

CHAPTER V
ANALYSIS AND
INTERPRETATION OF DATA

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CHAPTER V

ANALYSIS AND INTERPRETATION OF DATA

INTRODUCTION

Statistical methods render two invaluable services. The first is that of enabling us to organize, classify and summarize data so that they can be more rapidly comprehended and interpreted. The second service is that of enabling us to draw conclusions, to a stable degree of exactness about the probable nature of objects and events upon less completed evidence.

- Soundararaja Rao and Kanala (1976)

Analysis of data means studying the organized material in order to discover inherent facts. The data are studied from as many angles as possible to explore the new facts. In the present study only the two stages namely, demonstration stage and extension stage involve collection of data for analysis. A detailed analyses and interpretation of the collected data for these two stages are presented in this chapter.

DEMONSTRATION STAGE

The design of this stage is pretest, posttest, parallel, equated group – quasi-experimental design.

EQUATING GROUPS

For assigning the students as experimental and control groups, the marks of the terminal examination conducted just before the study, were taken into consideration. The total of 66 students were divided into two groups A and B consisting of 33 students in each group according to the scores of the terminal examination. The scores of the students of group A and B are given

in Appendix (8A). The mean, standard deviation and the t - statistic of these groups are presented in Table 5.1.

TABLE-5.1. t- TEST OF SIGNIFICANCE BETWEEN THE GROUPS A AND B WITH REGARD TO THE ACHIEVEMENT IN SCIENCE AS MEASURED BY THE TERMINAL EXAMINATION.

Group	N	Mean	S.D	t - Statistic
A	33	46.97	14.11	0.197 NS
B	33	47.15	14.13	

NS – Not significant

The above table reveals that there is no significant difference between the groups A and B with regard to their achievement in science in the terminal examination. Hence, it is concluded that the groups A and B could be considered as parallel-equated groups.

COMPARISON OF PERFORMANCE OF EXPERIMENTAL AND CONTROL GROUPS:

a. Comparison of Performance of Experimental and Control Groups in Pretest.

HYPOTHESIS - 1

The students of the control and experimental groups are identical in terms of their primary process skills, integrated process skills and scientific communication skills as measured by the pretest at the demonstration stage.

To test the above hypothesis the mean, standard deviation and the t - statistics of the experimental and control groups with regard to the pretest are calculated. The results are given in the Table 5.2.

TABLE 5.2. t-TEST OF SIGNIFICANCE BETWEEN THE EXPERIMENTAL AND CONTROL GROUPS WITH REGARD TO THE ATTAINMENT OF PRACTICAL SKILLS IN SCIENCE AS MEASURED BY THE PRETEST AT THE DEMONSTRATION STAGE.

Skills	Group	N	Mean	SD	t-Statistics
Primary Process Skills	Expt	33	3.27	1.07	1.08 NS
	Control	33	3.58	1.03	
Integrated Process Skills	Expt	33	3.18	0.95	0.68 NS
	Control	33	3.06	0.86	
Scientific Communication Skills	Expt	33	3.03	0.63	1.04 NS
	Control	33	2.82	0.85	

NS – Not Significant

It is evident from the above table that there is no significant difference between the experimental and control groups with regard to the attainment of primary process skills, integrated process skills and scientific communication skills. Hence, the null hypothesis is accepted. It is concluded that the experimental and control groups are identical in terms of the attainment of the practical skills before the treatment.

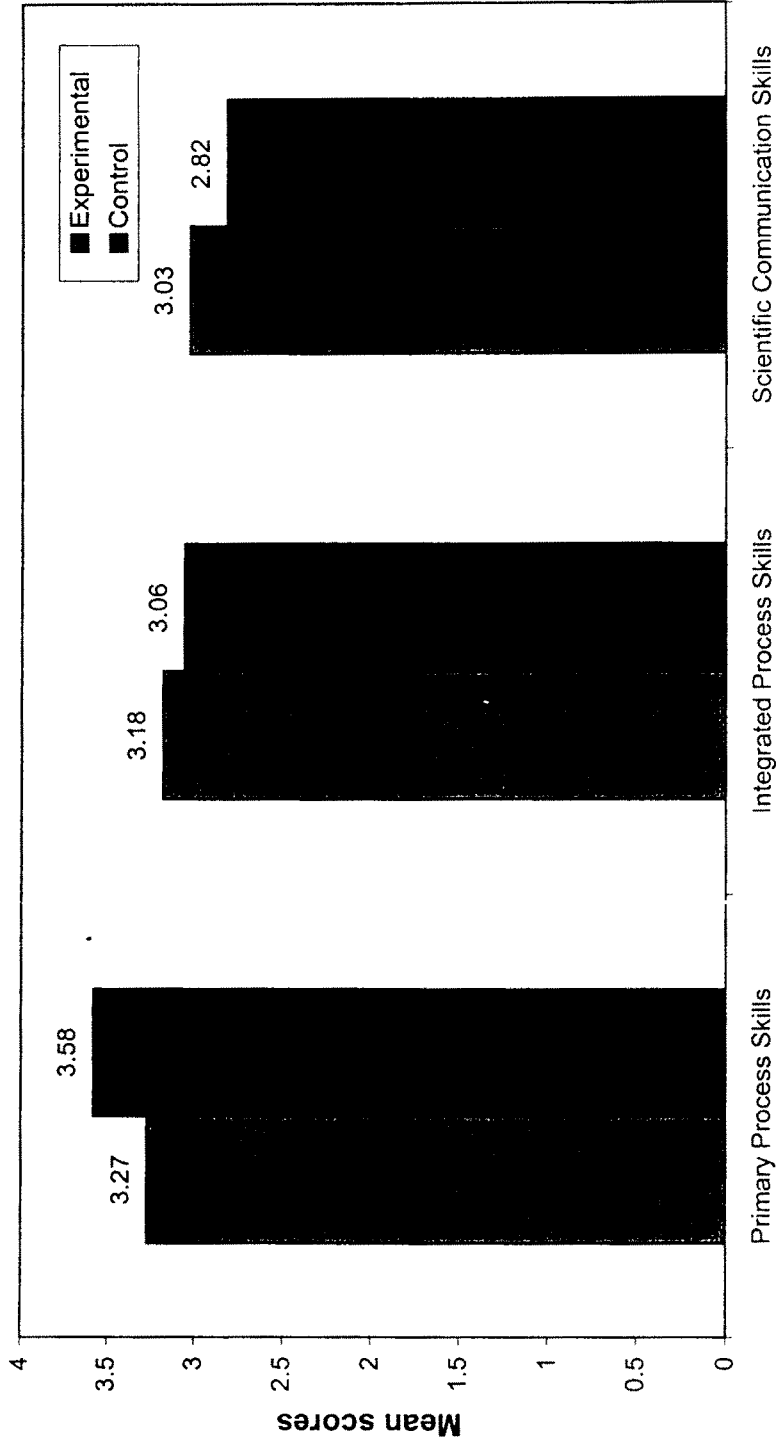
The graphical representation of the experimental and control groups with regard to the attainment of practical skills as measured by the pretest is presented in **graph 1**.

b. Comparison of Performance of Experimental and Control Groups in Posttest:

HYPOTHESIS - 2

The students of the control and experimental groups do not differ from each other in terms of their primary process skills, integrated process skills

GRAPH - 1. DEMONSTRATION STAGE - PRETEST



and scientific communication skills as measured by the posttest at the demonstration stage.

To test the above hypothesis the mean, standard deviation and the t-statistics of the experimental and control group with regard to the posttest are calculated. The results are given in the **Table 5.3**.

TABLE 5.3. t-TEST OF SIGNIFICANCE BETWEEN THE EXPERIMENTAL AND CONTROL GROUPS WITH REGARD TO THE ATTAINMENT OF PRACTICAL SKILLS IN SCIENCE AS MEASURED BY THE POSTTEST AT THE DEMONSTRATION STAGE.

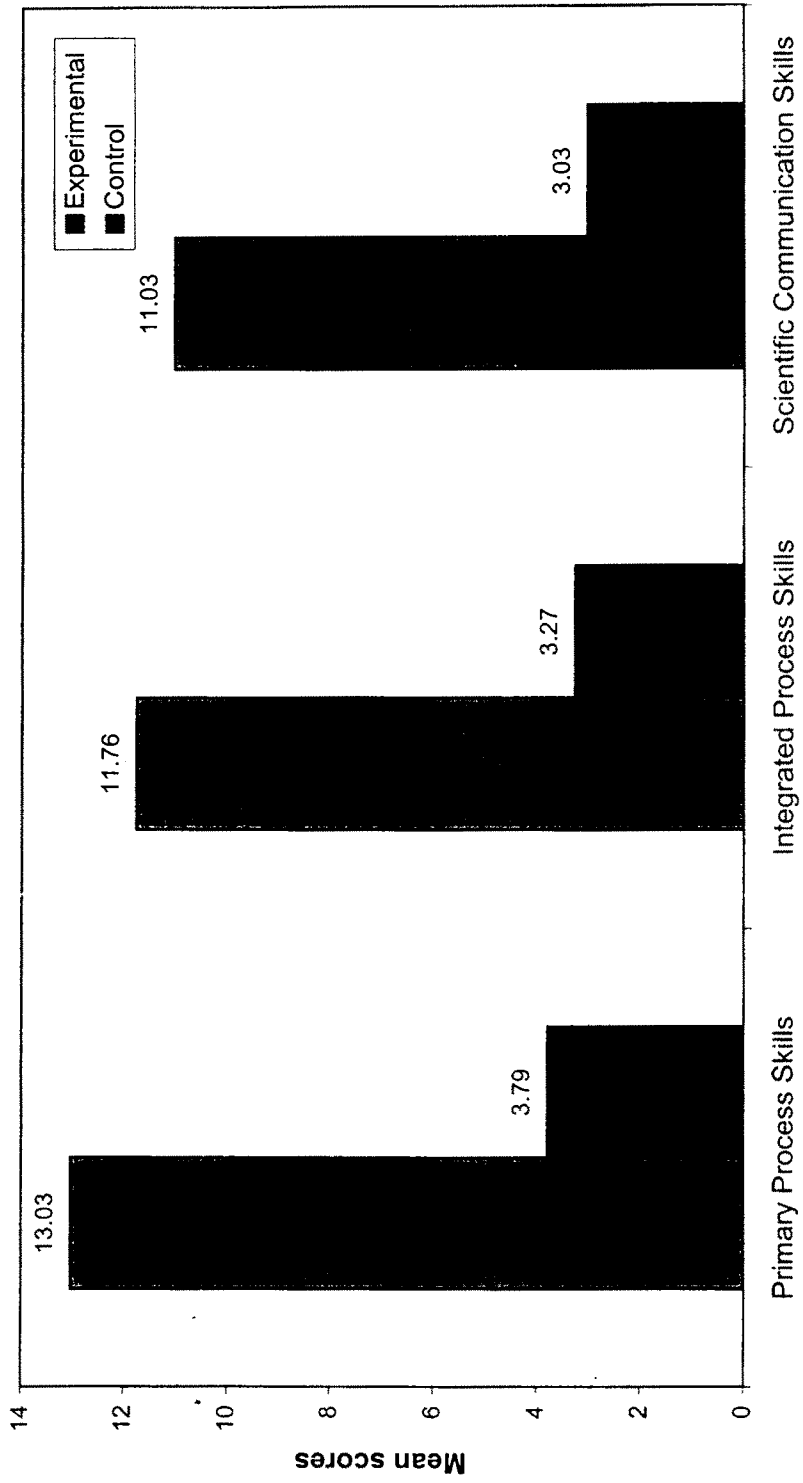
Skills	Group	N	Mean	SD	t -Statistics
Primary Process Skills	Expt	33	13.85	2.17	23.60**
	Control	33	3.79	0.99	
Integrated Process Skills	Expt	33	12.94	2.47	23.07**
	Control	33	3.27	0.98	
Scientific Communication Skills	Expt	33	12.52	2.64	22.23**
	Control	33	3.03	0.85	

** - Significant at 0.01 level

The above table indicates that there is significant difference between the experimental and control groups. Hence, the null hypothesis is rejected and the alternative hypothesis is accepted. The vast difference in the mean scores between the experimental and control groups shows the effectiveness of learning packages in developing the primary process skills, integrated process skills and scientific communication skills among the upper primary students.

The graphical representation of the experimental and control groups with regard to the attainment of practical skills as measured by the posttest is presented in **graph 2**.

GRAPH - 2. DEMONSTRATION STAGE - POSTTEST



c. Comparison of Performance of Pre and Posttests of Control Group:

HYPOTHESIS - 3

There is no significant difference between the pre and posttest scores of the students of the *control group* in terms of their primary process skills, integrated process skills and scientific communication skills at the demonstration stage.

To test the above hypothesis, the mean, standard deviation and t-statistics of the mean scores of performance of control group between pre and posttest are calculated and given in **table 5.4**.

TABLE 5.4. t-TEST OF SIGNIFICANCE BETWEEN THE PRE AND POSTTEST SCORES OF CONTROL GROUP WITH REGARD TO THE ATTAINMENT OF PRACTICAL SKILLS IN SCIENCE AT THE DEMONSTRATION STAGE.

Skills	Group	N	Mean	SD	t-Statistics
Primary Process Skills	Posttest	33	3.79	0.99	1.49 NS
	Pretest	33	3.58	1.03	
Integrated Process Skills	Posttest	33	3.27	0.98	1.56 NS
	Pretest	33	3.06	0.85	
Scientific Communication Skills	Posttest	33	3.03	0.85	1.56 NS
	Pretest	33	2.82	0.85	

NS - Not significant

From the above table it is evident that there is no significant difference between the pretest and posttest mean scores. So, null hypothesis is accepted. It is concluded that the performance of the control group in the posttest is not significant.

The graphical representation of the pre and posttest mean scores of control group with regard to the attainment of practical skills is presented in graph 3.

d. Comparison of Performance of Pre and Posttests of Experimental Group:

HYPOTHESIS - 4

There is no significant difference between the pre and posttest scores of the students of the *experimental group* in terms of their primary process skills, integrated process skills and scientific communication skills at the demonstration stage.

To test the above hypothesis the mean, standard deviation and t – statistic of performance of the experimental group between the pre and posttests are calculated. The results are given in Table 5.5

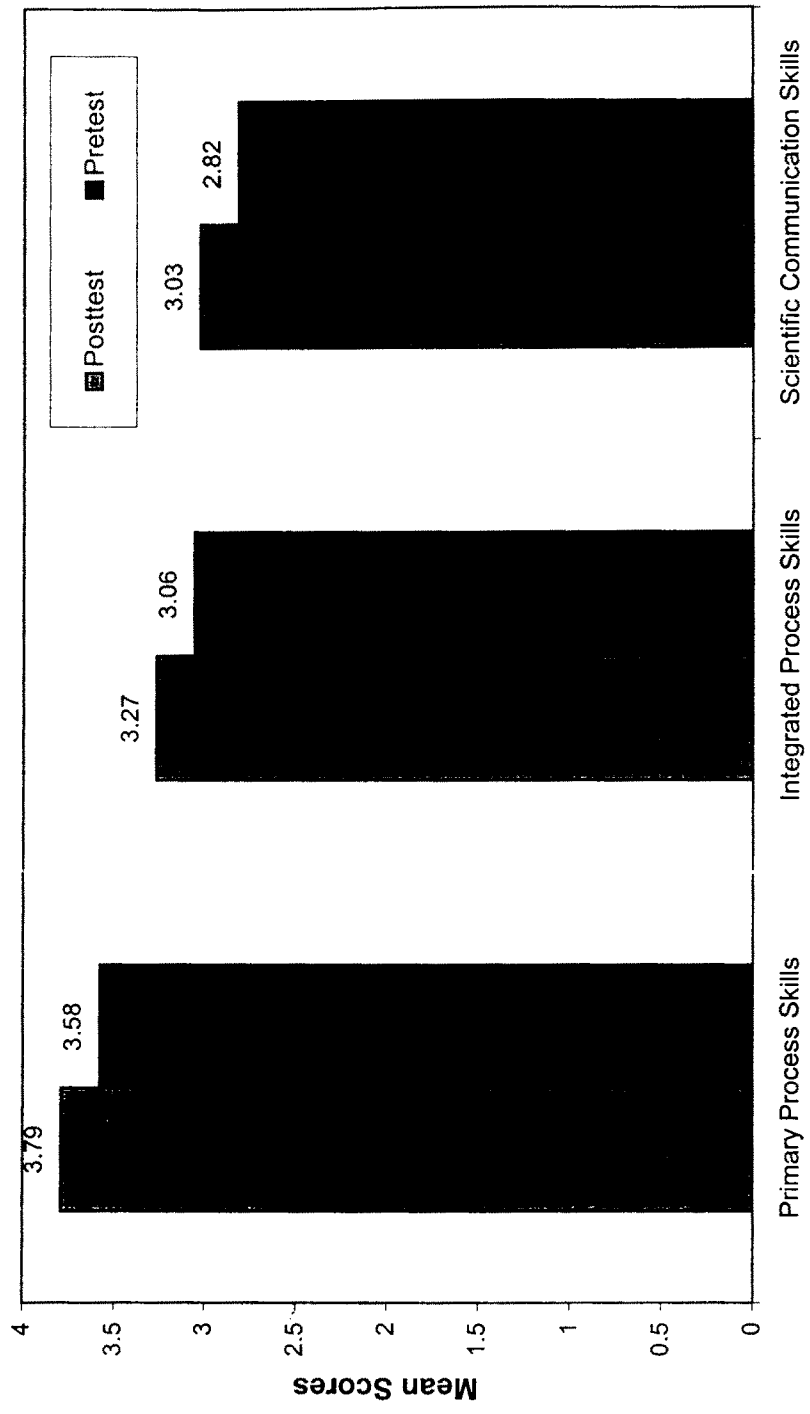
TABLE 5.5. t-TEST OF SIGNIFICANCE BETWEEN THE PRE AND POSTTESTS OF EXPERIMENTAL GROUP WITH REGARD TO THE ATTAINMENT OF PRACTICAL SKILLS IN SCIENCE AT THE DEMONSTRATION STAGE.

Skills	Group	N	Mean	SD	t-Statistic
Primary Process Skills	Posttest	33	13.85	2.17	40.49**
	Pretest	33	3.27	1.07	
Integrated Process Skills	Posttest	33	12.94	2.47	28.94**
	Pretest	33	3.18	0.95	
Scientific Communication Skills	Posttest	33	12.52	2.64	24.35**
	Pretest	33	3.03	0.63	

** - Significant at 0.01 level

The above table shows that there is significant difference between the mean scores of performance of pre and posttests of the experimental group. So, null hypothesis is rejected and alternative hypothesis is accepted. Further it is noted that there is a vast difference between the two means. Hence, it is

GRAPH - 3. DEMONSTRATION STAGE - CONTROL GROUP



concluded that the learning packages have made a good impact in attaining the primary process skills, integrated process skills and scientific communication skills. This establishes the criterion validity of the test.

The graphical representation of the pre and posttest mean scores of experimental group with regard to the attainment of practical skills is presented in **graph 4**.

HYPOTHESIS - 5

There is no significant difference in the mean scores of performance of control group among the three divisions of the skills at the demonstration stage.

To test the above hypothesis, analysis of variance was calculated among the three divisions of skills with regard to the performance of the posttest. The results are given in the **table 5.6**.

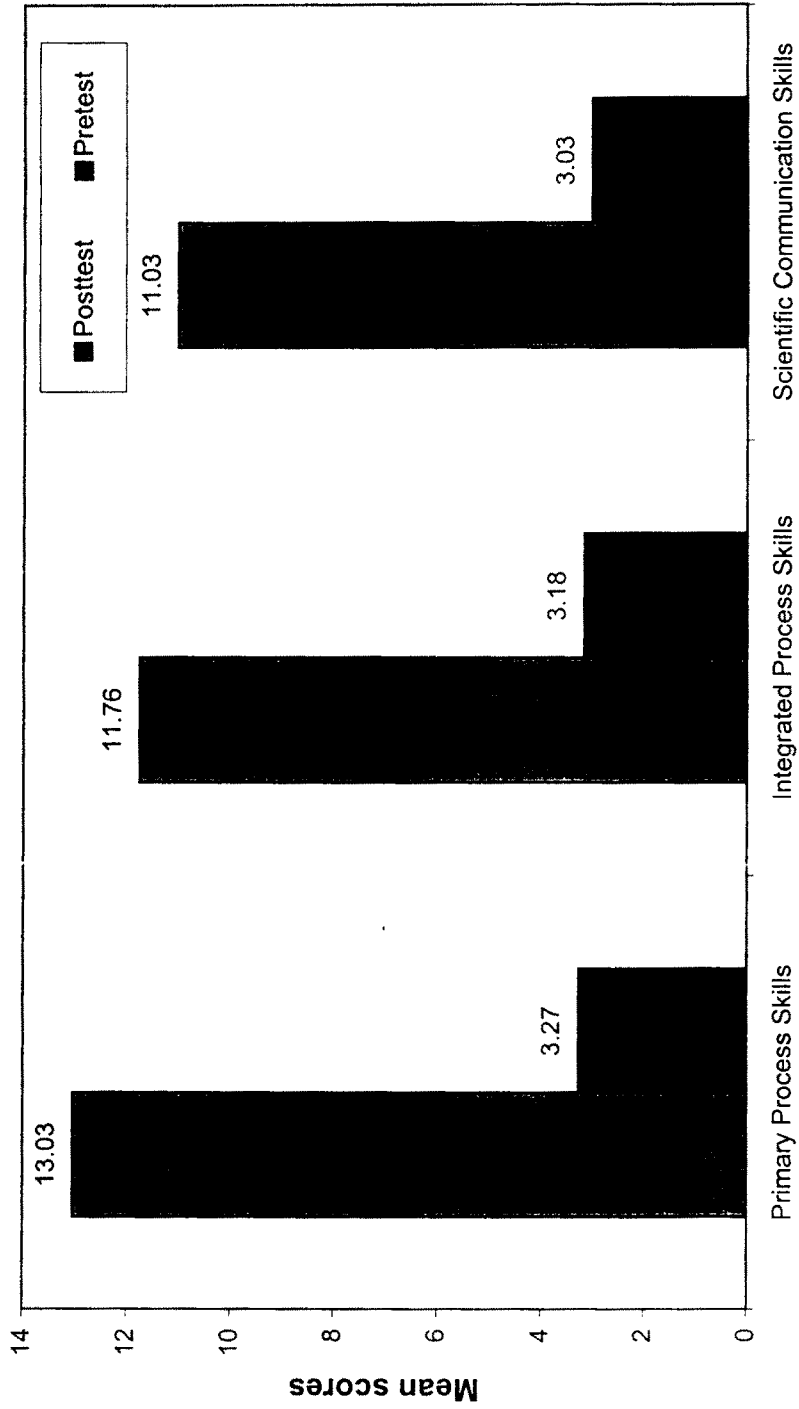
TABLE 5.6. ANALYSIS OF VARIANCE OF SCORES OF THE THREE DIVISIONS OF SKILLS OF CONTROL GROUP AS MEASURED BY THE POSTTEST AT THE DEMONSTRATION STAGE

Source	df	ss	ms	F-Statistic
Between Groups	2	9.88	4.94	5.58**
Within Groups	96	85.03	0.89	
Total	98	94.91		

** - Significant at 0.01 level

From the above table it is evident that the F-ratio is significant at 0.01 level. Hence, the null hypothesis is rejected and the alternative hypothesis is accepted. So it is concluded that there is significant difference among the three divisions of the skills of the control group as measured by the posttest.

GRAPH - 4. DEMONSTRATION STAGE - EXPERIMENTAL GROUP



HYPOTHESIS-6

There is no significant difference in the mean scores of performance of experimental group among the three divisions of the skills at the demonstration stage.

To test the above hypothesis, analysis of variance was calculated among the three divisions of skills with regard to the performance of the posttest. The results are given in the **table 5.7**

TABLE 5.7. ANALYSIS OF VARIANCE OF SCORES OF THE THREE DIVISIONS OF SKILLS OF EXPERIMENTAL GROUP AS MEASURED BY THE POSTTEST AT THE DEMONSTRATION STAGE

Source	df	ss	ms	F- Statistic
Between Groups	2	29.47	14.74	2.55 NS
Within Groups	96	554.30	5.77	
Total	98	583.77		

NS- Not Significant

From the above table it is evident that the F-ratio is not significant. Hence, the null hypothesis is accepted. It is concluded that there is no significant difference among the three divisions of the skills of the experimental group as measured by the posttest. It is also concluded that the experimental group received equivalent treatment with respect to the three divisions of skills viz., primary process, integrated process and scientific communication skills.

HYPOTHESIS - 7

There is no significant difference in the mean scores of performance of the experimental group among the individual skills as measured by the posttest at the demonstration stage.

To test the above hypothesis, analysis of variance was calculated among the individual skills with regard to the performance of the posttest. The results are given in the **table 5.8**.

TABLE 5.8. ANALYSIS OF VARIANCE OF SCORES OF INDIVIDUAL SKILLS AS MEASURED BY THE POSTTEST AT THE DEMONSTRATION STAGE.

Source	df	ss	ms	F-Statistic
Between Groups	14	75.87	5.42	8.94**
Within Groups	480	290.97	0.61	
Total	494	366.84		

** - Significant at 0.01 level

From the above table it is evident that the F-ratio is significant at 0.01 level. Hence, the null hypothesis is rejected and the alternative hypothesis is accepted. So, it is concluded that there exists significant difference in the performance of the experimental group among the individual skills.

The significance of the overall F-ratio means that among the mean scores of 15 skills, at least a few differ. The problem is to determine which specific means actually differs significantly. After F-ratio has been found to be significant, the t-test is often used to determine which specific means differ significantly from each other. For the present position to calculate the t-statistic for multiple comparisons a comprehensive method of post-hoc analysis called 'critical difference method' is used.

According to the critical difference method, the least significant difference between the two means, which is also known as critical difference, is computed. If the difference between any two mean values is greater than critical difference, then it means that they differ significantly.

The difference between the mean scores of the fifteen skills is calculated using the following procedure.

- i) The mean scores of the fifteen skills are arranged in the descending order. It is given in the following table.

TABLE – 5.9. THE MEAN SCORES AND THEIR RANK OF THE FIFTEEN INDIVIDUAL SKILLS AS MEASURED BY THE POSTTEST AT THE DEMONSTRATION STAGE.

Skills	Mean	Rank
Formulation of hypothesis	3.21	1
Measuring	3.09	2
Observation	3.00	3
Revision of hypothesis	2.94	4
Classification	2.91	5
Inquiry	2.82	6
Tabulation	2.79	7
Identification	2.70	8
Graphical	2.61	9
Generalisation	2.55	10
Drawing	2.36	11
Experimental set up	2.24	12
Inference	2.15	13
Testing hypothesis	2.00	14
Interpretation	1.94	15

It is evident from the above table that the skill component 'Formulation of hypothesis' stands first in the attainment with the mean score 3.21 and the skill component 'interpretation' is placed at the end in the attainment with the mean score 1.94.

The graphical representation of the development of the skills according to their rank is shown in the **Graph 5**.

- ii) The difference between the mean scores among the fifteen skills is calculated and tabulated using their rank numbers as follows:

GRAPH - 5. DEMONSTRATION STAGE - RANKING OF POSTTEST MEAN SCORES

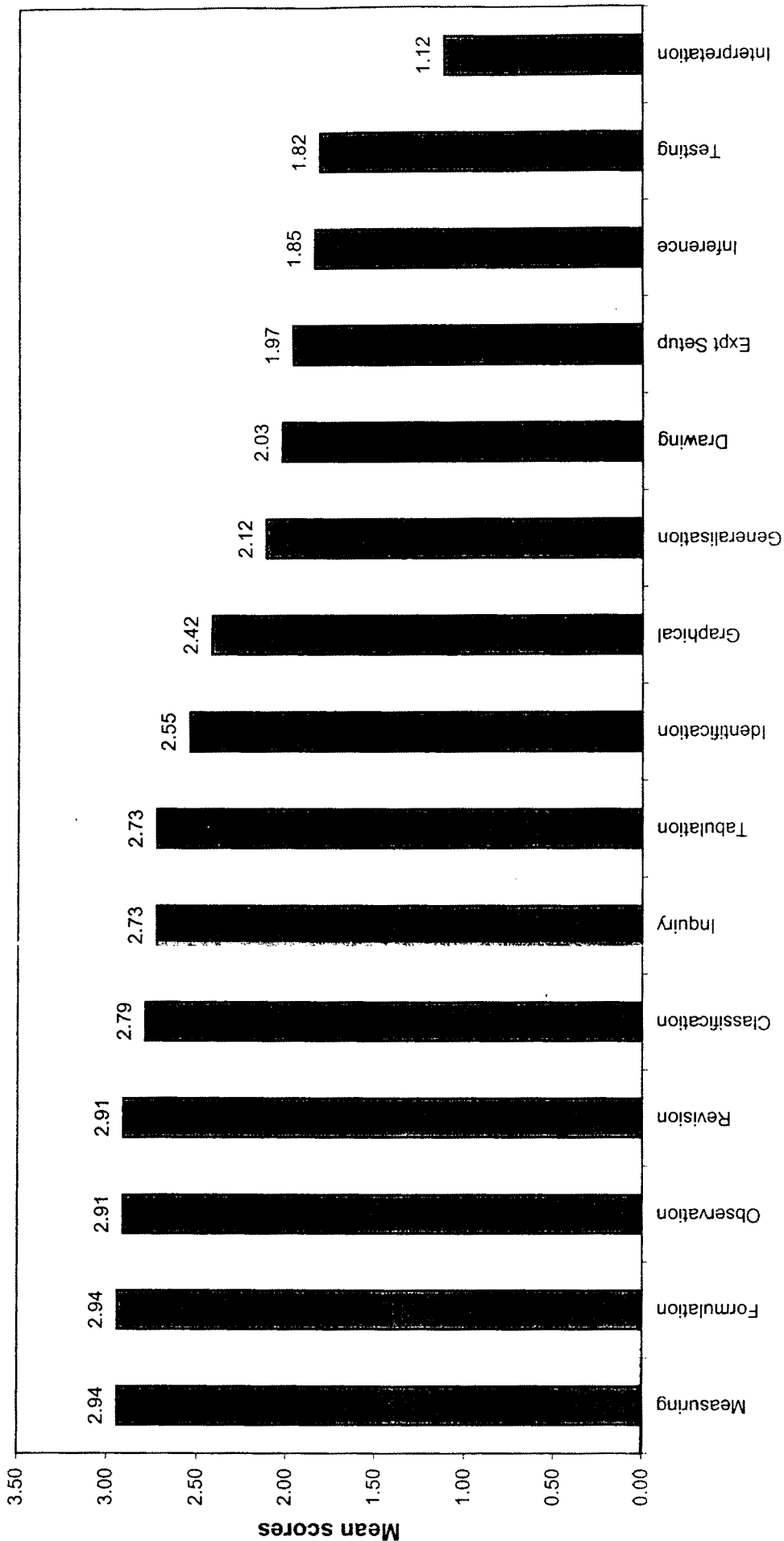


TABLE – 5.10. THE DIFFERENCE BETWEEN THE MEAN SCORES OF THE INDIVIDUAL SKILLS AS MEASURED BY THE POSTTEST AT THE DEMONSTRATION STAGE.

Rank	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	-														
2	0.12														
3	0.21	0.09													
4	0.27	0.15	0.06												
5	0.30	0.18	0.09	0.03											
6	0.39	0.27	0.18	0.12	0.09										
7	0.42	0.30	0.21	0.15	0.12	0.03									
8	0.51	0.39	0.30	0.24	0.21	0.12	0.09								
9	0.60	0.48	0.39	0.33	0.30	0.21	0.18	0.09							
10	0.66	0.54	0.45	0.39	0.36	0.27	0.24	0.15	0.06						
11	0.85	0.73	0.64	0.58	0.55	0.46	0.43	0.34	0.25	0.19					
12	0.97	0.85	0.76	0.70	0.67	0.58	0.55	0.46	0.37	0.31	0.12				
13	1.06	0.94	0.85	0.79	0.76	0.67	0.64	0.55	0.46	0.40	0.21	0.09			
14	1.21	1.09	1.00	0.94	0.91	0.82	0.79	0.70	0.61	0.55	0.36	0.24	0.15		
15	1.27	1.15	1.06	1.00	0.97	0.88	0.85	0.76	0.67	0.06	0.42	0.30	0.21	0.06	

The least significant difference, which is also known as 'critical difference' between the mean scores is computed for the above variables as 0.37. If the difference between the mean scores of any two skills is greater than the value of critical difference that is 0.37, then they differ significantly.

The following mean differences are significant according to the rank given in **table 5.10**

- | | |
|-------------------------|----------|
| 1 and 6, 1 and 7, ... | 1 and 15 |
| 2 and 8, 2 and 9, ... | 2 and 15 |
| 3 and 9, 3 and 10, ... | 3 and 15 |
| 4 and 10, 4 and 11, ... | 4 and 15 |
| 5 and 11, 5 and 12, ... | 5 and 15 |
| 6 and 11, 6 and 12, ... | 6 and 15 |
| 7 and 11, 7 and 12, ... | 7 and 15 |
| 8 and 12, 8 and 13, ... | 8 and 15 |

9 and 12, 9 and 13, ... 9 and 15

10 and 13, 10 and 14, 10 and 15,

11 and 15 ✓✓

HYPOTHESIS - 8

The students show favourable reaction towards the learning packages.

To find out whether the students have favourable or unfavorable attitude, the undecided score (a score of '0' for each item) considered as the neutral score. If the mean of the actual score is greater than the neutral score, then it indicates that the students have favourable reaction towards the learning packages and vice versa. The scores obtained by the students are shown in the Appendix (6).

In order to get the result, the t- statistic is computed. The table 5.11 shows the mean and standard deviation and the t-statistic of the scores.

TABLE 5.11. t-TEST OF SIGNIFICANCE AMONG THE STUDENTS WITH REGARD TO THE REACTION LEVEL TOWARDS THE LEARNING PACKAGES AT THE DEMONSTRATION STAGE.

Scores	Mean	S.D	N	t-Statistic
Actual	21.09	6.02	33	20.12**
Neutral	0	0	33	

** - Significant at 0.01 level

The above table reveals that the mean of the actual score is significantly greater than the mean of the neutral score. Hence the hypothesis is accepted. So, it is concluded that eighth standard students have favourable reactions towards the learning packages.

EXTENSION STAGE

The design of this stage is single group pretest-posttest pre-experimental design.

In this stage 24 upper primary schools, 24 science teachers and 594 students were involved. The science teachers and students were selected by convenience sampling method. The data collected from the 24 science teachers and 594 students were analyzed in this section.

HYPOTHESIS - 9

The students of the experimental groups are identical in terms of their primary process skills, integrated process skills and scientific communication skills as measured by the pretest at the extension stage.

To test this hypothesis, analysis of variance is computed. The mean pretest scores of the 24 groups (schools) were involved in computing the analysis of variance. The statistical values are presented in the **table 5.12**.

Table 5.12. ANALYSIS OF VARIANCE AMONG THE EXPERIMENTAL GROUPS WITH REGARD TO THE ATTAINMENT OF PRACTICAL SKILLS IN SCIENCE AS MEASURED BY THE PRETEST AT THE EXTENSION STAGE

Skills	Source	df	ss	ms	F-Statistics
Primary Process Skills	Between Groups	23	9.37	0.41	0.21 NS
	Within Group	570	1085.59	1.90	
	Total	593	1094.96		
Integrated Process Skills	Between Groups	23	30.06	1.31	1.01 NS
	Within Group	570	740.17	1.30	
	Total	573	770.23		
Scientific Communication Skills	Between Groups	23	33.26	1.45	1.05 NS
	Within Group	570	787.64	1.38	
	Total	573	820.90		

NS- Not Significant

From the above table, it is found that there is no significant difference among the experimental groups with regard to their attainment in science practical skills as measured by the pretest. Hence, the null hypothesis is accepted. So, it is concluded that all the 24 experimental groups are equivalent before the treatment.

HYPOTHESIS - 10

There is no significant difference between pre and posttest scores of the students of the experimental groups in terms of their primary process skills, integrated process skills and scientific communication skills at the extension stage.

To test this hypothesis all the twenty-four groups were treated as a single group and the mean, standard deviation and t- statistic are calculated for pre and posttests. The results are presented in the **table 5.13**

TABLE 5.13. t-TEST OF SIGNIFICANCE BETWEEN THE PRE AND POSTTESTS OF EXPERIMENTAL GROUP WITH REGARD TO THE ATTAINMENT OF PRACTICAL SKILLS IN SCIENCE AT THE EXTENSION STAGE.

Skills	Group	N	Mean	SD	t-Statistics
Primary Process Skills	Posttest	594	12.93	2.35	108.82**
	Pretest	594	6.01	1.36	
Integrated Process Skills	Posttest	594	11.79	3.69	80.73**
	Pretest	594	5.40	1.14	
Scientific Communication Skills	Posttest	594	11.01	3.11	80.90**
	Pretest	594	4.36	1.18	

** - Significant at 0.01 level

From the above table it is evident that there is significant difference in the mean scores of performance of practical skills between the pre and

posttests. Hence, the null hypothesis is rejected and the alternative hypothesis is accepted. So, the result indicates the effectiveness of learning packages in attaining the primary process skills, integrated process skill and scientific communication skills.

The graphical representation of the pre and posttest mean scores of experimental group with regard to the attainment of practical skills is presented in **graph 6**.

HYPOTHESIS - 11

There is no significant difference in the performance among the experimental groups in terms of their primary process skills, integrated process skills and scientific communication skills as measured by the posttest at the extension stage.

To test this hypothesis analysis of variance was calculated among the experimental groups with regard to the performance of practical skills as measured by the posttest. The results are given in the **table 5.14**.

GRAPH - 6. EXTENSION STAGE - EXPERIMENTAL GROUP

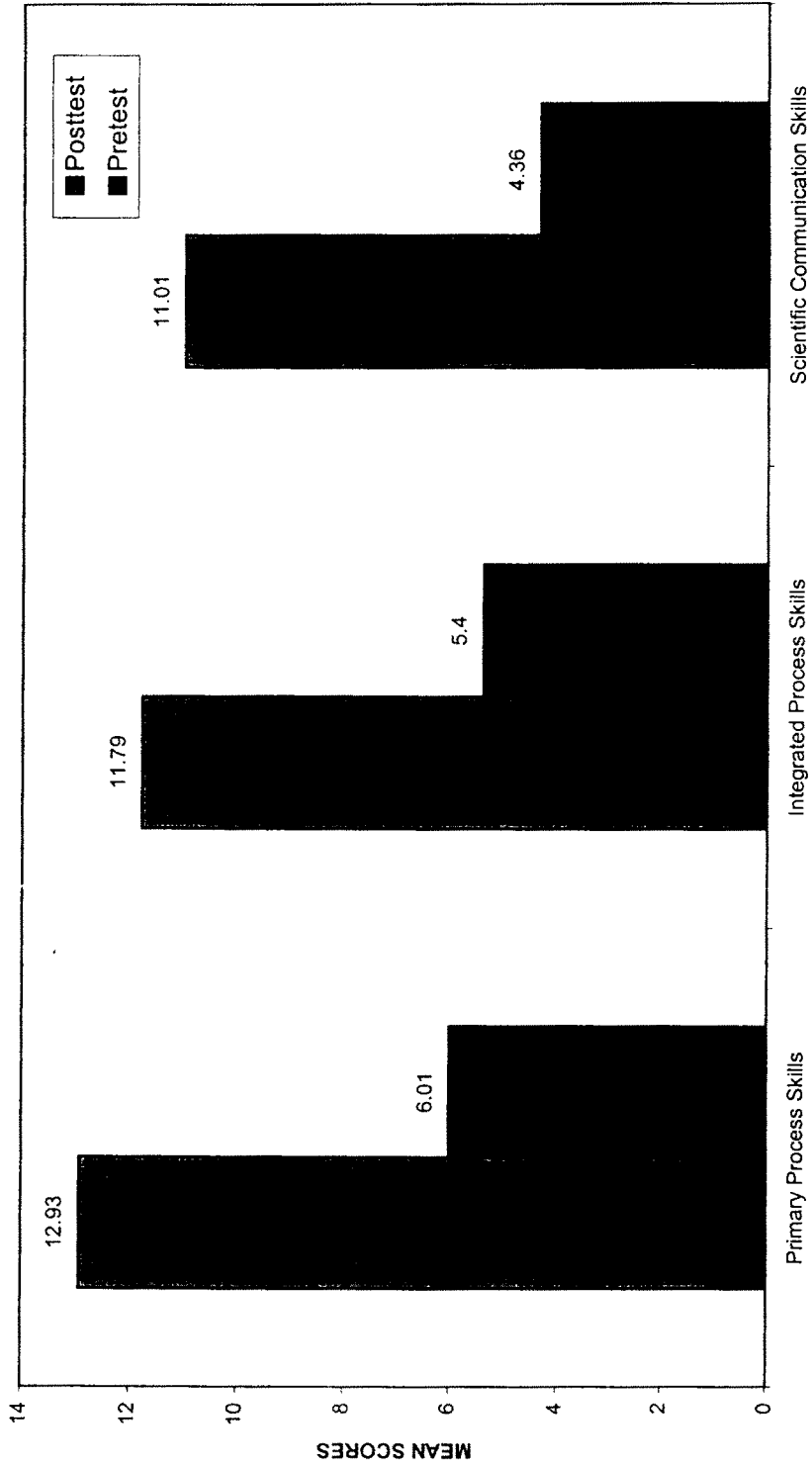


TABLE 5.14. ANALYSIS OF VARIANCE AMONG THE EXPERIMENTAL GROUPS WITH REGARD TO THE ATTAINMENT OF PRACTICAL SKILLS IN SCIENCE AS MEASURED BY THE POSTTEST AT THE EXTENSION STAGE

Skills	Source	df	ss	ms	F-Statistics
Primary Process Skills	Between Groups	23	46.39	2.02	0.36 NS
	Within Group	570	3222.05	5.65	
	Total	593	3268.44		
Integrated Process Skills	Between Groups	23	84.83	3.69	0.79 NS
	Within Group	570	2656.44	4.66	
	Total	573	2741.27		
Scientific Communication Skills	Between Groups	23	167.41	7.28	1.45 NS
	Within Group	570	2869.51	5.03	
	Total	573	3036.92		

NS–Not significant

The above table reveals that there is no significant difference among the experimental groups with regard to the performance of practical skills as measured by the posttest. So, the null hypothesis is accepted. Hence, it is concluded that all the 24 experimental groups got almost equal treatment using the learning packages.

HYPOTHESIS - 12

There is no significant difference in the mean scores of performance of experimental group among the three divisions of the skills at the extension stage.

To test the above hypothesis, analysis of variance was calculated among the three divisions of skills with regard to the performance of the posttest. The results are given in the **table 5.15**

TABLE 5.15. ANALYSIS OF VARIANCE AMONG THE THREE DIVISIONS OF SKILLS OF EXPERIMENTAL GROUP AS MEASURED BY THE POSTTEST AT THE EXTENSION STAGE

Source	df	ss	ms	F-Statistic
Between Groups	2	1111.36	555.68	109.27**
Within Group	1779	9046.63	5.09	
Total	1781	10157.99		

** - Significant 0.01 level

From the above table it is found that the F-ratio is significant at 0.01 level. Hence, the null hypothesis is rejected and the alternative hypothesis is accepted. So, it is concluded that there is significant difference among the three divisions of the skills of the experimental groups as measured by the posttest.

HYPOTHESIS - 13

There is no significant difference in the mean score of performance among the fifteen individual skills as measured by the posttest at the extension stage.

To test the above hypothesis, analysis of variance was computed considering the 594 students as single group and the F- ratio was calculated for the fifteen skills. The results are given in the **table 5.16**

TABLE 5.16. ANALYSIS OF VARIANCE OF SCORES OF INDIVIDUAL SKILLS OF EXPERIMENTAL GROUPS AS MEASURED BY THE POSTTEST AT THE EXTENSION STAGE

Source	df	ss	ms	F-Statistic
Between Groups	14	2127.38	151.96	296.76**
Within Group	8895	4554.62	0.51	
Total	8909	6681.00		

** - Significant 0.01 level

From the above table it is found that the F-ratio is significant at 0.01 level. Hence, the null hypothesis is rejected and the alternative hypothesis is accepted. So, it is concluded that there exists significant difference in the performance among the individual skills.

The significance of the overall F-ratio means that among the means of 15 skills at least a few differ. The problem is to determine which specific means actually differ significantly. For multiple comparisons of t-values the critical difference method was used.

The mean scores of the fifteen skills are arranged in the descending order. It is given in the following **table. 5.17.**

TABLE – 5.17. THE MEAN SCORES AND THEIR RANK OF THE FIFTEEN INDIVIDUAL SKILLS AS MEASURED BY THE POSTTEST AT THE EXTENSION STAGE.

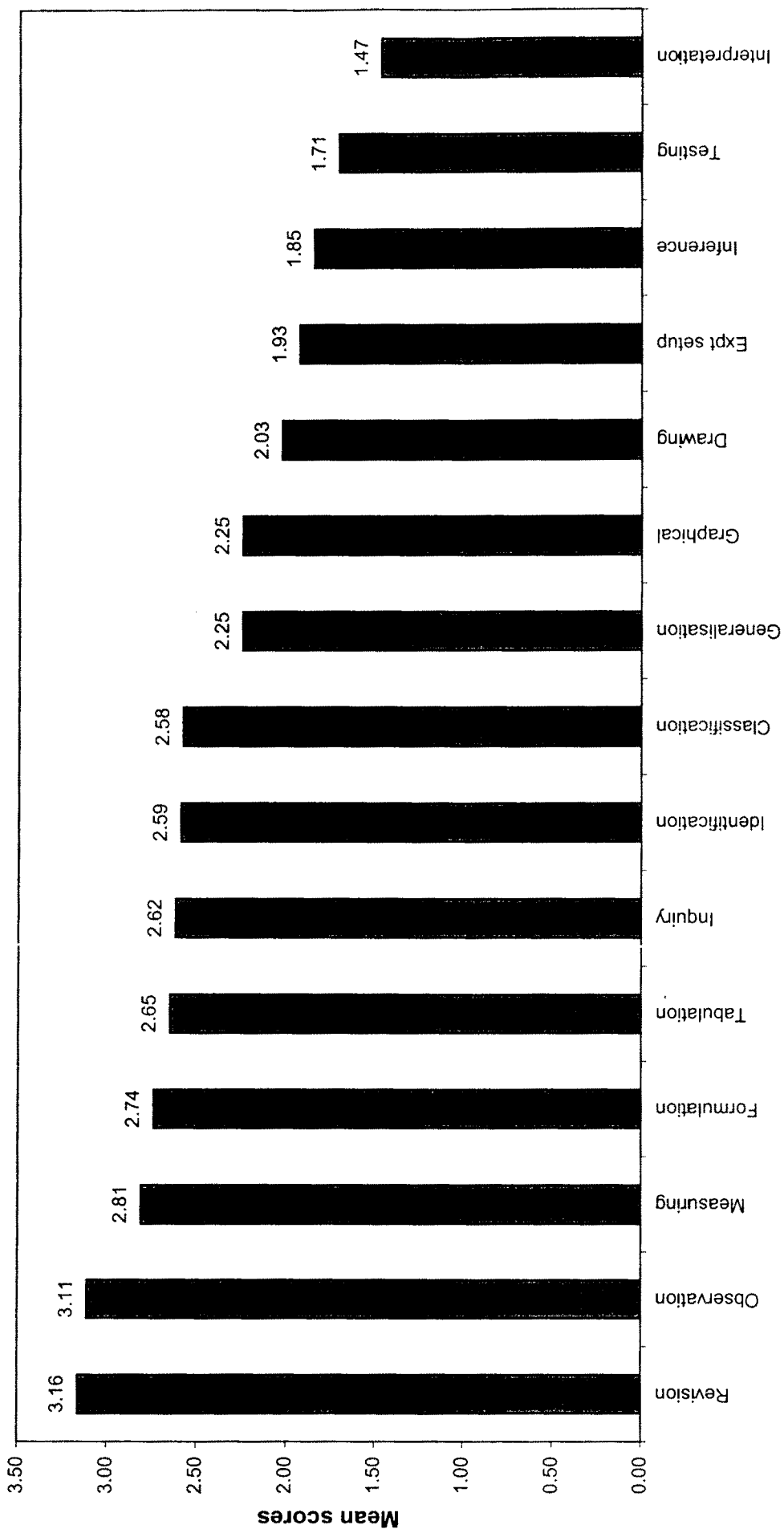
Skills	Mean	Rank
Revision of hypothesis	3.16	1
Observation	3.11	2
Measuring	2.81	3
Formulation of hypothesis	2.74	4
Tabulation	2.65	5
Inquiry	2.62	6
Identification	2.59	7
Classification	2.58	8
Generalization	2.25	9
Graphical	2.25	10
Drawing	2.03	11
Experimental set up	1.93	12
Inference	1.85	13
Testing hypothesis	1.71	14
Interpretation	1.47	15

It is evident from the above table that the skill component 'revision of hypothesis' stands first in the attainment with the mean score 3.16 and the skill component 'interpretation' is placed at the end in the attainment with the mean score 1.47.

The graphical representation of the development of the skills according to the rank is presented in the **graph 7**. Also the comparison of mean scores of the individual skills between the Extension Stage and the Demonstration Stage is given in **Graph 8**.

The difference between the mean scores among the fifteen skills is calculated and they are tabulated using their rank numbers as follows.

GRAPH - 7. EXTENSION STAGE - RANKING OF POSTTEST MEAN SCORES



GRAPH - 8. COMPARISON OF POSTTEST OF INDIVIDUAL SKILLS

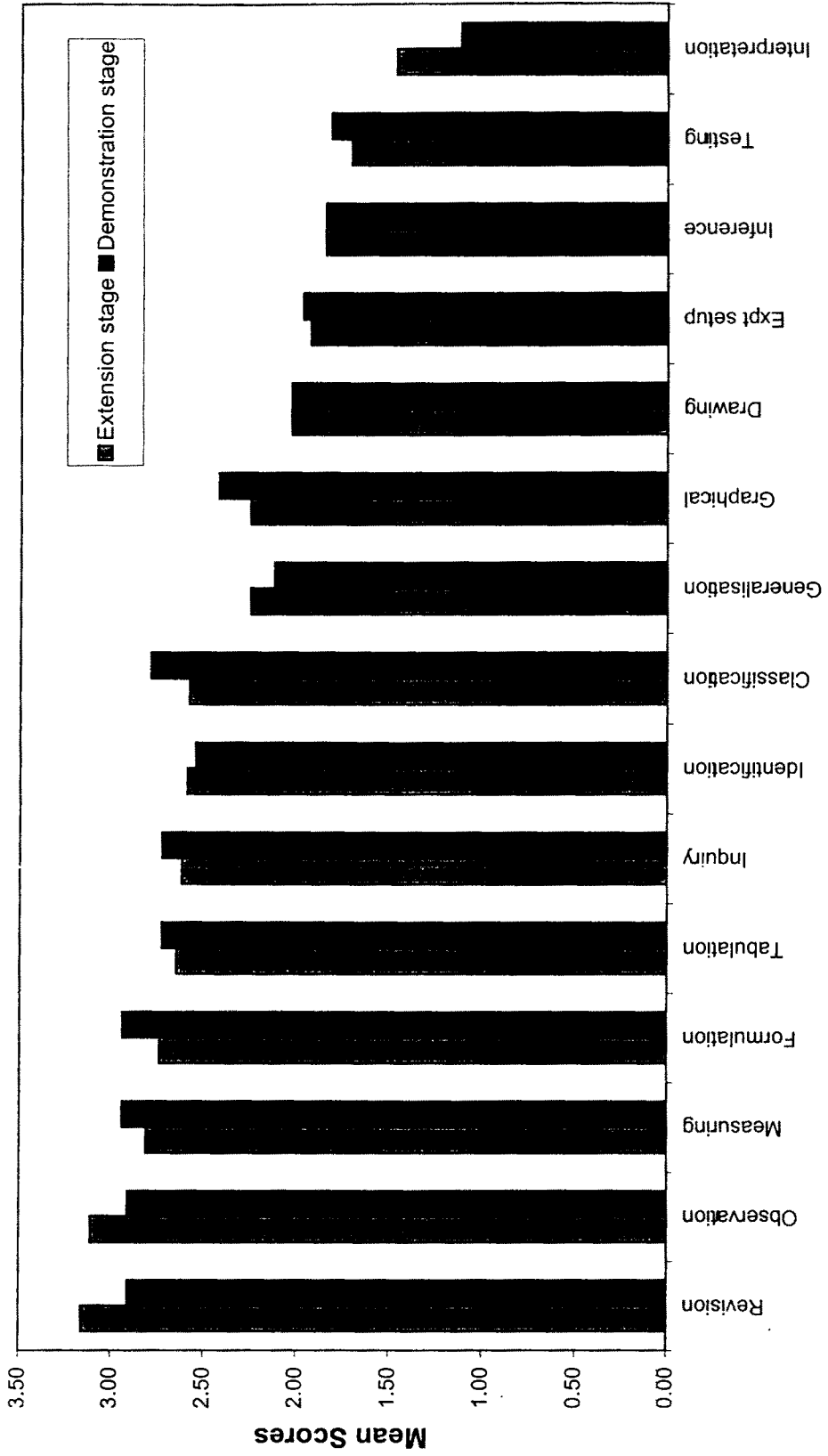


TABLE 5.18. THE DIFFERENCE BETWEEN THE MEAN SCORES OF THE INDIVIDUAL SKILLS AS MEASURED BY THE POSTTEST AT THE EXTENSION STAGE.

Rank	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1															
2	0.05														
3	0.35	0.30													
4	0.42	0.37	0.07												
5	0.51	0.46	0.16	0.09											
6	0.54	0.49	0.19	0.12	0.03										
7	0.57	0.52	0.22	0.15	0.06	0.03									
8	0.58	0.53	0.23	0.16	0.07	0.04	0.01								
9	0.91	0.86	0.56	0.49	0.40	0.37	0.34	0.33							
10	0.91	0.86	0.56	0.49	0.40	0.37	0.34	0.33	0.00						
11	1.13	1.08	0.78	0.71	0.62	0.59	0.56	0.55	0.22	0.22					
12	1.23	1.18	0.88	0.81	0.72	0.69	0.66	0.65	0.32	0.32	0.10				
13	1.31	1.26	0.96	0.89	0.80	0.77	0.74	0.73	0.40	0.40	0.18	0.08			
14	1.45	1.40	1.10	1.03	0.94	0.91	0.88	0.87	0.54	0.54	0.32	0.22	0.14		
15	1.69	1.64	1.34	1.27	1.18	1.15	1.12	0.24	0.78	0.78	0.56	0.46	0.38	0.24	

The least significant difference, which is also known as critical difference, was computed for the above variables as 0.09. If the difference between the mean scores of any two skills is greater than the value of critical difference (i.e. 0.09), then it is concluded that they differ significantly.

The following mean differences are significant according to the rank as given in table 5.18

1 and 3,	1 and 4, ...	1 and 15
2 and 3,	2 and 4, ...	2 and 15
3 and 5,	3, and 6, ...	3 and 15
4 and 5,	4 and 6, ...	4 and 15
5 and 9,	5 and 10, ...	5 and 15
6 and 9,	6 and 10, ...	6 and 15
7 and 9,	7 and 10, ...	7 and 15
8 and 9,	8 and 10, ...	8 and 15
9 and 11,	9 and 12, ...	9 and 15
10 and 12,	10 and 12, ...	10 and 15
11 and 12,	11 and 13, ...	11 and 15
12 and 14,	12 and 15, ...	

13 and 14, 13 and 15
14 and 15

HYPOTHESIS - 14

There is no significant difference between the mean score performance of the individual skills among the schools as measured by the posttest at the extension stage.

To test the above hypothesis F- ratio is computed for the fifteen individual skills for the 24 schools. The results are presented in the following table.

TABLE 5.19. ANALYSIS OF VARIANCE BETWEEN THE MEAN SCORES OF THE INDIVIDUAL SKILLS AMONG THE EXPERIMENTAL GROUPS AS MEASURED BY THE POSTTEST AT THE EXTENSION STAGE.

TABLE 5.19a PRIMARY PROCESS SKILLS

Skills	Source	df	ss	ms	F-Statistics
Observation	Between Groups	23	16.55	0.72	1.39 NS
	Within Group	570	295.34	0.52	
	Total	573	311.89		
Identification	Between Groups	23	7.75	0.34	0.56 NS
	Within Group	570	340.02	0.60	
	Total	573	347.77		
Classification	Between Groups	23	21.92	0.95	1.40 NS
	Within Group	570	389.02	0.68	
	Total	573	410.94		
Measuring	Between Groups	23	12.94	0.56	1.20 NS
	Within Group	570	267.32	0.47	
	Total	573	280.26		
Inferring	Between Groups	23	16.00	0.70	1.27 NS
	Within Group	570	311.75	0.55	
	Total	573	327.75		

NS – Not significant

TABLE 5.19b INTEGRATED PROCESS SKILLS

Skills	Source	df	ss	Ms	F-Statistics
Formulation Of Hypothesis	Between Groups	23	19.83	0.86	0.95 NS
	Within Group	570	515.67	0.90	
	Total	573	535.50		
Experimental Setup	Between Groups	23	10.51	0.46	0.70 NS
	Within Group	570	369.93	0.65	
	Total	573	380.44		
Testing Hypothesis	Between Groups	23	4.63	0.20	0.83 NS
	Within Group	570	137.56	0.24	
	Total	573	142.19		
Revision Of Hypothesis	Between Groups	23	24.24	1.05	1.70*
	Within Group	570	351.57	0.62	
	Total	573	375.81		
Generalization	Between Groups	23	9.17	0.40	0.92 NS
	Within Group	570	247.45	0.42	
	Total	573	256.62		

NS – Not significant

* - Significant at 0.05 level

TABLE 5.19c SCIENTIFIC COMMUNICATION SKILLS

Skills	Source	df	ss	ms	F-Statistics
Inquiry	Between Groups	23	10.06	0.44	1.10 NS
	Within Group	570	226.42	0.40	
	Total	573	236.48		
Tabulation	Between Groups	23	23.94	1.04	1.55*
	Within Group	570	381.82	0.67	
	Total	573	405.76		
Drawing	Between Groups	23	8.44	0.37	1.02 NS
	Between Groups	570	205.13	0.36	
	Total	573	213.57		
Graphical Representation	Between Groups	23	5.32	0.23	0.97 NS
	Between Groups	570	136.30	0.24	
	Total	573	141.62		
Interpretation	Between Groups	23	9.64	0.42	1.34 NS
	Between Groups	570	178.37	0.31	
	Total	573	188.01		

NS– Not significant

* - Significant at 0.05 level

It is found from the above table that there is no significant difference between the mean scores of individual skills among the experimental groups with regard to the posttest (except for the skill components: revision of hypothesis and tabulation). Hence, the null hypothesis is accepted. So, it is concluded that the effectiveness of the learning packages with regard to the individual skills are equivalent for all the 24 schools (except for the skill components: revision of hypothesis and tabulation).

HYPOTHESIS - 15

The teachers show favourable attitude towards the learning packages.

To test the hypothesis the t-statistic was computed for the responses of 24 teachers using the actual and neutral scores obtained from the attitude scale. The attitude scale is presented in appendix-7. The results obtained are given in the **table-5.20**.

TABLE 5.20. t- TEST OF SIGNIFICANCE AMONG THE TEACHERS WITH REGARD TO THEIR ATTITUDE TOWARDS THE LEARNING PACKAGES AT THE EXTENSION STAGE.

Scores	N	Mean	S.D	t- Statistic
Actual	24	114	19.83	5.93**
Neutral	24	90	0	

** - Significant 0.01 level

The above table reveals that the mean of the actual scores is significantly greater than the mean of the neutral scores. Hence, the hypothesis is accepted. So, it is concluded that the teachers have favourable attitude towards the learning packages.