Gender * Grade	1	1.053	11.053	0.45 NS
Error	36	83.867	2.330	
Total	41	22114.000		

NS - Not Significant

From table 4.36, it is evident that the adjusted F -value for Gender is 2.05 which is not significant. It indicates that the overall mean scores of Computer Assisted of Boys and Girls do not differ significantly when Pre Tactile score was taken as covariate. In this context, the null hypothesis that ***"there is no significant influence of Gender on Computer Assisted Cartesian Plane by considering Pre Tactile score as covariate"*** is not rejected. It may therefore be concluded that both Boys and Girls were found to have Computer Assisted Score to the same extent.

The adjusted F -value for Grade is 2.53 which is not significant. It indicates that the Computer Assisted Cartesian Plane belonging to Grade IX & X and XI & XII do not differ significantly when Pre Tactile score was taken as covariate. In this context, the null hypothesis that ***"there is no significant influence of Grade on Computer Assisted Cartesian Plane by considering Pre Tactile score as covariate"*** is not rejected. It may therefore be concluded that students of all Grades have Computer Assisted Cartesian Plane score to the same extent.

The adjusted F value for interaction between Gender and Grade is 0.45 which is not significant. It indicates that there was no significant influence of resultant of interaction between Gender and Grade when Pre Tactile score was taken as covariate. In this context, the null hypothesis that ***"there is no significant influence of interaction between Gender and Grade on Computer Assisted Cartesian Plane by considering the Pre Tactile score as covariate"*** is not rejected. It may therefore be concluded that Computer Assisted Cartesian Plane score was found to be independent of the interaction between Gender and Grade when Pre Tactile score was taken as covariate.

Table 4.37 Summary of 2×2 Factorial Design ANCOVA for Post Tactile by Considering Pre Tactile Score as Covariate

Source of Variance	df	$SS_{y,x}$	$MSS_{y,x}$	$F_{y.x}$
Gender	1	25.661	25.661	9.84 NS
Grade	1	9.958	9.958	3.82 NS
Gender * Grade	1	.050	.050	0.02 NS
Error	36	93.862	2.607	
Total	41	22181.000		

NS - Not Significant

From table 4.37, it is evident that the adjusted F -value for Gender is 9.84 which is not significant. It indicates that the Post Tactile mean scores of Boys and Girls do not differ significantly when Pre Tactile score was taken as covariate. In this context, the null hypothesis that ***"there is no significant influence of Gender on Post Tactile score by considering Pre Tactile score as covariate"*** is not rejected. It may therefore be concluded that both Boys and Girls were found to have Post Tactile score to the same extent.

The adjusted F -value for Grade is 3.82 which is not significant. It indicates that the Post Tactile mean scores belonging to Grade IX & X and XI & XII do not differ significantly when Pre Tactile score was taken as covariate. In this context, the null hypothesis that ***"there is no significant influence of Grade on Post Tactile score by considering Pre Tactile score as covariate***" is not rejected. It may therefore be concluded that students of all Grades have Post Tactile score to the same extent.

The adjusted F value for interaction between Gender and Grade is 0.02 which is not significant. It indicates that there was no significant influence of resultant of interaction between Gender and Grade when Pre Tactile score was taken as covariate. In this context, the null hypothesis that ***"there is no significant influence of interaction between Gender and Grade on Post Tactile Score by considering the Pre Tactile score as covariate"*** is not rejected. It may therefore be concluded that Post Tactile Score was found to be independent of the interaction between Gender and Grade when Pre Tactile score was taken as covariate.

Table 4.38 Summary of 2×2 Factorial Design ANCOVA for Concepts of Cartesian Plane with respect to Computer Assisted Cartesian Plane by Considering Pre Tactile Score as Covariate

Source of Variance	df	SS y,x	MSSy,x	$F_{y.x}$
Gender	1	.026	.026	0.01**
Grade	1	30.613	30.613	6.50 NS
Gender * Grade	1	46.745	46.745	9.92 NS
Error	32	150.795	4.712	
Total	36	22466.000		

***- Significant at 0.01 Level* *NS - Not Significant*

From table 4.38, it is evident that the adjusted F -value for Gender is 0.01 which is significant at 0.01 level. It indicates that the mean scores of Concepts of Cartesian plane using Computer Assisted Cartesian Plane for Boys and Girls differ significantly. It reflects that there is a significant influence of Grade on Concepts of Cartesian Plane in Computer Assisted Cartesian plane when Pre Tactile score was taken as covariate. In this context, the null hypothesis that ***"there is no significant influence of Gender on Concepts of Cartesian Plane with respect to Computer Assisted Cartesian Plane by considering Pre Tactile score as covariate"*** is rejected. It may therefore be concluded that both Boys and Girls were found to possess significantly higher in Concepts of Cartesian Plane in Computer Assisted Cartesian Plane when Pre Tactile Score was taken as covariate.

The adjusted F -value for Grade is 6.50 which are not significant. It indicates that the mean scores for Concepts of Cartesian Plane in Computer Assisted Cartesian Plane belonging to Grade IX & X and XI & XII do not differ significantly when Pre Tactile score was taken as covariate. In this context, the null hypothesis that ***"there is no significant influence of Grade on concept of Cartesian Plane with respect to Computer Assisted Cartesian Plane by considering Pre Tactile score as covariate"*** is not rejected. It may therefore be concluded that students of all Grades have Concept of Cartesian Plane with respect to Computer Assisted Cartesian Plane to the same extent.

The adjusted F value for interaction between Gender and Grade is 9.92 which is not significant. It indicates that there was no significant influence of resultant of interaction between Gender and Grade when Pre Tactile score was taken as covariate.

In this context, the null hypothesis that ***"there is no significant influence of interaction between Gender and Grade on Concepts of Cartesian Planes with respect to Computer Assisted Cartesian Plane by considering the Pre Tactile score as covariate"*** is not rejected. It may therefore be concluded that Concepts of Cartesian Plane in Computer Assisted Cartesian Plane was found to be independent of the interaction between Gender and Grade when Pre Tactile score was taken as covariate.

Table 4.39 Summary of 2 × 2 Factorial Design ANCOVA for Concepts of Cartesian Plane in Post Tactile by Considering Pre Tactile Score as Covariate

Source of Variance	df	SS y,x	MSSy,x	$F_{y.x}$
Gender	1	.345	.345	0.17 NS
Grade	1	1.337	1.337	0.64 NS
Gender * Grade	1	5.107	5.107	2.45 NS
Error	37	77.273	2.088	
Total	42	6565.000		

NS - Not Significant

From table 4.39, it is evident that the adjusted F -value for Gender is 0.17 which are not significant. It indicates that the mean scores of Concepts of Cartesian Plane in Post Tactile of Boys and Girls do not differ significantly when Pre Tactile score was taken as covariate. In this context, the null hypothesis that ***"there is no significant influence of Gender on Concepts of Cartesian Plane with respect to Post Tactile score by considering Pre Tactile score as covariate"*** is not rejected. It may therefore be concluded that both Boys and Girls were found to have Concepts of Cartesian Plane in Post Tactile to the same extent.

The adjusted F -value for Grade is 0.64 which is not significant. It indicates that the mean scores of Concepts of Cartesian Plane in Post Tactile belonging to Grade IX & X and XI & XII do not differ significantly when Pre Tactile score was taken as covariate. In this context, the null hypothesis that ***"there is no significant influence of Grade on Concepts of Cartesian Plane with respect to Post Tactile by considering Pre Tactile score as covariate"*** is not rejected. It may therefore be concluded that students of all Grades have Concepts of Cartesian Plane in Post Tactile Score to the same extent.

The adjusted F value for interaction between Gender and Grade is 2.45 which is not significant. It indicates that there was no significant influence of resultant of interaction between Gender and Grade when Pre Tactile score was taken as covariate. In this context, the null hypothesis that ***"there is no significant influence of interaction between Gender and Grade on Concepts of Cartesian Plane in Post tactile score by considering the Pre Tactile score as covariate"*** is not rejected. It may therefore be concluded that Concepts of Cartesian Plane in Post Tactile score was found to be independent of the interaction between Gender and Grade when Pre score was taken as covariate.

Table 4.40 Summary of 2×2 Factorial Design ANCOVA for Plotting Points on Quadrants with respect to Computer Assisted Cartesian Plane by Considering Pre Tactile Score as Covariate

Source of Variance	df	$SS_{y,x}$	$MSS_{y,x}$	$F_{y.x}$
Gender	1	.604	.604	1.06 NS
Grade	1	.888	.888	1.56 NS
Gender * Grade	1	1.611	1.611	2.83 NS
Error	37	21.063	.569	
Total	42	421.000		

NS - Not Significant

From table 4.40, it is evident that the adjusted F -value for Gender is 1.06 which is not significant. It indicates that the mean scores of Plotting Points on Quadrants in Computer Assisted Cartesian Plane of Boys and Girls do not differ significantly when Pre Tactile score was taken as covariate. In this context, the null hypothesis that ***"there is no significant influence of Gender on plotting points on quadrants in Computer Assisted Cartesian Plane by considering Pre Tactile score as covariate"*** is not rejected. It may therefore be concluded that both Boys and Girls were found to have Plotting Points on Quadrants in Computer Assisted Cartesian Plane to the same extent.

The adjusted F -value for Grade is 1.56 which is not significant. It indicates that the mean scores of Plotting Points on Quadrants with respect to Computer Assisted Cartesian Plane belonging to Grade IX & X and XI & XII do not differ significantly when Pre Tactile score was taken as covariate. In this context, the null hypothesis that ***"there is no significant influence of Grade on Plotting Points on Quadrants with***

respect to Computer Assisted Cartesian Plane by considering Pre Tactile score as covariate" is not rejected. It may therefore be concluded that students of all Grades have Plotting Points on Quadrants in Computer Assisted Cartesian Plane to the same extent.

The adjusted F value for interaction between Gender and Grade is 2.83 which is not significant. It indicates that there was no significant influence of resultant of interaction between Gender and Grade when Pre Tactile score was taken as covariate. In this context, the null hypothesis that ***"there is no significant influence of interaction between Gender and Grade on Plotting Points on Quadrants in Computer Assisted Cartesian Plane by considering the Pre Tactile score as covariate"*** is not rejected. It may therefore be concluded that plotting points on quadrants in Computer Assisted score was found to be independent of the interaction between Gender and Grade when Pre score was taken as covariate.

Table 4.41 Summary of 2×2 Factorial Design ANCOVA for Plotting Points on Quadrants with respect to Post Tactile by Considering Pre Tactile Score as Covariate

Source of Variance	df	$SS_{y,x}$	$MSS_{y,x}$	$F_{y.x}$
Gender	1	.353	.353	0.35 NS
Grade	1	.550	.550	0.55 NS
Gender * Grade	1	1.756	1.756	1.77 NS
Error	37	36.800	.995	
Total	42	384.000		

NS - Not Significant

From table 4.41, it is evident that the adjusted F -value for Gender is 0.35 which are not significant. It indicates that the mean scores of Plotting Points on Quadrants with respect to Post Tactile of Boys and Girls do not differ significantly when Pre score was taken as covariate. In this context, the null hypothesis that ***"there is no significant influence of Gender on Plotting Points on Quadrants with respect to Post Tactile by considering Pre Tactile score as covariate"*** is not rejected. It may therefore be concluded that both Boys and Girls were found to have Plotting Points on Quadrants in Post Tactile score to the same extent.

The adjusted F -value for Grade is 0.55 which is not significant. It indicates that the mean scores of Plotting Points on Quadrants with respect to Post Tactile score belonging to Grade IX & X and XI & XII do not differ significantly when Pre Tactile score was taken as covariate. In this context, the null hypothesis that ***"there is no significant influence of Grade on Plotting Points on Quadrants with respect to Post Tactile score by considering Pre score as covariate"*** is not rejected. It may therefore be concluded that students of all Grades have Plotting Points on Quadrants in Post Tactile score to the same extent.

The adjusted F value for interaction between Gender and Grade is 1.77 which is not significant. It indicates that there was no significant influence of resultant of interaction between Gender and Grade when Pre Tactile score was taken as covariate. In this context, the null hypothesis that ***"there is no significant influence of interaction between Gender and Grade on Plotting Points on Quadrants with respect to Post Tactile score by considering the Pre Tactile score as covariate"*** is not rejected. It may therefore be concluded that Plotting Points on Quadrants in Post Tactile score was found to be independent of the interaction between Gender and Grade when Pre Tactile score was taken as covariate.

Table 4.42 Summary of 2×2 Factorial Design ANCOVA for Plotting Points on Axes with respect to Computer Assisted by Considering Pre Tactile Score as Covariate

Source of Variance	df	$SS_{y,x}$	$MSS_{y,x}$	$F_{y.x}$
Gender	1	.098	.098	0.13 NS
Grade	1	1.197	1.197	1.55 NS
Gender * Grade	1	1.563	1.563	2.02 NS
Error	37	28.600	.773	

NS - Not Significant

From table 4.42, it is evident that the adjusted F -value for Gender is 0.13 which are not significant. It indicates that the mean scores of Plotting Points on Axes with respect to Computer Assisted Cartesian Plane of Boys and Girls do not differ significantly when Pre Tactile score was taken as covariate. In this context, the null hypothesis that ***"there is no significant influence of Gender on Plotting Points on Axes in Computer Assisted Cartesian Plane by considering Pre Tactile score as***

covariate" is not rejected. It may therefore be concluded that both Boys and Girls were found to have Plotting Points on Axes in Computer Assisted Cartesian Plane to the same extent.

The adjusted F -value for Grade is 1.55 which is not significant. It indicates that the mean scores of Plotting Points on Axes in Computer Assisted Cartesian Plane belonging to Grade IX & X and XI & XII do not differ significantly when Pre Tactile score was taken as covariate. In this context, the null hypothesis that ***"there is no significant influence of Grade on Plotting Points on Axes with respect to Computer Assisted Cartesian Plane by considering Pre Tactile score as covariate"*** is not rejected. It may therefore be concluded that students of all Grades have Plotting Points on Axes in Computer Assisted Cartesian Plane to the same extent.

The adjusted F value for interaction between Gender and Grade is 2.02 which are not significant. It indicates that there was no significant influence of resultant of interaction between Gender and Grade when Pre Tactile score was taken as covariate. In this context, the null hypothesis that ***"there is no significant influence of interaction between Gender and Grade on Plotting Points on Axes with respect to Computer Assisted Cartesian Plane by considering the Pre Tactile score as covariate"*** is not rejected. It may therefore be concluded that Plotting Points on Axes in Computer Assisted Cartesian Plane was found to be independent of the interaction between Gender and Grade when Pre Tactile score was taken as covariate.

Table 4.43 Summary of 2×2 Factorial Design ANCOVA for Plotting Points on Axes in Post Tactile by Considering Pre Tactile Score as Covariate

Source of Variance	df	SS y,x	MSSy,x	$F_{y.x}$
Gender	1	.196	.196	0.26 NS
Grade	1	.929	.929	1.23 NS
Gender * Grade	1	1.905	1.905	2.52 NS
Error	37	28.017	.757	

NS - Not Significant

From table 4.43, it is evident that the adjusted F -value for Gender is 0.26 which is not significant. It indicates that the mean scores of Plotting Points on Axes with respect to Post Tactile scores of Boys and Girls do not differ significantly when Pre

Tactile score was taken as covariate. In this context, the null hypothesis that ***"there is no significant influence of Gender on Plotting Points on Axes with respect to Post Tactile score by considering Pre Tactile score as covariate"*** is not rejected. It may therefore be concluded that both Boys and Girls were found to have Plotting Points on Axes in Post Tactile score to the same extent.

The adjusted F -value for Grade is 1.23 which is not significant. It indicates that the mean scores of Plotting Points on Axes in Post Tactile belonging to Grade IX & X and XI & XII do not differ significantly when Pre Tactile score was taken as covariate. In this context, the null hypothesis that ***"there is no significant influence of Grade on Plotting Points on Axes with respect to Post Tactile score by considering Pre Tactile score as covariate"*** is not rejected. It may therefore be concluded that students of all Grades have Plotting Points on Axes in Post Tactile score to the same extent.

The adjusted F value for interaction between Gender and Grade is 2.52 which is not significant. It indicates that there was no significant influence of resultant of interaction between Gender and Grade when Pre Tactile score was taken as covariate. In this context, the null hypothesis that ***"there is no significant influence of interaction between Gender and Grade on Plotting Points on Axes with respect to Post Tactile score by considering the Pre Tactile score as covariate"*** is not rejected. It may therefore be concluded that Plotting Points on Axes in Post Tactile score was found to be independent of the interaction between Gender and Grade when Pre score was taken as covariate.

Table 4.44 Summary of 2×2 Factorial Design ANCOVA for Finding Points on Quadrants in Computer Assisted Cartesian Plane by Considering Pre Tactile Score as Covariate

Source of Variance	df	SS y,x	MSSy,x	$F_{y.x}$
Gender	1	.136	.136	0.18 NS
Grade	1	1.474	1.474	1.93 NS
Gender * Grade	1	1.481	1.481	1.94 NS
Error	37	28.199	.762	
Total	42	354.000		

NS - Not Significant

From table 4.44, it is evident that the adjusted F -value for Gender is 0.18 which is not significant. It indicates that the mean scores of Finding Points on Quadrants with respect to Computer Assisted Cartesian Plane of Boys and Girls do not differ significantly when Pre Tactile score was taken as covariate. In this context, the null hypothesis that ***"there is no significant influence of Gender on Finding Points on Quadrants with respect to Computer Assisted Cartesian Plane by considering Pre score as covariate"*** is not rejected. It may therefore be concluded that both Boys and Girls were found to have Finding Points on Quadrants in Computer Assisted Cartesian Plane to the same extent.

The adjusted F - value for Grade is 1.93 which is not significant. It indicates that the mean scores of Finding Points on Quadrants with respect to Computer Assisted Cartesian Plane belonging to Grade IX & X and XI & XII do not differ significantly when Pre Tactile score was taken as covariate. In this context, the null hypothesis that ***"there is no significant influence of Grade on Finding Points on Quadrants with Computer Assisted Cartesian Plane by considering Pre Tactile score as covariate"*** is not rejected. It may therefore be concluded that students of all Grades have Finding Points on Quadrants in Computer Assisted Cartesian Plane to the same extent.

The adjusted F value for interaction between Gender and Grade is 1.94 which is not significant. It indicates that there was no significant influence of resultant of interaction between Gender and Grade when Pre Tactile score was taken as covariate. In this context, the null hypothesis that ***"there is no significant influence of interaction between Gender and Grade on Finding Points on Quadrants with respect to Computer Assisted Cartesian Plane by considering the Pre Tactile score as covariate"*** is not rejected. It may therefore be concluded that Finding Points on Quadrants in Computer Assisted Cartesian Plane was found to be independent of the interaction between Gender and Grade when Pre Tactile score was taken as covariate.

Table 4.45 Summary of 2×2 Factorial Design ANCOVA for Finding Points on Quadrants with respect to Post Tactile by Considering Pre Tactile Score as Covariate

Source of Variance	df	SS y,x	MSSy,x	$F_{y.x}$
Gender	1	.752	.752	0.70 NS
Grade	1	1.316	1.316	1.23 NS
Gender * Grade	1	1.394	1.394	1.30 NS
Error	37	39.581	1.070	
Total	42	307.000		

NS - Not Significant

From table 4.45, it is evident that the adjusted F -value for Gender is 0.70 which are not significant. It indicates that the mean scores of Finding Points on Quadrants with respect to Post Tactile of Boys and Girls do not differ significantly when Pre Tactile score was taken as covariate. In this context, the null hypothesis that ***"there is no significant influence of Gender on Finding Points on Quadrants with respect to Post Tactile score by considering Pre Tactile score as covariate"*** is not rejected. It may therefore be concluded that both Boys and Girls were found to have Finding Points on Quadrants in Post Tactile score to the same extent.

The adjusted F -value for Grade is 1.23 which is not significant. It indicates that the mean scores of Finding Points on Quadrants with respect to Post Tactile belonging to Grade IX & X and XI & XII do not differ significantly when Pre Tactile score was taken as covariate. In this context, the null hypothesis that ***"there is no significant influence of Grade on Finding Points on Quadrants with respect to Post Tactile score by considering Pre Tactile score as covariate"*** is not rejected. It may therefore be concluded that students of all Grades have Finding Points on Quadrants in Post Tactile score to the same extent.

The adjusted F value for interaction between Gender and Grade is 1.30 which is not significant. It indicates that there was no significant influence of resultant of interaction between Gender and Grade when Pre Tactile score was taken as covariate. In this context, the null hypothesis that ***"there is no significant influence of interaction between Gender and Grade on Finding Points on Quadrants with respect to Post Tactile score by considering the Pre Tactile score as covariate"*** is not rejected.

It may therefore be concluded that Finding Points on Quadrants in Post Tactile score was found to be independent of the interaction between Gender and Grade when Pre Tactile score was taken as covariate.

Table 4.46 Summary of 2×2 Factorial Design ANCOVA for Finding Points on Axes with respect to Computer Assisted Cartesian Plane by Considering Pre Tactile Score as Covariate

Source of Variance	df	SS y,x	MSS y,x	$F_{y.x}$
Gender	1	.103	.103	0.09 NS
Grade	1	.528	.528	0.44 NS
Gender * Grade	1	3.640	3.640	3.02 NS
Error	37	44.558	1.204	
Total	42	270.000		

NS - Not Significant

From table 4.46, it is evident that the adjusted F -value for Gender is 0.09which are not significant. It indicates that the mean scores of Finding Points on Axes in Computer Assisted Cartesian Plane of Boys and Girls do not differ significantly when Pre Tactile score was taken as covariate. In this context, the null hypothesis that ***"there is no significant influence of Gender on Finding Points on Axes in Computer Assisted Cartesian Plane by considering Pre Tactile score as covariate"*** is not rejected. It may therefore be concluded that both Boys and Girls were found to have Finding Points on Axes in Computer Assisted Cartesian Plane to the same extent.

The adjusted F -value for Grade is 0.44 which is not significant. It indicates that the mean scores of Finding Points on Axes in Computer Assisted Cartesian Plane belonging to Grade IX & X and XI & XII do not differ significantly when Pre Tactile score was taken as covariate. In this context, the null hypothesis that ***"there is no significant influence of Grade on Finding Points on Axes with respect to Computer Assisted Cartesian Plane by considering Pre Tactile score as covariate"*** is not rejected. It may therefore be concluded that students of all Grades have Finding Points on Axes in Computer Assisted Cartesian Plane to the same extent.

The adjusted F value for interaction between Gender and Grade is 3.02 which are not significant. It indicates that there was no significant influence of resultant of

interaction between Gender and Grade when Pre Tactile score was taken as covariate. In this context, the null hypothesis that ***"there is no significant influence of interaction between Gender and Grade on Finding Points on Axes in Computer Assisted Cartesian Plane by considering the Pre Tactile score as covariate"*** is not rejected. It may therefore be concluded that Finding Points on Axes in Computer Assisted Cartesian Plane was found to be independent of the interaction between Gender and Grade when Pre Tactile score was taken as covariate.

Table 4.47 Summary of 2×2 Factorial Design ANCOVA for Finding Points on Axes with respect to Post Tactile by Considering Pre Tactile Score as Covariate

Source of Variance	df	SS y,x	MSSy,x	$F_{y.x}$
Gender	1	1.618	1.618	1.48 NS
Grade	1	.211	.211	0.19 NS
Gender * Grade	1	7.274	7.274	6.63 NS
Error	37	40.572	1.097	
Total	42	340.000		

NS - Not Significant

From table 4.47, it is evident that the adjusted F -value for Gender is 1.48 which is not significant. It indicates that the mean scores of Finding Points on Axes with respect to Post Tactile of Boys and Girls do not differ significantly when Pre Tactile score was taken as covariate. In this context, the null hypothesis that ***"there is no significant influence of Gender on Finding Points on Axes with respect to Post Tactile score by considering Pre Tactile score as covariate"*** is not rejected. It may therefore be concluded that both Boys and Girls were found to have Finding Points on Axes in Post Tactile score to the same extent.

The adjusted F - value for Grade is 0.19 which is not significant. It indicates that the mean scores of Finding Points on Axes with respect to Post Tactile belonging to Grade IX & X and XI & XII do not differ significantly when Pre Tactile score was taken as covariate. In this context, the null hypothesis that ***"there is no significant influence of Grade on Finding Points on Axes with respect to Post Tactile score by considering Pre Tactile score as covariate"*** is not rejected. It may therefore be

concluded that students of all Grades have Finding Points on Axes in Post Tactile score to the same extent.

The adjusted F value for interaction between Gender and Grade is 6.63 which are not significant. It indicates that there was no significant influence of resultant of interaction between Gender and Grade when Pre Tactile score was taken as covariate. In this context, the null hypothesis that ***"there is no significant influence of interaction between Gender and Grade on Finding Points on Axes with respect to Post Tactile score by considering the Pre Tactile score as covariate"*** is not rejected. It may therefore be concluded that Finding Points on Axes in Post Tactile score was found to be independent of the interaction between Gender and Grade when Pre Tactile score was taken as covariate.