C H A P T E R IV

RESULTS

4.00 INTRODUCTION

This chapter would present the results in the sequence of description of intervening variables of intelligence and pre-achievement for subgroups (sample under Patterns I, II, III and IV) and the total sample (an additive number of subgroups), description of criterion variables of total achievement (T), knowledge (K), comprehension (C) and application (A); analytical picture classwise for all the six variables viz.(two intervening and four criterion); product-moment correlations amongst all the intervening and criterion variables; three-way analysis of variance, analysis of covariance; and 't' test. The results relating to the four criterion variables are obtained from two approaches of the study - global and analytical. The global approach dealswith the total attainment (T) on the post-treatment attainment test and the analytical with the three criterion measures of attainment for the objectives of knowledge, comprehension and application. In order to have uniformity of presentation and convenience for comparisons, tables of similar formats and having similar statistical

treatments are grouped together. Sometimes a few results may appear to be redundant to the readers but it is the faith of the investigator that these results would help in the discussion of the study and would further help to float new problems and hypotheses in the area of teacher behaviour and pupil achievement. It is in this context that extra efforts have been made and results have been knowingly kept in the body of the thesis which otherwise could easily be placed in the Appendix. It may be noted that some of the terms like narration, open questions, narrow questions and narrow questions with feedback, total sample, subgroups, intelligence, pre-achievement, total attainment, attainment for knowledge, comprehension and application will be used again and again in results and discussion. To save space within tables for the presentation of results and even in the discussion part, abbreviations for these key-words have been used. Abbreviations are given in the Table 4.1.

TABLE 4.1

ABBREVIATIONS USED FOR DIFFERENT TERMS

Terms	Abbreviation
Narration - Pattern I	P_1
Open questions - Pattern II	P_2
Narrow questions - Pattern III	P_3
Narrow questions with feedback - Pattern IV	P_4
Total sample - $P_1+P_2+P_3+P_4$	Total Sample
Variable of Intelligence	I
Variable of Pre-achievement	PA
Total attainment on Post-treatment Test	T
Attainment for knowledge objective	K
Attainment for comprehension objective	C
Attainment for application objective	A

4.10 DESCRIPTIVE STATISTICS FOR INTELLIGENCE AND PRE-ACHIEVEMENT SCORES AND CRITERION SCORES

The data for the two variables of intelligence and pre-achievement and four criterion variables of T, K, C and A were collected from subgroups under P_1 (N = 239), P_2 (N = 235), P_3 (N = 246) and P_4 (N = 253) yielding a total sample of 973 of VII grade pupils. In order to

present a comparative picture as well as to save space, overlapping frequency distributions for the sub-groups and total sample were prepared. This has been done for all the variables.

4.11 Descriptive Analysis for Intelligence and Pre-achievement

Along with the frequency distributions, the measures of central tendency (mean and median), measures of dispersion (SD) and standard errors of mean (SE_M) and standard error of SD (SE_{SD}) are reported in the following tables. Table 4.2 gives the above mentioned information about the variable of intelligence.

A study of the Table 4.2 reveals that the intelligence scores within the four subgroups, under treatments P_1, P_2, P_3 and P_4 and also the total sample are continuous and are having some trends of normality. Although rigorous statistical techniques have not been employed to test normality of the distribution yet the clustering of frequencies in the centre of the distribution helps to infer in favour of it. The graphical presentation of distribution of scores as given in Fig. 4.1 further supports this. The mean scores of intelligence for different subgroups vary from 82.711 under P_3 to 85.664 under P_2 conditions. In order to see whether or not the I scores for subgroups under P_1, P_2,

TABLE 4.2

FREQUENCY DISTRIBUTIONS, MEANS, MEDIANS, SD, SE_M AND SE_{SD} FOR THE SCORES OF INTELLIGENCE FOR THE SUBGROUPS AND TOTAL SAMPLE

Scores	P_1	P_2	P_3	P_4	Total sample
110-114	0	1	0	0	1
105-109	2	5	1	3	11
100-104	5	10	3	9	27
95- 99	8	26	14	25	73
90- 94	30	29	31	41	131
85- 89	58	57	46	58	219
80- 84	56	51	57	49	213
75- 79	46	36	58	40	180
70- 74	34	20	36	28	118
N	239	235	246	253	973
M	83.121	85.664	82.711	85.253	84.232
Mdn	83.266	85.638	81.970	85.133	83.725
SD	7.652	8.550	7.543	8.201	8.107
SE_M	0.495	0.558	0.481	0.516	0.260
SE_{SD}	0.350	0.394	0.340	0.365	0.184

P_3 and P_4 differ significantly, 't' ratios were calculated and are being reported in Table 4.3.

FIG - 4-1

FREQUENCY POLYGON OF INTELLIGENCE SCORES OF TOTAL SAMPLE (973)

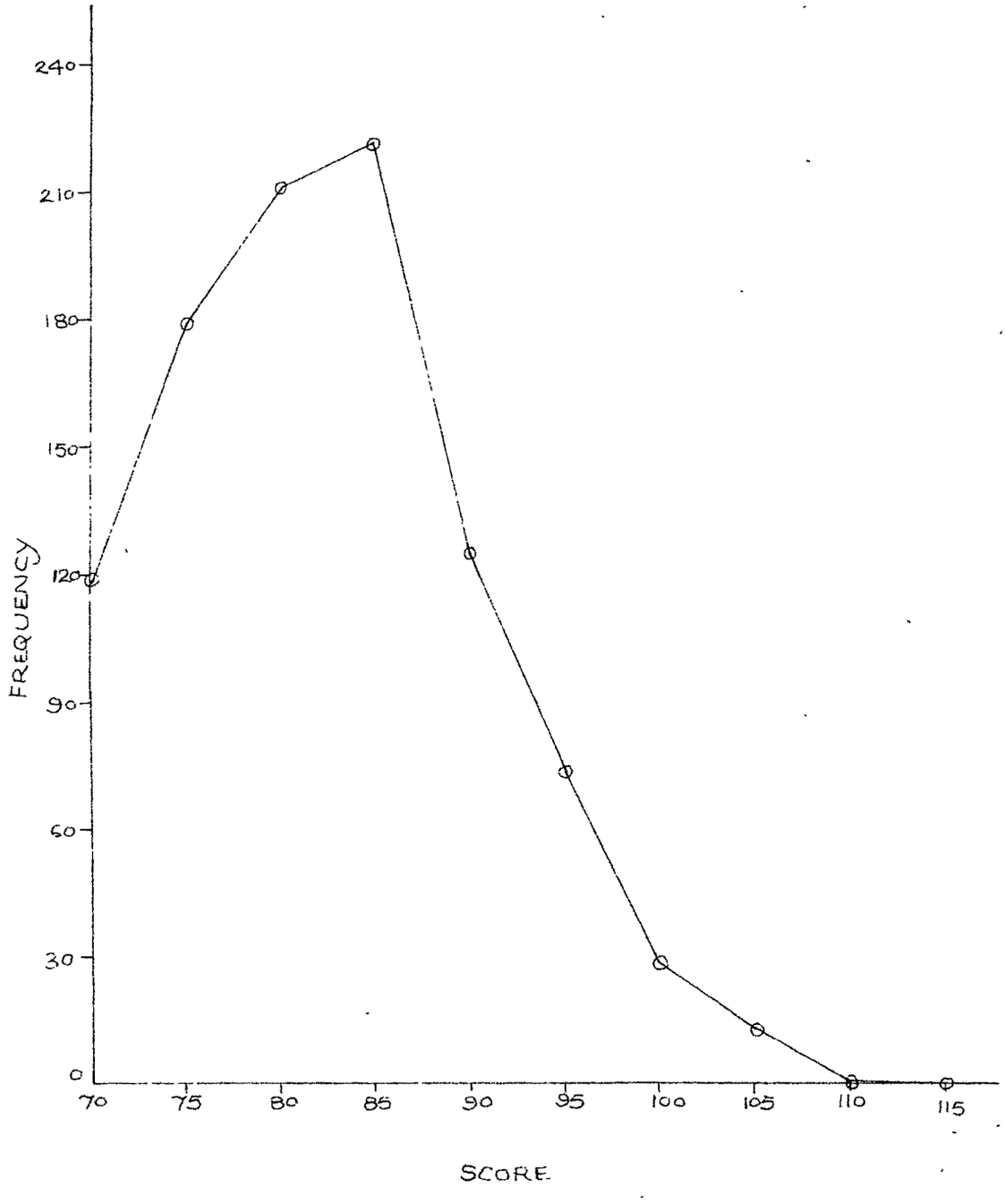


TABLE 4.3

SIGNIFICANCE OF DIFFERENCE BETWEEN MEANS AND SD'S FOR THE SCORES OF INTELLIGENCE FOR THE SUBGROUPS UNDER P_1, P_2, P_3 & P_4

Sub-groups	M	SD	N	P_1	P_2	P_3	P_4
P_1	83.121	7.652	239		1.985*	2.648@	3.769@
P_2	85,664	8.550	235	1.163		3.674@	1.377
P_3	82.711	7.543	246	1.011	1.707		5.011@
P_4	85.253	8.201	253	1.474	0.225	1.939	

Note: Values in cells above the diagonal represent 't' ratios for mean differences and below the diagonal for SD differences.

* Significant at .05 level
@ Significant at .01 level

It can be inferred from the above table that the inter subgroup mean intelligence levels differ significantly in all the combinations except between P_2 and P_4 (see 't' values above the diagonal in Table 4.3. The subgroups do not differ significantly in variance for the variable of intelligence as is being indicated in Table 4.3 (values below the diagonal). This situation demands that either the groups should be controlled by experimental manipulations or by statistical manipulations. For this study, the latter approach of statistical control employing analysis of covariance is preferred and followed.

The second variable refers to the pre-achievement

scores of pupils in history. The frequency distributions along with means, medians, SD's, SE_M and SE_{SD} for pre-achievement are being presented in the following Table 4.4.

TABLE 4.4

FREQUENCY DISTRIBUTIONS, MEANS, MEDIANS, SD's, SE_M AND SE_{SD} FOR THE VARIABLE OF PRE-ACHIEVEMENT FOR THE SUBGROUPS AND TOTAL SAMPLE

Scores	P_1	P_2	P_3	P_4	Total sample
20-21	0	0	1	2	3
18-19	0	1	2	7	10
16-17	5	4	15	24	48
14-15	6	21	8	30	65
12-13	31	21	19	38	109
10-11	48	41	34	35	158
8- 9	52	45	44	37	178
6- 7	49	52	70	53	224
4- 5	27	38	40	24	139
2- 3	11	10	12	3	36
0- 1	0	2	1	0	3
N	239	235	246	253	973
M	8.431	8.472	8.329	10.308	8.903
Mdn	8.437	8.096	7.500	9.952	8.362
SD	3.112	3.474	3.760	3.986	3.701
SE_M	.201	.227	.240	.251	.119
SE_{SD}	.142	.160	.169	.177	.084

Like the variable of intelligence, the variable of pre-achievement for different subgroups under P_1, P_2, P_3 and P_4 as well as for the total sample is continuous. The frequency distributions are clustering around the central ordinate and tapering towards the ends. The small differences between the two measures of central tendency, mean and median, for the subgroups and total sample is another evidence of near normality of the variable. Similar evidence is again available from graphical representation of frequency distribution vide Fig.4.2. The mean scores under different subgroups range from 8.329 under P_3 to 10.308 under P_4 (see Table 4.4). To see whether or not the pre-achievement levels of subgroups under P_1, P_2, P_3 and P_4 differ significantly, 't' test results are given in Table 4.5.

TABLE 4.5

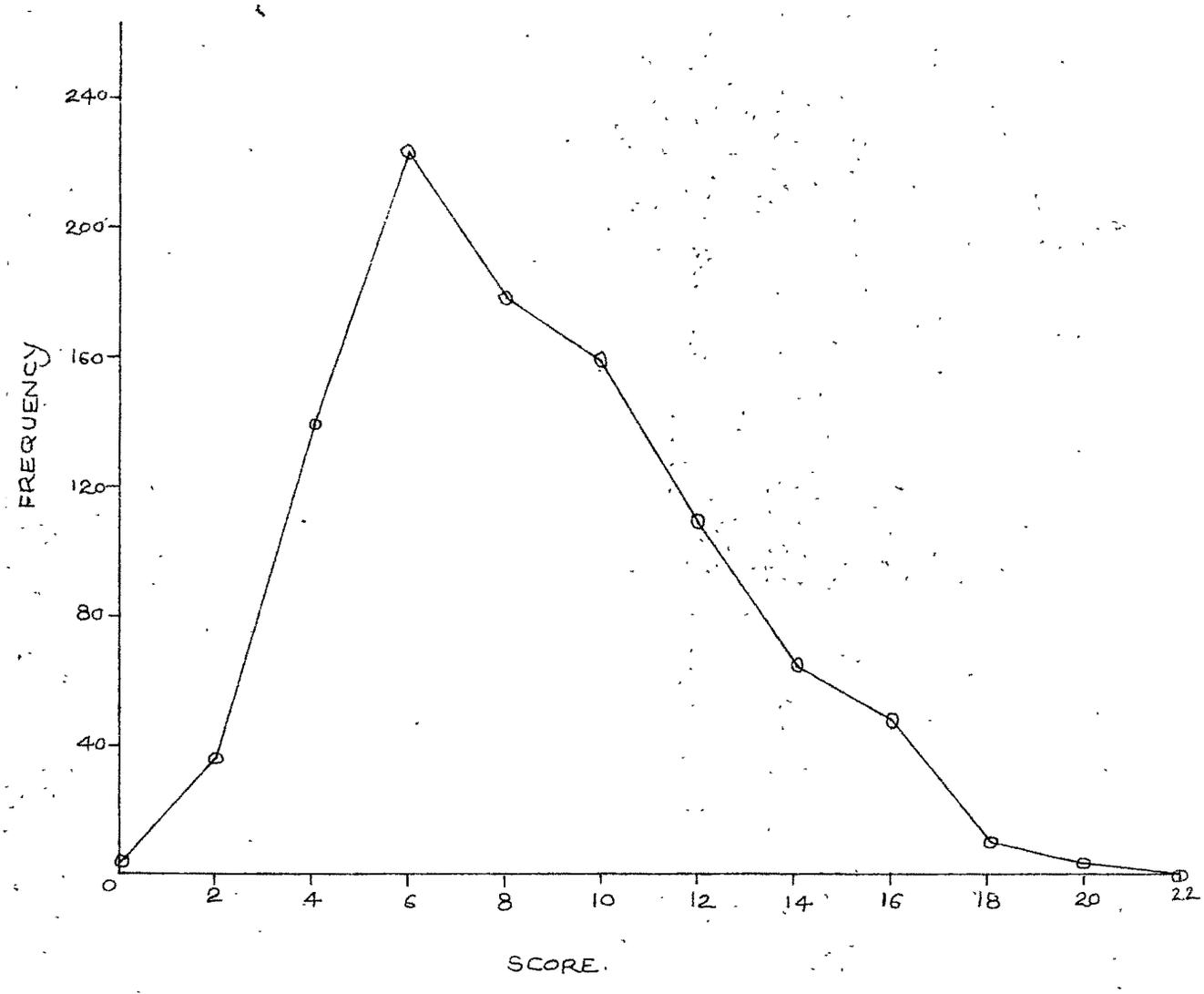
SIGNIFICANCE OF DIFFERENCE BETWEEN MEANS AND SD'S FOR PRE-ACHIEVEMENT FOR THE SUBGROUPS

Sub-groups	M	SD	N	P_1	P_2	P_3	P_4
P_1	8.431	3.112	239		2.012*	1.682	2.132*
P_2	8.472	3.474	235	3.572@		0.132	0.319
P_3	8.329	3.760	246	1.272	1.681		0.424
P_4	10.308	3.986	253	0.317	2.937@	1.243	

* Significant at .05 level
@ Significant at .01 level

FIG- 4·2

FREQUENCY POLYGON OF PRE-ACHIEVEMENT SCORES OF TOTAL SAMPLE (973)



The 't' values as entered in the above table indicate that the mean pre-achievement scores for different subgroups differ significantly as differences between P_1 and P_2; and between P_1 and P_4 are significant. These significant differences between the pre-achievement levels for different subgroups require the adjustment of post-treatment scores based upon the initial pre-achievement. Analysis of covariance has been used for this adjustment.

4.12 Descriptive Analysis for Criterion Variables of Total Attainment and Attainment for Knowledge, Comprehension and Application Objectives

The descriptive results for the criterion measures of total attainment and attainment for knowledge, comprehension and application in terms of frequency distributions and mean, median, SD, SE_M and SE_{SD} for different subgroups under P_1, P_2, P_3 and P_4 and the total sample are given in Tables 4.6 to 4.9. The figures 4.3 to 4.6 present the data for the distribution of scores for the dependent variables graphically.

TABLE 4.6

FREQUENCY DISTRIBUTIONS, MEANS, MEDIANS, SD's, SE_M AND SE_{SD} for the TOTAL ATTAINMENT SCORE FOR SUBGROUPS AND THE TOTAL SAMPLE

Scores	P_1	P_2	P_3	P_4	Total sample
28-30	0	5	5	6	16
25-27	10	18	37	26	91
22-24	33	43	44	71	191
19-21	56	52	60	43	211
16-18	57	52	52	48	209
13-15	51	34	35	37	157
10-12	28	21	8	12	69
7- 9	4	4	4	8	20
4- 6	0	2	1	0	3
1- 3	0	4	0	2	6
N	239	235	248	253	973
M	17.343	18.238	19.524	19.198	18.593
Mdn	17.175	18.550	19.384	19.952	18.821
SD	4.099	5.202	4.563	4.953	4.799
SE_M	.265	.339	.291	.311	.154
SE_{SD}	.187	.240	.206	.220	.109

TABLE 4.7

FREQUENCY DISTRIBUTIONS, MEANS, MEDIANS, SD's, SE_M AND SE_{SD} FOR KNOWLEDGE ATTAINMENT FOR THE SUBGROUPS AND TOTAL SAMPLE

Scores	P_1	P_2	P_3	P_4	Total Sample
16-17	8	18	35	20	81
14-15	37	48	40	67	192
12-13	63	48	72	63	246
10-11	55	52	53	46	206
8- 9	48	37	35	32	152
6- 7	17	18	8	15	58
4- 5	9	8	1	8	26
2- 3	2	3	2	2	9
0- 1	0	3	0	0	3
N	239	235	246	253	973
M	10.874	11.204	12.122	11.759	11.499
Mdn	11.189	11.397	12.131	12.283	11.764
SD	2.824	3.373	2.831	3.106	3.078
SE_M	.183	.220	.180	.195	.099
SE_{SD}	.129	.156	.128	.138	.070

TABLE 4.8

FREQUENCY DISTRIBUTIONS, MEANS, MEDIANS, SDs, SE_M AND SE_{SD} FOR COMPREHENSION ATTAINMENT FOR THE SUBGROUPS AND TOTAL SAMPLE

Scores	P_1	P_2	P_3	P_4	Total sample
10	0	2	0	1	3
9	6	6	19	9	40
8	8	17	27	28	80
7	22	42	46	38	148
6	37	55	44	61	197
5	57	37	47	28	169
4	52	31	29	41	153
3	32	19	20	23	94
2	15	10	11	16	52
1	8	10	0	4	22
0	2	6	3	4	15
N	239	235	246	253	973
M	4.690	5.234	5.715	5.360	5.255
Mdn	4.684	5.581	5.795	5.672	5.390
SD	1.787	2.079	1.946	2.030	1.998
SE_M	.116	.136	.124	.128	.064
SE_{SD}	.081	.096	.088	.090	.045

TABLE 4.9

FREQUENCY DISTRIBUTIONS FOR MEANS, MEDIANS, SD's, SE_M AND SE_{SD} FOR APPLICATION ATTAINMENT FOR SUBGROUPS AND TOTAL SAMPLE

Scores	P_1	P_2	P_3	P_4	Total sample
5	6	1	1	2	10
4	18	15	19	17	69
3	45	55	42	73	215
2	66	57	56	85	264
1	58	68	83	57	266
0	46	39	45	19	149
N	239	235	246	253	973
M	1.787	1.753	1.650	2.071	1.818
Mdn	1.734	1.684	1.433	2.094	1.759
SD	1.297	1.192	1.236	1.072	1.211
SE_M	.084	.078	.079	.067	.039
SE_{SD}	.059	.055	.056	.048	.027

The criterion variable of total attainment demonstrates continuity in terms of frequency distribution under all the four subgroups and total sample. The frequencies are clustering near the centre and decreasing towards the tails. The differences between mean and median values within subgroups and total sample appear to be small. It is, therefore, another rough estimate of

FIG - 4.3.

FREQUENCY POLYGON OF TOTAL ATTAINMENT SCORES OF TOTAL SAMPLE (973).

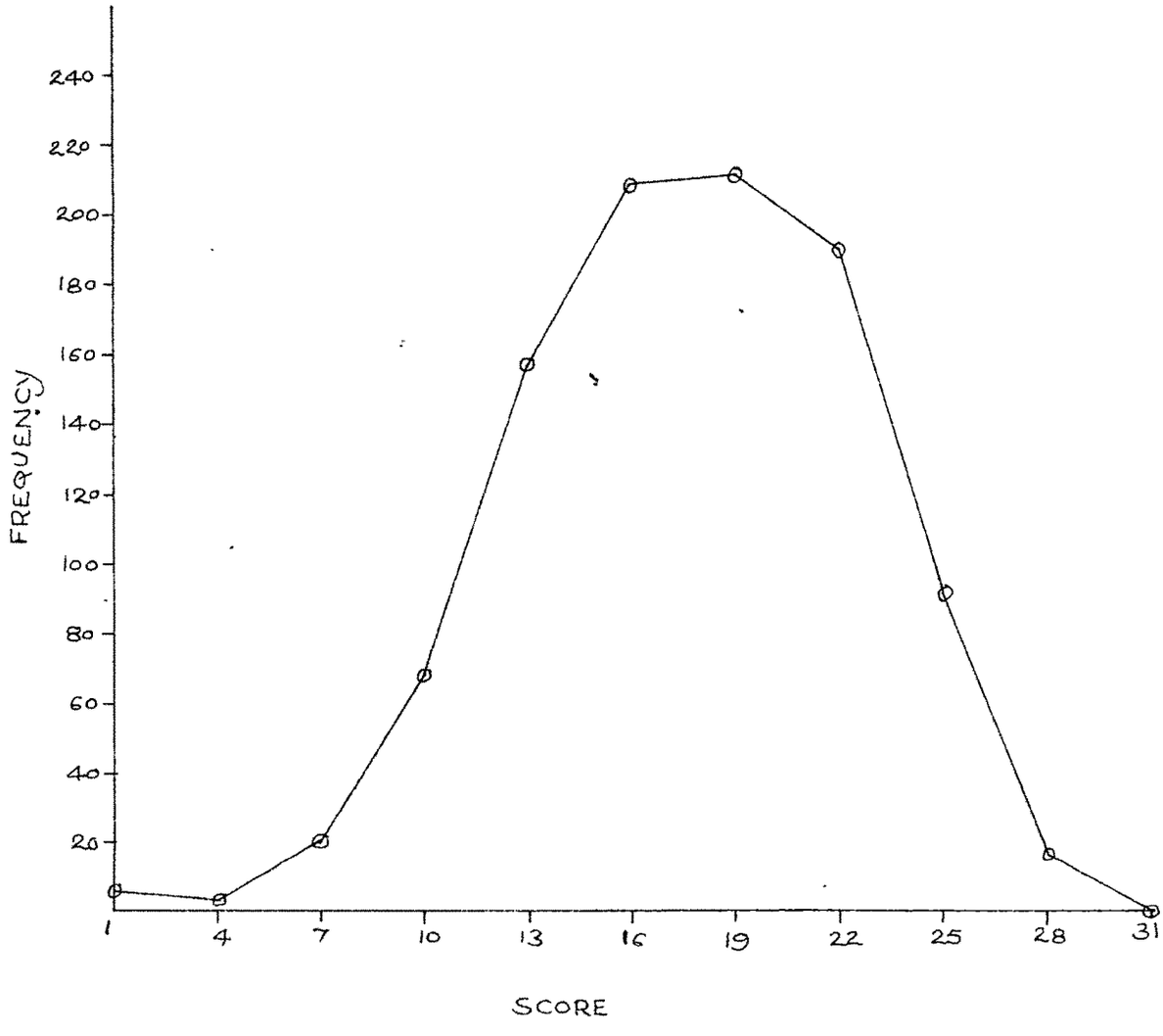


FIG - 4.4

FREQUENCY POLYGON OF KNOWLEDGE SCORES OF TOTAL SAMPLE (973)

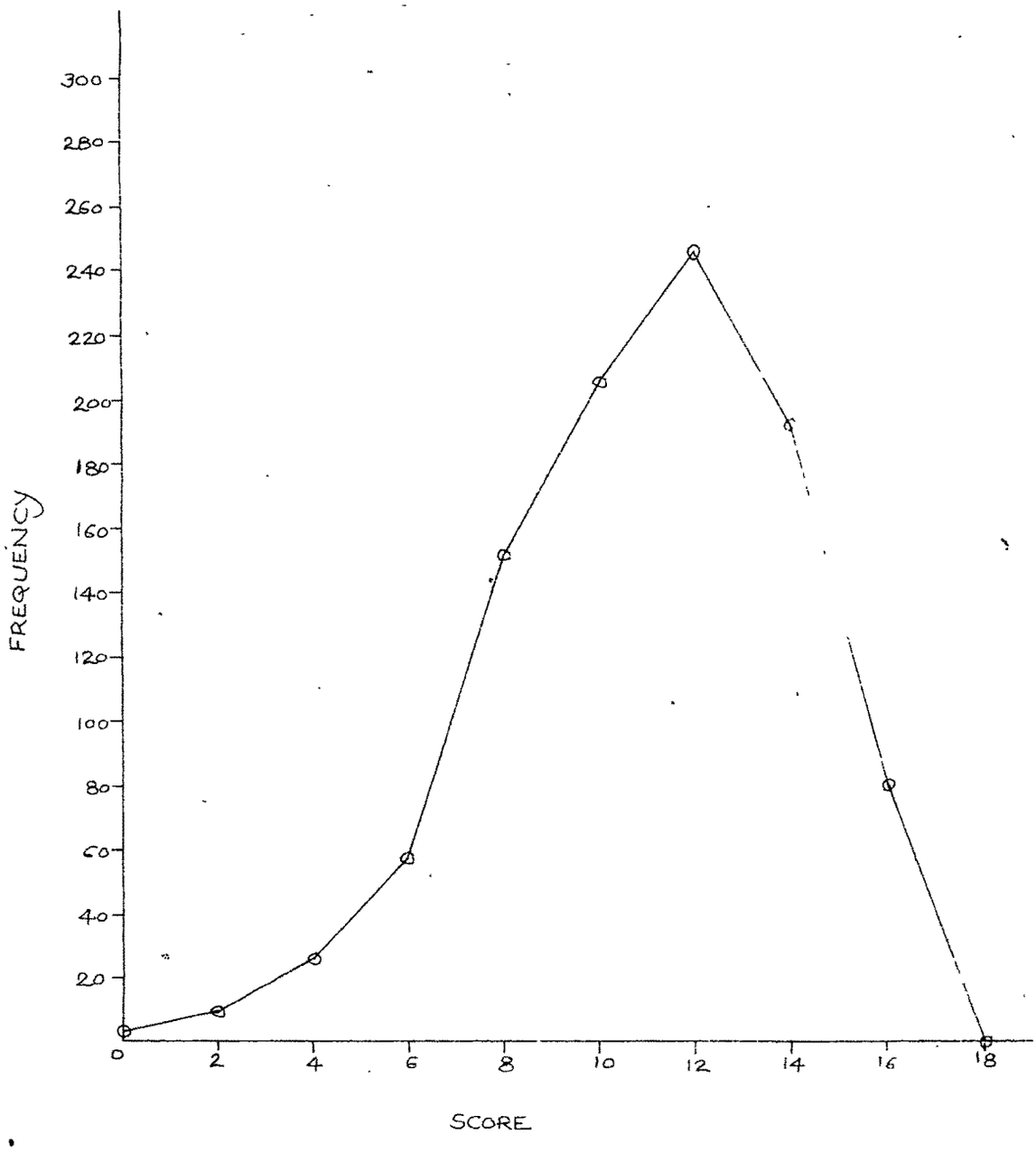


FIG - 4.5

FREQUENCY POLYGON OF COMPREHENSION SCORES OF TOTAL SAMPLE (973).

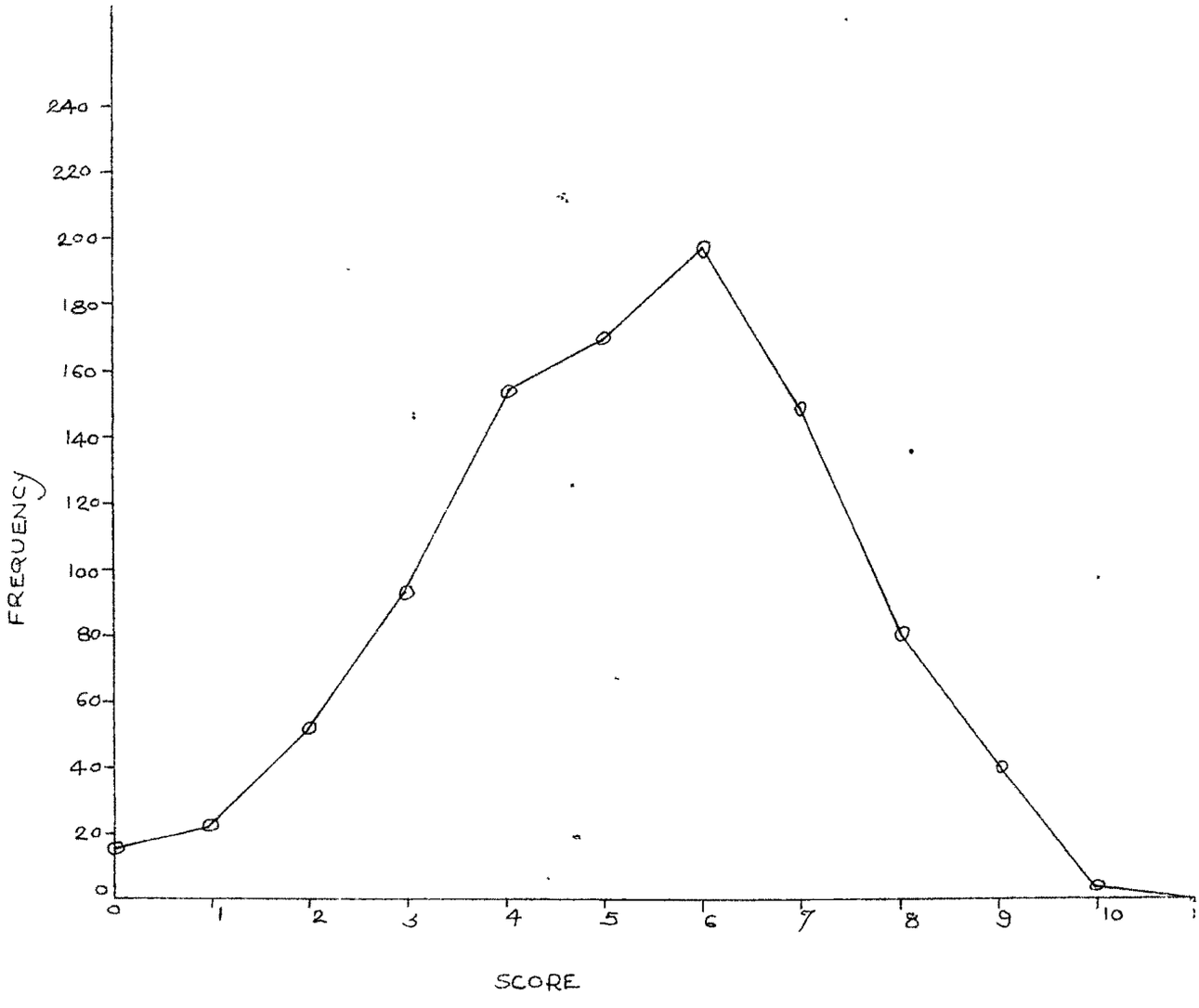
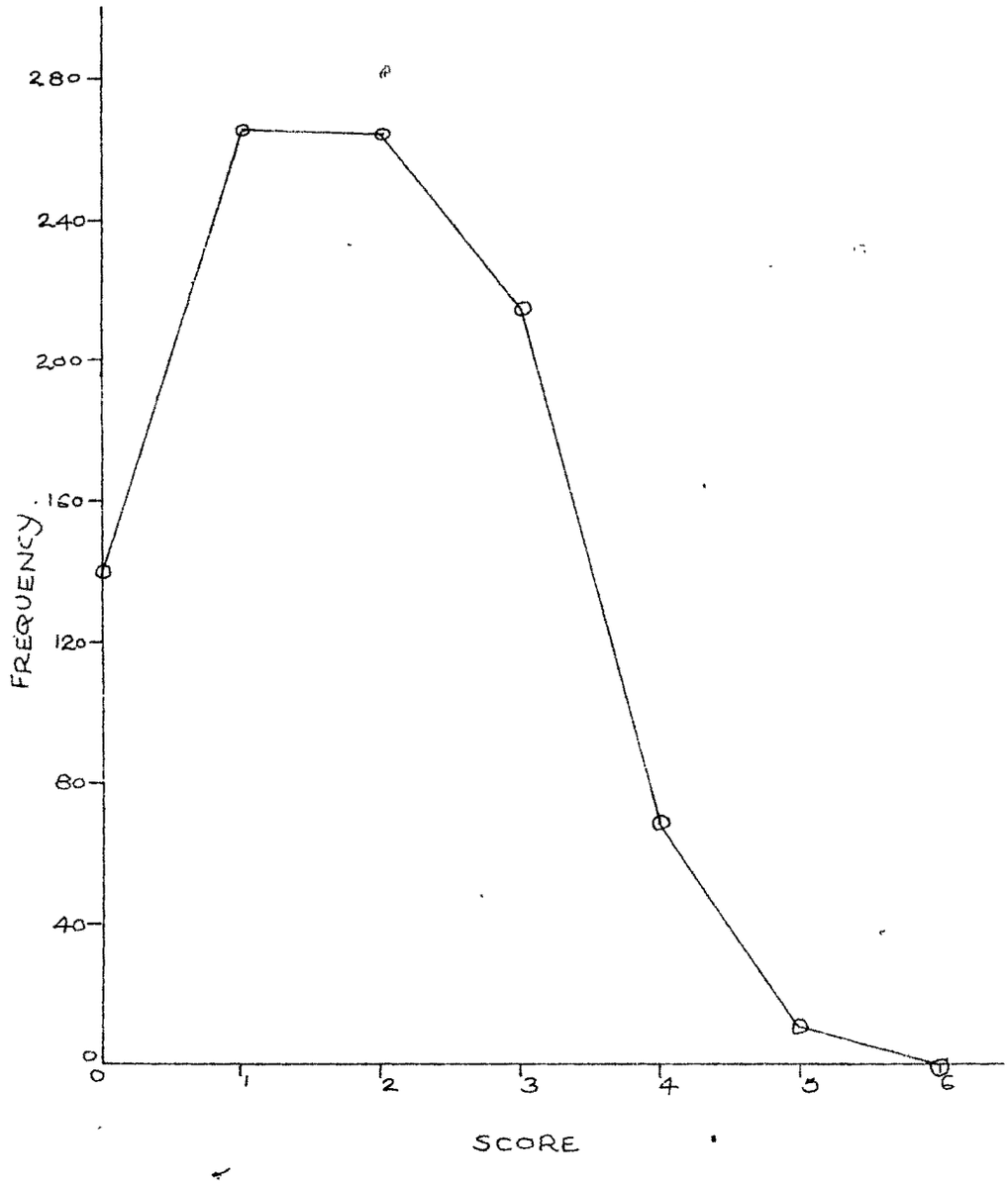


FIG - 46.

FREQUENCY POLYGON OF APPLICATION SCORES OF TOTAL SAMPLE (973)



normality of the criterion measure of total attainment. Fig. 4.3 also helps to support the near normal tendency of this variable. It is being mentioned here that the normality of variable is being referred to not as a necessary assumption for analysis of variance and covariance. McNemar (1962) comments in this respect as follows:

> Although these assumptions are incorporated in the mathematical derivations of the F-distribution, there is ample evidence that marked skewness, departure from normal kurtosis, and extreme difference in variance do not greatly disrupt the F-test as a basis for judging significance in the analysis of variance. (McNemar, 1962, p. 252)

Lindquist (1953) has also reported a study by Norton which showed that inequality of variance within the experimental sets did not seriously effect the applicability of F-test of analysis of variance.

The treatment with the other criterion variables of knowledge, comprehension and application constitutes the analytical aspect of the study. The nature of these variables in terms of frequency distributions, mean, median, SD, SE_M and SE_{SD} for subgroups and total sample have been presented in Tables 4.7 to 4.9. The figures 4.4 to 4.6 are the graphical representation of these data. The frequency distributions for all the three variables (K, C and A) for all the subgroups and total sample are

continuous. The smaller differences between mean and median values also help to infer the near normal tendencies of these variables.

4.20 ANALYTICAL APPROACH (Classwise Results)

For the purpose of having an estimation of the performance on all the six variables for the subgroups under P_1, P_2, P_3 and P_4, classwise analysis was done in terms of Mean and SD. The results related to mean and SD for all the six variables for each class under the four subgroups are presented in Tables 4.10 to 4.15.

Although, as mentioned in caption 3.60, the classes were randomly selected and assigned to different treatments yet some differences in the class mean scores of intelligence and pre-achievement are observed from the Tables 4.10 and 4.11. In case of classes under treatment P_1, the mean values within the twelve classes range from 78.631 to 88.695 for intelligence and 5.529 to 12.560 for pre-achievement. In case of P_2, the range for intelligence is from 79.67 to 91.160 and 7.200 to 12.833 for pre-achievement. For the subgroup under P_3, the range for intelligence scores and pre-achievement scores is from 74.500 to 87.609 and from 6.143 to 13.467 respectively. The results for P_4 show a range between 78.818 and 89.857 for intelligence and between 6.555 and 15.238 for pre-achievement. No attempt has been made to check

TABLE 4.10

CLASSWISE RESULTS FOR THE SCORES OF INTELLIGENCE IN TERMS OF N, M AND SD

Teacher	Class	P_1			P_2			P_3			P_4		
		N	M	SD	N	M	SD	N	M	SD	N	M	SD
T_1	C_1	15	80.928	5.982	19	79.67	1.828	30	80.667	6.472	19	82.20	5.800
	C_2	14	78.631	6.531	23	85.00	7.94	32	86.406	6.832	22	83.591	8.310
	C_3	19	80.353	6.173	21	83.00	7.458	18	82.611	5.293	23	82.609	8.015
	C_4	17	86.205	8.379	10	86.800	4.935	23	87.609	8.096	35	89.857	8.229
T_2	C_5	18	80.760	7.830	16	82.312	7.920	12	80.833	5.014	18	81.667	6.708
	C_6	18	80.526	6.762	23	85.869	10.512	25	79.960	5.219	26	85.538	8.932
	C_7	19	85.933	4.008	23	84.826	7.971	34	84.882	8.083	25	87.480	7.106
	C_8	14	80.569	5.830	24	89.916	9.327	15	80.867	8.500	13	82.231	8.666
T_3	C_9	22	79.954	6.392	23	81.687	5.587	10	82.900	9.364	21	80.762	5.051
	C_{10}	21	81.905	7.217	12	91.160	7.281	14	74.500	3.500	11	78.818	6.293
	C_{11}	23	88.695	5.996	16	86.956	8.062	14	83.714	4.949	22	86.454	7.596
	C_{12}	39	86.160	7.215	25	88.917	6.103	19	81.474	7.301	18	89.777	6.442

TABLE 4.11

CLASSWISE RESULTS FOR THE SCORES OF PRE-ACHIEVEMENT IN TERMS OF N, M and SD

Teacher	Class	P_1			P_2			P_3			P_4		
		N	M	SD	N	M	SD	N	M	SD	N	M	SD
T_1	C_1	15	9.643	1.986	19	8.210	2.607	30	7.600	4.005	19	12.895	2.860
	C_2	14	7.053	1.932	23	8.956	2.805	32	8.594	3.408	22	11.136	5.128
	C_3	19	5.529	1.144	21	9.286	3.354	18	7.111	2.787	23	11.565	3.386
	C_4	17	7.590	2.915	10	7.200	2.713	23	10.174	3.252	35	11.828	3.629
T_2	C_5	25	8.480	2.802	16	10.625	2.736	12	7.750	2.291	18	11.667	3.480
	C_6	25	7.158	1.980	23	8.739	3.578	25	6.240	2.566	26	8.846	3.613
	C_7	14	9.933	1.611	23	7.522	2.447	34	9.058	3.918	25	8.800	2.842
	C_8	13	8.480	2.802	24	6.250	2.681	15	13.467	4.334	13	7.615	1.689
T_3	C_9	22	8.545	3.525	23	6.187	2.007	10	7.000	1.265	21	15.238	1.743
	C_{10}	21	6.476	2.538	12	12.040	2.271	14	6.428	2.871	11	8.182	2.729
	C_{11}	23	9.609	2.080	16	4.956	1.601	14	6.143	1.641	22	8.345	2.648
	C_{12}	39	12.560	2.723	25	12.833	2.478	19	9.421	3.529	18	6.555	1.212

TABLE 4.12

CLASSWISE RESULTS FOR THE SCORES OF TOTAL ATTAINMENT IN TERMS OF N,M and SD

Teacher	Class	P_1			P_2			P_3			P_4		
		N	M	SD	N	M	SD	N	M	SD	N	M	SD
T_1	C_1	15	18.643	4.046	19	18.316	3.510	30	19.200	3.059	19	22.421	2.871
	C_2	14	18.526	2.098	23	18.696	4.572	32	19.625	4.255	22	19.227	6.529
	C_3	19	14.882	2.968	21	19.762	5.750	18	20.778	4.049	23	21.217	3.878
	C_4	17	17.282	3.909	10	20.100	5.787	23	20.826	3.952	35	21.257	4.115
T_2	C_5	25	15.840	4.046	16	19.750	7.284	12	18.083	4.030	18	17.167	5.795
	C_6	25	16.684	3.341	23	20.522	3.048	25	17.840	4.921	26	18.500	3.785
	C_7	19	18.933	3.678	23	17.391	5.122	34	21.059	4.849	25	18.880	3.421
	C_8	13	15.840	4.046	24	16.417	6.720	15	18.600	5.942	13	22.154	3.759
T_3	C_9	22	19.681	4.373	23	16.625	5.862	10	17.800	4.308	21	20.857	4.486
	C_{10}	21	14.762	4.628	12	19.480	3.061	14	21.00	3.854	11	18.182	5.390
	C_{11}	23	18.956	2.612	16	16.435	3.062	14	15.357	4.134	22	18.349	4.655
	C_{12}	39	17.160	4.249	25	14.917	4.962	19	21.105	3.528	18	17.778	6.442

TABLE 4.13

CLASSWISE RESULTS FOR THE SCORES OF KNOWLEDGE IN TERMS OF N, M and SD

Teacher	Class	P_1			P_2			P_3			P_4		
		N	M	SD	N	M	SD	N	M	SD	N	M	SD
T_1	C_1	15	11.500	2.692	19	10.737	2.551	30	11.367	2.228	19	13.842	1.814
	C_2	14	10.895	2.314	23	10.826	3.595	32	11.594	2.089	22	11.273	3.756
	C_3	19	10.470	3.310	21	11.524	3.347	18	12.555	2.630	23	12.304	2.696
	C_4	17	11.231	2.768	10	11.800	3.945	23	13.217	2.620	35	13.543	2.272
T_2	C_5	25	9.560	2.624	16	12.562	4.046	12	12.750	3.700	18	9.889	3.740
	C_6	25	10.789	2.105	23	12.652	1.991	25	11.000	2.668	26	11.385	2.482
	C_7	19	11.867	3.344	23	10.435	3.561	34	13.059	2.743	25	9.080	2.544
	C_8	13	9.560	2.624	24	10.167	3.933	15	11.267	3.586	13	13.308	1.937
T_3	C_9	22	12.364	3.141	23	11.000	3.984	10	11.500	3.354	21	12.619	2.420
	C_{10}	21	9.381	2.360	12	12.360	2.415	14	13.071	2.186	11	11.595	2.965
	C_{11}	23	11.174	1.810	16	10.435	2.550	14	9.786	1.858	22	10.695	2.985
	C_{12}	39	10.680	2.976	25	9.917	2.871	19	13.895	2.245	18	10.889	3.430

TABLE 4.14

CLASSWISE RESULTS FOR THE SCORES OF COMPREHENSION IN TERMS OF N. M and SD

Teacher	Class	P_1			P_2			P_3			P_4		
		N	M	SD	N	M	SD	N	M	SD	N	M	SD
T_1	C_1	15	4.786	1.372	19	5.631	1.783	30	6.167	1.185	19	6.263	1.250
	C_2	14	4.842	1.586	23	5.739	1.594	32	6.531	2.031	22	5.318	2.457
	C_3	19	3.941	1.211	21	5.571	2.28	18	6.655	1.802	23	6.043	1.574
	C_4	17	4.282	1.880	10	6.200	1.249	23	5.913	1.282	35	5.686	1.769
T_2	C_5	25	4.520	1.962	16	5.625	2.848	12	4.083	1.552	18	5.495	2.191
	C_6	25	4.421	1.388	23	5.348	1.784	25	4.920	2.261	26	5.038	1.829
	C_7	19	4.733	1.526	23	4.913	1.976	34	5.853	2.060	25	3.560	1.699
	C_8	13	4.520	1.962	24	4.625	2.595	15	5.467	2.125	13	6.923	1.859
T_3	C_9	22	5.273	1.629	23	4.187	2.530	10	4.700	1.187	21	6.333	2.031
	C_{10}	21	4.809	2.217	12	6.000	0.980	14	5.786	1.820	11	4.459	2.310
	C_{11}	23	5.522	1.281	16	5.043	1.429	14	4.500	2.096	22	5.460	2.034
	C_{12}	39	4.640	2.261	25	3.500	2.141	19	6.000	1.589	18	4.944	1.508

TABLE 4.15

CLASSWISE RESULTS FOR THE SCORES OF APPLICATION IN TERMS OF N, M and SD

Teacher	Class	P_1			P_2			P_3			P_4		
		N	M	SD	N	M	SD	N	M	SD	N	M	SD
T_1	C_1	15	2.071	1.033	19	1.947	1.538	30	1.667	1.011	19	2.316	1.126
	C_2	14	2.789	1.151	23	1.696	1.158	32	1.500	1.090	22	2.636	1.263
	C_3	19	0.470	0.915	21	2.267	1.089	18	1.611	1.008	23	2.913	0.829
	C_4	17	1.770	0.919	10	2.100	1.300	23	1.696	1.653	35	2.028	1.082
T_2	C_5	25	1.760	1.41	16	1.562	1.273	12	1.250	0.722	18	1.833	1.014
	C_6	25	1.579	1.426	23	2.522	01714	25	1.680	1.191	26	2.077	0.874
	C_7	19	2.233	0.596	23	2.043	0.954	34	2.000	1.328	25	1.290	0.763
	C_8	13	1.760	1.141	24	1.625	0.922	15	1.867	1.204	13	1.923	1.071
T_3	C_9	22	2.045	1.492	23	1.437	0.933	10	1.600	1.281	21	1.762	1.151
	C_{10}	21	0.619	0.575	12	1.120	0.952	14	2.143	1.245	11	2.182	0.936
	C_{11}	23	2.391	1.276	16	0.956	1.042	14	1.071	1.100	22	2.016	1.054
	C_{12}	39	1.840	1.433	25	1.417	0.862	19	1.368	1.265	18	1.944	0.780

the significance of these differences but in case the differences are significant, a vigorous design of analysis of covariance has been followed to account for such differences in initial abilities.

In the case of criterion variables of total attainment and attainment for knowledge, comprehension and application, the range of mean values under different subgroups, classwise is as follows: (i) For total attainment, the x range for P_1 is between 14.882 and 19.681, for P_2 it is 14.917 and 20.522, for P_3 the range is from 15.357 to 21.105 and from 13,880 to 22.421 for P_4; (ii) in case of knowledge, the range is from 9.560 to 12.364 for P_1, from 9.917 to 12.652 for P_2, from 9.786 to 13.895 for P_3 and from 9.080 to 13.842 for P_4; (iii) for comprehension, the mean values range from 3.941 to 5.522 for P_1, from 3.500 to 6.200 for P_2, from 4.083 to 6.655 for P_3 and from 3.560 to 6.923 for P_4; (iv) as far as the mean values for application are concerned, the range is between .470 and 2.789 for P_1; .956 and 2.552 for P_2; 1.071 and 2.143 for P_3 and 1.240 and 2.913 for P_4. The significance of the differences between means across the patterns shall be discussed later on when the 't' values for these x scores shall be presented and hypotheses for the study will be tested.

4.30 PRODUCT-MOMENT CORRELATION AMONGST INTELLIGENCE, PRE-ACHIEVEMENT AND CRITERION VARIABLES

In order to see the relationship between variables of intelligence and pre-achievement and criterion variables of total attainment and attainment for knowledge, comprehension and application, product-moment correlations were worked out for the four subgroups under P_1, P_2, P_3 and P_4 and total sample. The results of intercorrelations along with N, M and SD for each pattern are being presented in Tables 4.16 to 4.20.

TABLE 4.16

CORRELATION MATRIX (6 x 6) FOR PATTERN I
(N = 239)

Variables	I	PA	T	K	C	A
I		.326**	.308**	.231**	.258**	.127
PA			.334**	.201**	.258**	.261**
T				.834**	.667**	.407**
K					.286**	.071
C						.094
A						

** Significant at .01 level.

TABLE 4.17

CORRELATION MATRIX (6 x 6) FOR PATTERN II
(N = 235)

Variables	I	PA	T	K	C	A
I		.288**	.347**	.363**	.288**	-.014
PA			.375**	.373**	.267**	.106
T				.902**	.797**	.383**
K					.578**	.148*
C						.125
A						

* Significant at .05 level. ** Significant at .01 level

TABLE 4.18

CORRELATION MATRIX (6 x 6) FOR PATTERN III
(N = 246)

Variables	I	PA	T	K	C	A
I		.382**	.326**	.313**	.257**	.101
PA			.376**	.370**	.281**	.129
T				.874**	.736**	.494**
K					.437**	.276**
C						.131
A						

** Significant at .01 level.

TABLE 4.19

CORRELATION MATRIX (6 x 6) FOR PATTERN IV
(N = 253)

Variables	I	PA	T	K	C	A
I		.072	.253**	.298**	.092	.135
PA			.421**	.358**	.379**	.188**
T				.895**	.843**	.430**
K					.580**	.138*
C						.322**
A						

* Significant at .05 level ** Significant at .01 level

TABLE 4.20

CORRELATION MATRIX (6 x 6) for TOTAL SAMPLE
(N = 973)

Variables	I	PA	T	K	C	A
I		.263**	.298**	.293**	.213**	.095**
PA			.380**	.329**	.294**	.190**
T				.882**	.776**	.416**
K					.498**	.153**
C						.158**
A						

** Significant at .01 level

The intercorrelations amongst the variables were worked out to see from a correlational approach whether the variables I & PA share some common variance with the criterion variables. In case of significant relationship between these two sets of variables coupled with varying levels of the variables I & PA (measured in terms of mean scores) between subgroups under P_1, P_2, P_3 and P_4, it becomes necessary to adjust the final criterion scores for the influence of initial differences in intelligence and pre-achievement scores. The presence of the significant mean differences amongst subgroups have already been demonstrated vide Table 4.3 for intelligence and vide Table 4.5 for pre-achievement. It, therefore, becomes necessary to see the intercorrelations amongst all the six variables. It was sufficient to calculate inter-correlations for the total sample but to have wider and comprehensive analysis and treatment, the results were worked out for the subgroups as well as for the total sample.

The Table 4.16 represents the intercorrelations amongst different variables for the subgroup P_1. It shows that except for the relationship between intelligence and application, knowledge and application and comprehension and application all other correlations are significant at .01 level. The two variables of intelligence and pre-

achievement have a positive correlation of .326 sharing about 10.63 per cent of the common variance. This indicates that the two variables of intelligence and pre-achievement are of different nature. The relationships between the two sets of variables range from .127 (between I and A) to .334 (between PA and T). This again suggests that the common variance shared between I and PA on the one hand and criterion variables on the other, is rather low. The relationships within the criterion variables range from .071 (between K and A) to .834 (between T and K). This suggests that the constituents of the application scores are different from those of knowledge and comprehension. This may be a hopeful sign of the purity of the measures of knowledge, comprehension and application.

The table 4.17 similar to table 4.16 includes the intercorrelations amongst the same sets of variables for Pattern II. The picture is almost same except that the relationship between pre-achievement and application is not significant. In case of Table 4.18, the variable of application is not significantly related to the variables of intelligence and pre-achievement and also to the dependent variable of comprehension. All other intercorrelations are significant.

The Table 4.19 presents a little bit different picture in the sense that the behaviour of the variable

of intelligence resulted into not significant relationship between intelligence and pre-achievement and intelligence and comprehension. It is interesting to note that the variable of application is significantly related to all other variables. If the samples under P_1, P_2, P_3 and P_4 can be assumed to be similar then the differences in patterns of correlation matrices in Tables 4.16 to 4.19 can be attributed to the treatment variables of patterns of teacher behaviour.

Table 4.20 unlike Tables 4.16 to 4.19 presents the intercorrelations amongst the various variables under consideration for the total sample. All the fifteen correlation coefficients are significant either at .01 level or at .05 level. In general, three statements can be made based upon all the five matrices (Tables 4.16 to 4.20). Firstly, the relationship between the two variables of I and PA is low. Secondly, the relationship between the variables I and PA and criterion variables are either not significant or low. Thirdly, the relationship within the set of criterion variables is positive and significant in general except for the variable of application.

4.40 THREE-WAY ANALYSIS OF VARIANCE

It has been mentioned in chapter III, caption 3.94 and in the introduction of the present chapter, caption 4.00 that three-way analysis of variance will be

followed. The relationship between the intervening variables I and PA and criterion variables has been studied with the help of correlational approach vide Tables 4.16 to 4.20 and 't' ratio approach vide Tables 4.3 and 4.5. To be doubly cautious, efforts have been made again to see if the variables I and PA influence the dependent variables with the help of three-way analysis of variance. This approach is going to provide extra information of two types than that provided by the earlier analysis. Firstly, the interactional effects and secondly the effect of twovariables of I and PA and the treatment patterns in terms of P_1, P_2, P_3 and P_4. Keeping this in view three-way analysis of variance having varied two variables of I and PA at three levels (high, average and low) and treatment variables varied in four ways in terms of Pattern I, Pattern II, Pattern III and Pattern IV was employed. Since the study involves four criterion variables, the results were calculated four times.

The four assumptions of the analysis of variance vide Guilford (1956) are: (i) the contributions to variance in the total sample must be additive; (ii) the observations between steps must be mutually independent; (iii) the variances within experimentally homogeneous sets must be approximately equal; and (iv) the variations within experimentally homogeneous sets should be from normally distributed populations. Some of these

assumptions have been taken care of by empirical verifications in the present study. The observations within the sets of the tables of analysis of variance are mutually exclusive. The distributions of the scores for criterion variables of total attainment and attainment for knowledge, comprehension and application are having near normal conditions (see Tables 4.6 to 4.9 and Figures 4.3 to 4.6). The equal homogeneity of variances within the experimental sets have been tested with the help of the Bartlett's test of Homogeneity. The data and the results for the three-way analysis of variance are given below in Tables 4.21 to 4.28.

TABLE 4.21

BARTLETT'S TEST OF HOMOGENEITY FOR THREE-WAY ANALYSIS OF VARIANCE FOR I, PA AND PATTERNS (3x3x4) HAVING THE CRITERION SCORES OF TOTAL ATTAINMENT

Level of Intelligence	Level of Pre-achievement	P_1	P_2	P_3	P_4
		22	17	14	22
		24	23	12	22
	H	19	22	15	14
		21	24	7	21
		26	28	13	28
		17	20	14	25
		18	19	10	23
	M	15	28	15	22
		20	25	17	20
		22	20	17	16

Level of Intelligence	Level of Pre-Achievement	P_1	P_2	P_3	P_4
H					
		16	15	9	16
		10	14	12	12
	L	21	13	16	21
		14	20	13	17
		13	16	12	12
		10	18	13	24
		19	21	17	24
	H	11	15	16	22
		19	24	16	16
		21	13	17	25
M					
		20	11	9	20
		21	23	11	20
	M	18	25	14	13
		23	17	13	22
		13	28	14	20
		13	19	10	14
		12	2	13	16
	L	14	18	10	16
		11	15	11	20
		16	16	12	9
		13	20	16	16
		11	11	26	9
	M	17	4	21	24
		12	10	24	14
		19	18	19	23
L					
		18	17	19	26
		14	15	22	12
	L	14	18	12	17
		16	17	18	11
		12	17	13	3

TABLE 4.22

SUMMARY OF ANALYSIS OF VARIANCE (3x3x4) WITH THE CRITERION SCORES OF TOTAL ATTAINMENT

Sources of variation	S.S.	df.	M.V.	F
I	297.900	2	148.950	6.813**
PA	575.033	2	287.517	13.150**
Patterns	249.022	3	83.007	3.797**
I x PA	96.967	4	24.242	1.109
I x P	57.744	6	9.624	.440
PA x P	77.011	6	12.835	.587
I x PA x P	375.103	12	31.258	1.430
SSU	3148.400	144	21.864	
SST	4877.200	179		

** Significant at .01 level.

TABLE 4.23

BARTLETT'S TEST OF HOMOGENEITY FOR THREE-WAY ANALYSIS OF VARIANCE FOR INTELLIGENCE, PRE-ACHIEVEMENT AND PATTERNS (3x3x4) HAVING THE CRITERION SCORES OF KNOWLEDGE

Level of Intelligence	Level of Pre-Achievement	P_1	P_2	P_3	P_4
		12	11	14	14
		14	15	12	14
	H	13	15	15	11
		12	13	7	12
		16	17	13	17

Level of Intelligence	Level of Pre-Achievement	P_1	P_2	P_3	P_4
		11	13	14	17
		10	13	10	13
	M	11	17	15	12
		13	15	17	11
		12	14	17	10
		11	8	9	9
		4	9	12	5
	L	15	9	16	13
		8	13	13	11
		9	10	12	5
		5	9	13	15
		14	12	17	17
M	H	5	9	16	13
		12	16	10	8
		15	9	17	13
		13	9	9	12
		15	13	11	12
	M	13	16	14	10
		14	11	13	15
		8	16	14	13
		10	10	10	6
		9	0	13	10
	L	12	13	10	9
		6	10	11	12
		12	10	12	7
		11	2	9	8
L		17	8	11	15
	H	8	11	8	12
		9	11	16	11
		15	10	15	13
		11	10	11	10
		8	6	16	4
	M	8	3	12	15
		5	7	16	10
		11	10	12	12

Level of Intelligence	Level of Pre-Achievement	P_1	P_2	P_3	P_4
		12	9	11	16
		9	8	11	10
	L	8	11	9	9
		12	11	13	6
		9	10	9	3

TABLE 4.24

SUMMARY OF ANALYSIS OF VARIANCE (3x3x4) WITH THE CRITERION SCORES OF ATTAINMENT FOR KNOWLEDGE

Source of variation	S.S.	df.	M.V.	F
I	103.878	2	51.939	6.143**
PA	222.178	2	111.089	13.139**
Patterns	86.422	3	288.073	34.071**
I x PA	63.889	4	15.972	1.889
I x P	35.011	6	5.835	.690
PA x P	39.411	6	6.568	.778
I x PA x P	332.256	12	27.688	3.275
SSW	1217.600	144	8.455	
SST	1900.645	179		

** Significant at .01 level.

TABLE 4.25

BARTLETT'S TEST OF HOMOGENEITY FOR THREE-WAY ANALYSIS OF VARIANCE FOR INTELLIGENCE, PRE-ACHIEVEMENT AND PATTERNS (3x3x4) HAVING THE CRITERION SCORES OF COMPREHENSION

Level of Intelligence	Level of Pre-Achievement	Patterns			
		P_1	P_2	P_3	P_4
H	H	6	6	6	5
		8	8	7	6
		4	4	6	8
		8	8	8	4
		8	8	8	7
	M	5	5	7	9
		6	6	6	3
		4	4	9	9
		6	6	6	9
		6	6	5	5
	L	4	4	6	3
		5	5	3	5
		4	4	3	7
		4	4	6	3
		3	3	4	7
M	H	3	3	8	9
		1	1	3	7
		3	3	6	7
		4	4	7	5
		4	4	2	8
	M	4	4	1	5
		3	3	7	9
		4	4	7	4
		6	6	4	9
		5	5	10	5
	L	3	3	6	3
		3	3	6	7
		2	2	3	6
		4	4	5	7
		4	4	4	7

Level of Intelligence	Level of Pre-Achievement	Patterns			
		P_1	P_2	P_3	P_4
H	H	6	7	4	0
		6	6	4	5
		5	3	3	6
		4	3	8	6
		6	5	6	6
	M	2	7	3	4
		1	5	7	3
		5	0	8	7
		5	3	6	3
		5	7	6	9
	L	5	5	2	10
		4	5	7	2
		5	4	2	5
		4	5	2	4
		3	6	4	0

TABLE 4.26

SUMMARY OF ANALYSIS OF VARIANCE (3x3x4) WITH THE CRITERION SCORES OF ATTAINMENT FOR COMPREHENSION

Sources of variation	S.S.	df.	M.V.	F
I	35.100	2	17.55	4.525*
PA	57.733	2	28.866	7.443**
Patterns	41.133	3	13.711	3.535**
I x PA	9.267	4	2.317	.597
I x P	37.033	6	6.172	1.591
PA x P	5.333	6	.889	.229
I x PA x P	40.201	12	3.350	.864
SSW	558.400	144	3.878	
SST	784.200	179		

* Significant at .05 level
** Significant at .01 level

TABLE 4.27

BARTLETT'S TEST OF HOMOGENEITY FOR THREE-WAY ANALYSIS OF VARIANCE FOR INTELLIGENCE, PRE-ACHIEVEMENT AND PATTERNS (3x3x4) HAVING THE CRITERION SCORES OF APPLICATION

Level of Intelligence	Level of Pre-Achievement	Patterns			
		P_1	P_2	P_3	P_4
	H	4	0	1	2
		2	1	2	1
		2	1	2	1
		1	3	0	3
		2	3	1	3

Level of Intelligence	Level of Pre-Achievement	Patterns			
		P_1	P_2	P_3	P_4
H	M	1	0	2	2
		2	0	0	4
		0	2	2	3
		1	4	3	3
		4	1	4	2
	L	1	1	2	4
		1	2	2	3
		2	1	4	2
		3	1	5	2
		0	0	3	3
	H	2	5	1	3
		2	1	1	2
		5	3	3	3
		3	1	1	4
		2	2	3	3
M	M	3	1	0	2
		3	3	2	2
		1	2	0	1
		3	2	1	1
		0	2	0	2
	L	0	3	0	2
		0	2	4	3
		0	2	0	2
		1	0	1	3
		0	2	1	1
	H	1	3	2	0
		3	3	0	4
		2	0	1	3
		3	0	3	0
		3	2	2	2
L	M	0	3	2	2
		2	0	3	2
		4	1	1	2
		2	0	2	1
		3	1	1	3
	L	1	3	6	0
		1	2	4	0
		1	3	2	3
		0	1	3	1
		0	1	0	0

TABLE 4.28

SUMMARY OF ANALYSIS OF VARIANCE (3x3x4) WITH THE CRITERION SCORES OF ATTAINMENT FOR APPLICATION

Sources of variation	S.S.	df	M.V.	F
I	1.478	2	0.739	0.512
PA	4.011	2	2.005	1.388
Patterns	5.750	3	1.917	1.327
I x PA	13.022	4	3.255	2.54
I x P	20.300	6	3.383	2.342*
PA x P	30.433	6	5.072	3.511**
I x PA x P	16.667	12	1.389	0.961
SSW	208.000	144	1.444	
SST	299.601	179		

* Significant at .05 level
** Significant at .01 level

The results vide Tables 4.21 and 4.22 are given for the criterion variables of T. Table 4.21 includes data for 36 experimental conditions resulted due to 3 levels of I x 3 levels of PA x 4 treatment patterns. Each of these 36 cells include five mutually exclusive cases selected by using random tables, thus, covering 130 cases. The Bartlett's test applied according to the procedural steps of Edward (1960) resulted into corrected Chi-square value of 34.137 for df 35 which is not significant. This indicates that the variances within the experimental sets

are equal, thus the third assumption of analysis of variance as given by Guilford (1956) is satisfied. Table 4.22 presents summary of analysis (3x3x4) with the criterion score of total attainment. The major effects of the variables of I and PA and treatment patterns P_1, P_2, P_3 and P_4 on the dependent variable of T are significant at .01 level (F ratio of 6.313 for df 2/144 for I; F ratio of 13.150 for df 2/144 for PA and F ratio of 3.791 for df 3/144 for patterns). The results indicate that all the three variables have significant influence upon the criterion variable. The two variables of intelligence and pre-achievement are non-manipulative whereas the variable of treatment patterns has been manipulated. Since the aim is to see the uncontaminated effect of treatment variables on attainment, it is necessary that the criterion scores should be adjusted for the initial differences in intelligence and pre-achievement. This would necessitate the use of another treatment of analysis of covariance.

The analytical results for the criterion variables of attainment for knowledge, comprehension and application by following three-way analysis of variance are given in Tables 4.23 to 4.28. The values of Chi-square found with the help of Bartlett's test are 34.004, 45.857 and 32.570 with df 35 for the criterion variables of knowledge, comprehension and application respectively. The summary of analysis of variance for the criterion variable of

knowledge given in Table 4.24 indicates that intelligence and pre-achievement and treatment patterns have significant effect upon attainment for knowledge (F ratio of 6.143 for df 2/144 for intelligence and F ratio of 13.139 for df 2/144 for pre-achievement and F ratio of 34.071 for df 3/144 for patterns). This also suggests the necessity of analysis of covariance design where the effects of treatment patterns can be seen when final criterion scores are adjusted for initial differences in intelligence and achievement.

Table 4.26 shows that the variables of intelligence, pre-achievement and pattern have significant effect upon attainment for comprehension (F ratio of 4.525 for df 2/144 for I, F ratio of 7.443 for df 2/144 for PA, and F ratio of 3.535 for df 3/144 for patterns). In this case, the F ratio for I is significant at .05 level while it has been previously significant at .01 level for total attainment and attainment for knowledge both. Again the treatment of analysis of covariance becomes a must to adjust for the effects of intelligence and pre-achievement on the criterion variable of attainment for comprehension.

In case of the criterion variable of application the effects of variables of intelligence, pre-achievement and patterns are not significant vide Table 4.28, whereas the simple interaction of I by pattern is significant at .05 level (F ratio of 2.342 for df 6/144) and pre-achievement

and patterns is significant at .01 level (F ratio of 3.511 for df 6/144). This implies that in a particular pattern the varying levels of intelligence as well as pre-achievement produce variations within the criterion variable of application.

4.50 ANALYSIS OF COVARIANCE

The results given in the above captions have indicated that the variables of intelligence and pre-achievement have significant influence upon the dependent variables of total attainment and attainment for knowledge, comprehension and application (see results of correlation and three-way analysis of variance under captions 4.30 and 4.40). The 't' ratio results for the variables of intelligence and pre-achievement vide Table 4.3 and Table 4.5 demonstrated that initial levels (mean scores) of intelligence and pre-achievement differed within the experimental subgroups under treatments P_1, P_2, P_3 and P_4. Both these conditions necessitated the application of one way analysis of covariance in order to have uncontaminated results for the effect of treatments P_1, P_2, P_3 and P_4 on the criterion variables of total attainment and attainment for knowledge, comprehension and application. The analysis of covariance with two variables taken at the same time would have been better but the non-availability of the computer programme for two way analysis of

covariance within the reach of the investigator restricted the approach to one way analysis of covariance. The two variables with each of the criterion variables resulted into eight studies of analysis of covariance. From the subgroups under each treatment of P_1, P_2, P_3 and P_4 twenty cases from each subgroup were selected randomly using the random tables for analysis purpose. The results in the form of analysis of variance and covariance, adjusted means, differences amongst adjusted means for each of the eight covariance studies are given in Tables 4.29 to 4.36.

The Tables 4.29 to 4.32 comprise the results for the criteria measures of total attainment and attainment for knowledge, comprehension and application under treatments P_1, P_2, P_3 and P_4. The scores of the criterion measures have been adjusted for the initial differences of intelligence among pupils under different subgroups. The significance of differences amongst the adjusted mean scores for the different treatments has been finally tested with the help of 't' test.

According to Table 4.29, the treatment P_3 resulted into the highest adjusted mean score (21.405) for total attainment which is significantly higher at .01 level from the mean values for P_1 (17.454), P_2 (17.887) and P_4 (17.752). The Table 4.30 too shows treatment P_3 with the highest adjusted mean scores (13.438) for knowledge which is

TABLE 4.29

Adjusting the Mean Criterion Score for Total Attainment (T) for Initial Differences in Intelligence (I)
(X = Scores for I, Y = Scores for T)

Analysis of Variance of X and Y Scores, taken separately

Sources of variations	df	SSx	SSy	MSx(Vx)	MSy(Vy)
Among Means	3	341.650	213.650	113.883	71.083
Within Groups	76	4469.900	1823.500	58.814	23.993
Total	79	4811.550	2037.050		

Fx = 1.936
Fy = 2.962

From Table F
df 3/76
F.at .05 level = 2.72
F.at .01 level = 4.04

Computation of Adjusted SS for Y: i.e. SSy,x

Total SS	Within SS	Among M'S SS
1934.547	1726.461	208.086

Analysis of Covariance

Sources of variations	df	SSx	SSy	Sxy	SSy.x	MSy.x(Vy.x)	SDy.x
Among Means	3	341.650	213.250	42.650	208.086	69.362	
Within Groups	75	4469.900	1823.500	658.600	1726.461	23.019	4.797
Total	78	4811.550	2036.750	701.250	1934.547		

Fy.x = 3.013

From Table F
df 3/75
F at .05 level = 2.74
F at .01 level = 4.07

Correlation and Regression

r total	r among means	r within	total	among means	within
.224	.158	.230	.145	.124	.147

Calculation of Adjusted Y Means

Groups	N	Mx	My	My.x (adjusted)
1 (P_1)	20	82.350	17.200	17.454
2 (P_2)	20	87.550	18.400	17.887
3 (P_3)	20	83.700	21.350	21.405
4 (P_4)	20	82.700	17.550	17.752

Significance of difference among Adjusted Y Means

SDy.x	$SE_{My.x}$	SE$_D$ between any two adjusted means
4.797	1.072	1.517

From Table D
df 75
t .05 = 2.00
t .01 = 2.65

Significant differences at .05 level = 2 x 1.517 = 3.034
Significant differences at .01 level = 2.65 x 1.517 = 4.020

Difference between Adjusted Means for P_1, P_2, P_3 and P_4 and their significance

$P_1 - P_2$	= 0.133	$P_2 - P_3$	= 3.518*
$P_1 - P_3$	= 3.951*	$P_2 - P_4$	= 0.135
$P_1 - P_4$	= 0.298	$P_3 - P_4$	= 3.653*

* Significant at .05 level ** Significant at .01 level

TABLE 4.30

ADJUSTING THE MEAN CRITERION SCORE FOR ATTAINMENT OF KNOWLEDGE OBJECTIVE (K) FOR INITIAL DIFFERENCES IN INTELLIGENCE (I)
(for X = Scores I, Y = Scores for K)

Analysis of Variance of X and Y Scores, taken separately

Sources of variations	df	SSx	SSy	MSx(Vx)	MSy(Vy)
Among Means	3	341.650	87.250	113.883	29.083
Within groups	76	4469.900	728.700	58.814	9.588
Total	79	4811.550	815.950		

Fx = 1.936
Fy = 3.033

From Table F
df 3/76
F at .05 level = 2.72
F at .01 level = 4.04

Computation of Adjusted SS for Y: i.e., SSy.x

Total SS	Within SS	Among M'S SS
763.230	682.170	81.059

Analysis of Covariance

Sources of variation	df	SSx	SSy	Sxy	SSy.x	MSy.x(Vy.x)	SDy.x
Among Means	3	341.650	87.250	47.600	81.059	27.419	
Within Groups	75	4469.900	728.700	456.050	682.170	9.095	3.015
Total	78	4811.550	815.950	503.650	763.230		

Fy.x = 2.970

From Table F
df 3/75
F at .05 level = 2.76
F at .01 level = 4.07

Correlation and Regression

r total	r among means	r within	total	among means	within
.254	.275	.254	.104	.139	.102

Calculation of Adjusted Y Means

Groups	N	Mx	My	My.x (adjusted)
1 (P_1)	20	82.350	4.650	10.925
2 (P_2)	20	87.550	4.850	11.448
3 (P_3)	20	83.700	6.100	13.438
4 (P_4)	20	82.700	4.750	11.093

Significance of difference among Adjusted Y Means

SDy.x	$SE_{My.x}$	SE_D between any two adjusted means
3.015	.674	.953

From Table D
df 75
t .05 = 2.00
t .01 = 2.65

Significant differences at .05 level = 2 x .953 = 1.906
Significant differences at .01 level = 2.65 x .953 = 2.299

Difference between Adjusted Means for P_1, P_2, P_3 and P_4 and their significance

$P_1 - P_2$ = .520
$P_1 - P_3$ = 2.513 **
$P_1 - P_4$ = .167
$P_2 - P_3$ = 1.993 *
$P_2 - P_4$ = .343
$P_3 - P_4$ = 2.34 *

* Significant at .05 level ** Significant at .01 level

TABLE 4.31

ADJUSTING THE MEAN CRITERION SCORE FOR ATTAINMENT FOR COMPREHENSION OBJECTIVE (C) FOR INITIAL DIFFERENCES IN INTELLIGENCE (I) (X = Scores for I, Y = Scores for C)

Analysis of Variance of X and Y Scores, taken separately

Sources of variations	df	SSx	SSy	MSx(Vx)	MSy(Vy)
Among Means	3	341.650	27.737	113.883	9.245
Within Groups	76	4469.900	300.650	58.814	3.955
Total	79	4811.550	328.387		

Fx = 1.936
Fy = 2.337

From Table F
df 3/76
F at .05 level = 2.72
F at .01 level = 4.04

Computation of Adjusted SS for Y; i.e. SSy.x

Total SS	Within SS	Among M'S SS
323.867	295.802	28.064

Analysis of Covariance

Sources of variations	df	SSx	SSy	Sxy	SSy.x	MSy.x(Vy.x)	SDy.x
Among Means	3	341.650	27.737	0.275	28.064	9.354	
Within Groups	75	4469.900	300.650	147.200	295.802	3.944	1.985
Total	78	4811.550	328.387	147.475	323.867		

Fy.x = 2.371

From Table F
df 3/75
F at .05 level = 2.74
F at .01 level = 4.07

Correlation and Regression

r total	r among means	r within	total	among means	within
.117	.002	.126	.030	.000	.032

Calculation of Adjusted Y Means

Groups	N	Mx	My	My.x (adjusted
1 (P_1)	20	82.350	4.650	4.706
2 (P_2)	20	87.550	4.850	4.735
3 (P_3)	20	83.700	6.100	6.112
4 (P_4)	20	82.700	4.750	4.795

Significance of Difference among Adjusted Y Means

SDy.x	$SE_{M_{y.x}}$	SE_D between any two adjusted means
1.985	.444	.628

From Table D
df = 75
t .05 = 2.00
t .01 = 2.65

Significant differences at .05 level = 2 x .628 = 1.256
Significant differences at .01 level = 2.65 x .628 = 1.664

Difference between Adjusted Means for P_1, P_2, P_3 and P_4 and their significance

$P_1 - P_2$ = .028
$P_1 - P_3$ = 1.406 *
$P_1 - P_4$ = .089
$P_2 - P_3$ = 1.377 *
$P_2 - P_4$ = .060
$P_3 - P_4$ = 1.317 *

* Significant at .05 level ** Significant at .01 level

TABLE 4.32

ADJUSTING THE MEAN CRITERION SCORE FOR ATTAINMENT FOR APPLICATION OBJECTIVE (A) FOR INITIAL DIFFERENCES IN INTELLIGENCE (I)
(X = Scores for I, Y = Scores for A)

Analysis of Variance of X and Y Scores, taken separately

Sources of variations	df	SSx	SSy	MSx(Vx)	MSy(Vy)
Among Means	3	341.650	0.137	113.883	0.045
Within Groups	76	4469.900	118.050	58.814	1.553
Total	79	4811.550	118.187		

Fx = 1.936
Fy = 0.029

From Table F
df 3/76
F at .05 level = 2.72
F at .01 level = 4.04

Computation of Adjusted SS for Y i.e. SSy.x

Total SS	Within SS	Among M'S SS
117.665	117.364	0.300

Analysis of Covariance

Sources of Variations	df	SSx	SSy	Sxy	SSy.x	MSy.x(Vy.x)	SDy.x
Among Means	3	341.650	.137	- 5.225	.300	.100	
Within Groups	75	4469.900	118.050	55.360	117.364	1.565	1.250
Total	78	4811.550	118.187	50.135	117.665		

Fy.x = 0.64

From Table F
df 3/75
F at .05 level = 2.74
F at .01 level = 4.07

Correlation and Regression

r total	r among means	r within	total	among means	within
.066	-.762	.076	.010	-.015	.012

Calculation of Adjusted Y Means

Groups	N	Mx	My	My (adjusted)
1 (P_1)	20	82.350	1.800	1.821
2 (P_2)	20	87.550	1.750	1.706
3 (P_3)	20	83.700	1.850	1.854
4 (P_4)	20	82.700	1.850	1.867

Significance of Difference among Adjusted Y Means

SDy.x	$SE_{My.x}$	SE_D between any two adjusted means
1.250	.079	.395

From Table D
df = 75
t .05 = 2.00
t .01 = 2.65

Significant differences at .05 level = 2 x .395 = .790
Significant differences at .01 level = 2.65 x .395 = 1.047

Difference between Adjusted Means for P_1, P_2, P_3 and P_4 and their significance

$P_1 - P_2 = .015$
$P_1 - P_3 = .033$
$P_1 - P_4 = .046$
$P_2 - P_3 = .048$
$P_2 - P_4 = .161$
$P_3 - P_4 = .007$

* Significant at .05 level ** Significant at .01 level

significantly higher at .01 level from P_1 (10.925) and at .05 level from P_2 (11.445) and P_4 (11.092). The Table 4.31 gives results for comprehension, In this case too, as for total attainment and application, the treatment P_3 attained the highest adjusted mean scores of 6.112 which is significantly higher at .05 level from those for P_1 (4.706), P_2 (4.735) and P_4 (4.795). However, the Table 4.32 presents a different picture than that of the Tables 4.29 to 4.31. The adjusted mean scores for application for the four treatments are 1.821 for P_1, 1.706 for P_2, 1.854 for P_3 and 1.867 for P_4. The differences amongst them are not significant.

The above Tables 4.29 to 4.32 help to draw the conclusion that treatment P_3 is the most effective treatment as far as the total attainment and the attainment for knowledge and comprehension objectives are concerned but as far as the objective of application is concerned, all the four treatments do not produce differential effects.

The Tables 4.33 to 4.36 present results for analysis of covariance for the criterion measures of total attainment and attainment for knowledge, comprehension and application adjusted for the initial differences in pre-achievement.

The procedural steps are the same as followed for the adjustment of criterion scores for the effects of

TABLE 4.33

ADJUSTING THE MEANS CRITERION SCORE FOR TOTAL ATTAINMENT (T)
FOR INITIAL DIFFERENCES IN PRE-ACHIEVEMENT (PA)
(X = Scores for PA, Y = Scores for T)

Analysis of Variance of X and Y Scores, taken separately

Sources of variations	df	SSx	SSy	MSx(Vx)	MSy(Vy)
Among Means	3	68.537	213.250	22.846	71.083
Within Groups	76	871.350	1823.500	11.466	23.993
Total	79	939.887	2036.750		

Fx = 1.992
Fy = 2.62

From Table F
df 3/76
F at .05 level = 2.72
F at .01 level = 4.04

Computation of Adjusted SS for Y: i.e. SSy.x

Total SS	Within SS	Among M'S SS
1944.080	1648.853	295.226

Analysis of Covariance

Sources of Variation	df	SSx	SSy	Sxy	SSy.x	MSy.x(Vy.x)	SDy.x
Among Means	3	68.537	213.250	- 94.975	295.226	98.408	
Within Groups	75	871.350	1823.500	390.100	1648.853	21.984	4.688
Total	78	939.887	2036.750	295.125	1944.080		

Fy.x = 4.476

From Table F
df 3/75
F at .05 level = 2.74
F at .01 level = 4.07

Correlation and Regression

r total	r among means	r within	total	among means	within
.213	-.785	.309	.314	-1.385	.447

Calculation of Adjusted Y Means

Groups	N	Mx	My	My.x (adjusted)
1 (P_1)	20	9.350	17.200	17.283
2 (P_2)	20	10.300	18.400	18.058
3 (P_3)	20	8.100	21.350	21.993
4 (P_4)	20	10.400	17.550	17.163

Significance of difference among Adjusted Y Means

SDy.x	$SE_{My.x}$	SE_D between any two adjusted means
4.688	1.048	1.482

From Table D
df = 75
t .05 = 2.00
t .01 = 2.65

Significant differences at .05 level = 2 x 1.482 = 2.964
Significant differences at .01 level = 2.65 x 1.482 = 3.927

Difference between Adjusted Means for P_1, P_2, P_3 and P_4 and their Significance

$P_1 - P_2 = .775$
$P_1 - P_3 = 3.710$ **
$P_1 - P_4 = 0.120$
$P_2 - P_3 = 3.935$ **
$P_2 - P_4 = 0.895$
$P_3 - P_4 = 4.830$ **

* Significant at .05 level ** Significant at .01 level

TABLE 4.34

ADJUSTING THE MEAN CRITERION SCORE FOR ATTAINMENT FOR KNOWLEDGE OBJECTIVE (K) FOR INITIAL DIFFERENCES IN PRE-ACHIEVEMENT (PA)
(X = Scores for PA, Y = Scores for K)

Analysis of Variance of X and Y scores, taken separately

Sources of variation	df	SSx	SSy	MSx(Vx)	MSy(Vy)
Among Means	3	68.537	93.438	22.845	31.146
Within Groups	76	871.350	711.750	11.466	9.365
Total	79	939.887	805.188		

Fx = 1.992
Fy = 3.325

From Table F
df = 3/76
F at .05 level = 2.72
F at .01 level = 4.04

Computation of Adjusted SS for Y. i.e., SSy.x

Total SS	Within SS	Among M'S SS
780.464	661.811	118.653

Analysis of Covariance

Sources of variation	df	SSx	SSy	Sxy	SSy.x	MSy.x(Vy.x)	SDy.x
Among Means	3	68.537	93.438	- 56.162	118.653	39.551	
Within Groups	75	871.350	711.750	208.600	661.811	8.824	2.970
Total	78	939.887	805.188	152.437	780.464		

Fy.x = 4.482

From Table F
df = 3/75
F at .05 level = 2.74
F at .01 level = 4.07

Correlation and Regression

r total	r among means	r within	total	among means	within
.175	-.701	.264	.162	-.810	.239

Calculation of Adjusted Y Means

Groups	N	Mx	My	My.x (adjusted)
1 (P_1)	20	9.350	10.600	10.644
2 (P_2)	20	10.300	11.800	11.617
3 (P_3)	20	8.100	13.400	13.744
4 (P_4)	20	10.400	10.950	10.743

Significance of Difference among Adjusted Y Means

SDy.x	$SE_{My.x}$	SE_D between any two adjusted means
2.970	0.664	0.939

From Table D
df = 75
t .05 = 2.00
t .01 = 2.65

Significant differences at .05 level = 2.00 x .939 = 1.878
Significant differences at .01 level = 2.65 x .939 = 2.488

Difference between Adjusted Means for P_1, P_2, P_3 and P_4 and their significance

$P_1 - P_2 = .973$
$P_1 - P_2 = 3.100$ **
$P_1 - P_4 = .099$
$P_2 - P_3 = 2.027$ *
$P_2 - P_4 = .874$
$P_3 - P_4 = 3.001$ **

* Significant at .05 level ** Significant at .01 level

TABLE 4.35

ADJUSTING THE MEAN CRITERION SCORE FOR ATTAINMENT FOR COMPREHENSION OBJECTIVE (C) FOR INITIAL DIFFERENCES IN PRE-ACHIEVEMENT (PA)
(X = Scores for PA, Y = Scores for C)

Analysis of Variance of X and Y scores, taken separately

Sources of variations	df	SSx	SSy	MSx(Vx)	MSy(Vy)
Among Means	3	68.537	26.900	22.843	8.966
Within Groups	76	871.350	302.300	11.465	3.977
Total	79	939.887	329.200		

Fx = 1.992
Fy = 2.254

From Table F
df 3/76
F at .05 level = 2.72
F at .01 level = 4.04

Computation of Adjusted SS for Y: i.e., SSy.x

Total SS	Within SS	Among M'S SS
322.940	287.437	35.503

Analysis of Covariance

Sources of variation	df	SSx	SSy	Sxy	SSy.x	MSy.x(Vy.x)	SDy.x
Among Means	3	68.537	26.900	- 37.1	35.503	11.834	
Within Groups	75	871.350	302.300	113.8	287.437	3.832	1.957
Total	78	939.887	329.200	76.7	322.940		

Fy.x = 3.089

From Table F
df 3/75
F at .05 level = 2.74
F at .01 level = 4.07

Correlation and Regression

r total	r among means	r within	total	among means	within
.137	-.864	.221	.081	-.541	.130

Calculation of Adjusted Y Means

Groups	N	Mx	My	My.x (adjusted)
1 (P_1)	20	9.350	4.700	4.724
2 (P_2)	20	10.300	4.850	4.750
3 (P_3)	20	8.100	6.100	6.287
4 (P_4)	20	10.400	4.750	4.637

Significance of Difference among Adjusted Y Means

SDy.x	$SE_{My.x}$	SE_D BETWEEN ANY TWO ADJUSTED MEANS
1.957	.437	.619

From Table D
df = 75
t .05 = 2.00
t .01 = 2.65

Significant differences at .05 level = 2.00 x .619 = 1.238
Significant differences at .01 level = 2.65 x .619 = 1.640

Difference between Adjusted Means for P_1, P_2, P_3 and P_4 and their significance

P_1	-	P_2	=	.026
P_1	-	P_3	=	1.563 *
P_1	-	P_4	=	.087
P_2	-	P_3	=	1.537 *
P_2	-	P_4	=	.113
P_3	-	P_4	=	1.650 **

* Significance at .05 level ** Significance at .01 level

TABLE 4.26

ADJUSTING THE MEAN CRITERION SCORE FOR ATTAINMENT FOR APPLICATION OBJECTIVE (A) FOR INITIAL DIFFERENCES IN PRE-ACHIEVEMENT (PA)
(X = Scores for PA, Y = Scores for A)

Analysis of Variance of X and Y Scores, taken separately

Sources of variations	df	SSx	SSy	MSx(Vx)	MSy(Vy)
Among Means	3	68.537	.437	22.845	0.145
Within Groups	76	871.350	119.050	11.465	1.566
Total	79	939.887	119.487		

Fx = 1.992
Fy = 0.93

From Table F
df 3/70
F at .05 level = 2.72
F at .01 level = 4.04

Computation of Adjusted SS for Y: i.e., $SS_{y.x}$

Total SS	Within SS	Among M'S SS
114.723	113.182	1.540

Analysis of Covariance

Sources of variation	df	SSx	SSy	Sxy	$SS_{y.x}$	$MS_{y.x}(V_{y.x})$	$SD_{y.x}$
Among Means	3	68.537	.437	- 1.587	1.540	.513	
Within Groups	75	871.350	119.050	71.500	113.182	1.509	1.228
Total	78	939.887	119.487	66.312	114.723		

$F_{y.x}$ = -340

From Table F
df 3/75
F at .05 level = 2.74
F at .01 level = 4.07

Correlation and Regression

R r total	r among means	r within	total	among means	within
.199	-.837	.221	.071	-.066	.082

Calculation of Adjusted Y Means

Groups	N	Mx	My	My.x (adjusted)
1 (P_1)	20	9.350	1.900	1.915
2 (P_2)	20	10.300	1.750	1.687
3 (P_3)	20	8.100	1.950	2.067
4 (P_4)	20	10.400	1.850	1.779

Significance of difference among Adjusted Y Means

$SD_{y.x}$	$SE_{M_{y.x}}$	SE_D between any two adjusted means
1.228	.274	.388

From Table D
df = 75
t .05 = 2.00
t .01 = 2.65

Significant differences at .05 level = 2.00 x .388 = 0.776
Significant differences at .01 level = 2.65 x .388 = 1.028

Difference between Adjusted Means for P_1, P_2, P_3 and P_4 and their significance

$P_1 - P_2 = 0.228$
$P_1 - P_3 = 0.152$
$P_1 - P_4 = 0.136$
$P_2 - P_3 = 0.380$
$P_2 - P_4 = 0.092$
$P_3 - P_4 = 0.288$

* Significant at .05 level ** Significant at .01 level

intelligence. As far as the total attainment of pupils is concerned, treatment P_3 resulted in the highest adjusted mean score of 21.993. This value is significantly (.01 level) higher than that of the mean values for P_1 (17.283), P_2 (18.058) and P_4 (17.163). In the case of knowledge, again treatment P_3 has the highest mean value of 13.744 which is higher than the values for P_1 (3.100) significant at .01 level, P_2 (11.617) significant at .05 level and P_4 (10.743) significant at .01 level. Similarly, the adjusted mean values for comprehension under treatment P_3 is significantly higher at .05 level than the adjusted mean values for P_1 (4.724) and P_2 (4.250) and at .01 level than that for P_4 (4.637). The application mean scores under different patterns when adjusted for pre-achievement too did not show any significant differences. The respective adjusted mean values for different treatments are 1.915 for P_1, 1.687 for P_2, 2.067 for P_3 and 1.779 for P_4. The above mentioned results also qualify treatment P_3 as the most effective treatment for pupils' total attainment and attainment for knowledge and comprehension objectives. The treatments could not be differentiated as far as the attainment for application is concerned.

The next chapter discusses the results as presented in this chapter for each hypothesis.