CHAPTER SIX

RESULTS AND DISCUSSION

II - FOR CONTROL AND EXPERIMENTAL No.2 GROUPS (C AND E_2 GROUPS)

6.1 COMPARISON OF DIFFERENCE IN VERBAL TEACHING BEHAVIOUR PATTERNS

6.2 COMPARISON OF DIFFERENCE IN MEAN ACHIEVEMENT AT KNOWLEDGE, UNDERSTANDING AND APPLICATION LEVELS

6.3 DISCUSSION

CHAPTER SIX

RESULTS AND DISCUSSION

II - FOR CONTROL AND EXPERIMENTAL No. 2 GROUPS (C AND E_2 GROUPS)

In this chapter is presented results and discussion related to Control and Experimental No. 2 groups (C and E_2 groups).

6.1 COMPARISON OF DIFFERENCE IN VERBAL TEACHING BEHAVIOUR PATTERNS :

Results of various comparisons indicating the direction and significance of difference in verbal teaching behaviour patterns between C and E_2 groups of teachers are given as below:

1. Direction and Significance of Difference in all the 14 categories :

The results given in this section deal with comparisons of all the 14 categories between C and E_2 groups of teachers. Table 6.1 contains a comparative statement of percentage occurrence of these categories and table 6.2 gives the results of median test applied to the data of table 6.1.

Table 6.1

Percentage Occurrence of all the 14 Categories in C and E_2 Groups of Teachers

Teachers		CATEGORIES													
		1	2	3a	3b	4a	4b	4c	4d	5	6	7	8	9	10
C	1.	0.00	0.87	1.46	1.74	6.26	3.96	1.02	0.00	48.56	2.16	0.55	23.80	0.50	9.12
	2.	0.00	0.11	2.09	0.64	4.65	0.29	0.00	0.00	84.49	0.24	0.00	5.79	0.05	1.64
	3.	0.00	0.44	2.61	1.48	2.93	1.10	0.44	0.00	67.33	2.62	0.23	7.75	1.68	11.29
E_2	1.	0.40	4.88	11.12	4.09	7.37	4.55	2.92	2.03	25.84	0.65	0.00	29.91	1.41	4.77
	2.	0.07	0.91	3.37	0.16	5.02	1.65	1.69	0.37	44.31	0.96	0.04	38.26	0.23	2.85
	3.	0.48	1.35	5.36	1.05	6.07	2.60	2.38	0.81	44.06	0.62	0.02	33.16	0.97	1.00

Note : In the process of rounding off the values to two decimal places, small decimal values have either been lost or added to the total of 100%.

Median test was applied to the percentage occurrence of each of the above 14 categories given in table 6.1 in order to test the direction of difference and significance of difference as a result of training in the use of certain types of teaching behaviours in E_2 group of teacher as compared to C group of teachers who were not trained and who served as control. The results obtained are presented in table 6.2 which are then followed by explanation.

Table 6.2

Mean percentage occurrence of 14 categories, direction of difference and significance of difference in C and E_2 groups of teachers

Category	Teachers	Mean percentage occurrence of the category	Direction of difference	Significance of difference
1	2	3	4	5
1	C	0.00	This category was absent in C group of teachers whereas in all the E_2 group of teachers this category was found to be present though in small amount.	--
	E_2	0.32		
2	C	0.47	In all the three combined matrices category 2 was above common median in E_2 group of teachers.	Sig.at .05 level
	E_2	2.38		
3a	C	2.05	In all the three combined matrices category 3a was above common median in E_2 group of teacher.	Sig.at .05 level
	E_2	6.62		

1	2	3	4	5
3b	C	1.29	In about 67% of the combined matrices category 3b was below common median in E_2 group of teachers.	N.S.
	E_2	1.77		
4a	C	4.61	In about 67% of the combined matrices category 4a was above common median in E_2 group of teachers.	N.S.
	E_2	6.15		
4b	C	1.78	In about 67% of the combined matrices category 4b was above common median in E_2 group of teachers.	N.S.
	E_2	2.93		
4c	C	0.49	In all the three combined matrices category 4c was above common median in E_2 group of teachers.	Sig.at .05 level
	E_2	2.33		
4d	C	0.00	This category was absent in C group of teachers whereas in all the E_2 group of teachers this category was present, though in small amount.	--
	E_2	1.07		
5	C	66.79	In all the three combined matrices category 5 was below common median in E_2 group of teachers.	Sig. at .05 level
	E_2	38.07		
6	C	1.67	In about 67% of the combined matrices category 6 was below common median in E_2 group of teachers.	N.S.
	E_2	0.74		
7	C	0.26	Occurrence of this category was rare in general. However, this was so more in E_2 group of teachers.	--
	E_2	0.02		
8	C	12.45	In all the three combined matrices category 8 was above common median in E_2 group of teachers.	Sig.at .05 level
	E_2	33.78		

1	2	3	4	5
9	C	0.74	In about 67% of the combined matrices category 9 was above common median in E_2 group of teachers. However, the occurrence of this category was low.	N.S.
	E_2	0.87		
10	C	7.35	In about 67% of the combined matrices, category 10 was below common median in E_2 group of teachers.	N.S.
	E_2	2.89		

Note : (1) N.S. = Not significant
(2) Sig. = Significant

A look at table 6.2 above reveals that none of the C group teachers used category 1, accepting the feelings of the students, when they interacted with their students. As against this, all the three E_2 group teachers used this behaviour in their classes, though its occurrence was rare, particularly in the case of one of these three teachers. However, the result indicates effect of training on E_2 group of teachers in accepting the feelings of their students while interacting with their classes. As regards category 2, praising or encouraging the students, the combined matrices of all the three E_2 group teachers were above the common median which indicates effect of training in the use of this behaviour as also significance of difference of the occurrence of this behaviour in favour of E_2 group of teachers. Similarly category 3, providing confirmatory feedback was found to occur above common median in all the combined matrices of E_2 group of teachers and the difference of occurrence of this category

between C and E_2 groups of teachers was also found significant at .05 level of significance. So far as category 3b, providing corrective feedback is concerned, training did not seem to have produced significant variance. Rather inspite of the training, in about 67% of the combined matrices, this category was below common median in E_2 group of teachers.

About category 4a, asking cognitive memory questions in about 67% of the combined matrices this teaching behaviour was above common median in E_2 groups of teachers. This means that 2 out of 3 E_2 group of teachers asked cognitive memory question more as compared to 1 out of 3 C group of teachers. This difference in favour of E_2 group of teachers was, however, not significant. Similarly about category 4b, asking convergent questions, in 67% of the combined matrices this teaching behaviour was above common median in E_2 group of teachers. This means that 2 out of 3 E_2 group of teachers asked convergent type of questions more as compared to 1 out of 3 C group of teachers. This difference in favour of E_2 group of teachers was, however, not significant. Occurrence of category 4c, asking divergent questions, was significantly high (at .05 level) in E_2 group of teachers. That is, in all the three combined matrices, category 4c was above common median in E_2 group of teachers. As regards category 4d, asking evaluative questions, this teaching behaviour was found absent in all the three C group of teachers. As against this, all the E_2 group of teachers asked evaluative questions while interacting with their students. The incidence of category 5, lecturing, was found low in E_2 group of teachers. That is, in all the three combined matrices category 5 was below common

median in E_2 group of teachers which means that all these three teachers lectured less in comparison to the three teachers of C group. This difference in lecturing behaviour between C and E_2 groups of teachers was significant at .05 level of significance.

As regards category 6, giving direction and command, in about 67% of the combined matrices this behaviour was below common median in E_2 group of teacher. That is, only 1 out of 3 E_2 group of teachers used this behaviour as compared to 2 out of 3 C group of teachers. However, this difference was not found to be significant. Occurrence of category 7, criticising and justifying authority, was found rare in both the groups of teachers but this was so more in E_2 group of teachers. That is, as compared to C group of teachers, E_2 group of teachers used this teaching behaviour less frequently. About category 8, student-talk in response to teacher-talk, in all the three combined matrices, this student behaviour was above common median in E_2 group of teachers and was found to be significant at .05 level of significance. This means that students responded more to their teachers' talk in E_2 group than in C group. As regards category 9, student initiating talk on their own, in about 67% of the combined matrices this student behaviour was above common median in E_2 group of teachers although the occurrence of this category was generally low in both the groups of teachers. About category 10, silence or confusion, in 67% of the combined matrices, this category was below common median in E_2 group of teachers which means that in this group verbal communication lasted for longer time as compared to C group of teachers.

To summarize the above results :(i) significant

difference at .05 level of significance in favour of E_2 group of teachers was found in such teaching behaviours as praising and encouraging students (Cat.2), accepting students' ideas (Cat.3a), asking divergent questions (Cat.4c), lecturing (Cat.5) and students' talking in response to teacher talk, (ii) occurrence of teachers' accepting students' feelings (Cat.1) and teachers' asking evaluative questions (Cat. 4d) was also observed in E_2 group of teachers, though in small amount, whereas in C group of teachers this behaviour was altogether absent, (iii) occurrence of category 7, criticising and justifying authority, was rare in both the groups but this was so more in E_2 group of teachers, (iv) occurrence of asking more cognitive memory questions (Cat.4a), asking more convergent questions (4b), and students initiating their talk more was also found in favour of E_2 group of teachers although the occurrence of these behaviours were not found significant when compared to C group of teachers, (v) a somewhat surprising result was the use of category 3b, providing corrective feedback, by E_2 group of teachers. Despite training to use more of this behaviour, only 1 out of 3 E_3 group of teachers used this behaviour more as compared to 2 out of 3 C group of teachers, although this difference in favour of C group of teacher was not found significant.

2. <u>Direction and Significance of Difference in Teacher-talk Categories</u> :

The results presented in this section deals with comparison of different teacher-talk categories only between C and E_2 groups of teachers. Table 6.3 contains a comparative statement of percentage occurrence of teacher talk categories and table 6.4 gives the results of median test applied to the data of table 6.3.

Table 6.3

Percentage Occurrence of 11 Teacher-talk Categories in C and E_2 Groups of Teachers

Teachers		CATEGORIES										
		1	2	3a	3b	4a	4b	4c	4d	5	6	7
C	1.	0.00	1.31	2.18	2.62	9.40	5.94	1.53	0.00	72.92	3.23	0.83
	2.	0.00	0.11	2.26	0.68	5.02	0.31	0.00	0.00	91.33	0.25	0.00
	3.	0.00	0.55	3.29	1.86	3.69	1.39	0.58	0.00	84.94	3.37	0.29
E_2	1.	0.63	7.64	17.40	6.40	11.54	7.13	4.58	3.18	40.45	1.01	0.00
	2.	0.12	1.56	5.75	0.28	8.56	2.81	2.89	0.64	75.62	1.65	0.08
	3.	0.75	2.09	8.27	1.63	9.36	4.01	3.67	1.25	67.93	0.96	0.04

Note : In the process of rounding off the values to two decimal places, small decimal values have either been lost or added to the total of 100%

Median test was applied to the above percentage occurrence of each of the eleven categories in order to test the direction and significance of difference in the teaching behaviours represented by these categories. The results thus obtained are presented in table 6.4 below :

Table 6.4

Mean percentage occurrence of 11 teacher-talk Categories, direction of difference and significance of difference in C & E_2 groups of teachers

Category	Teachers	Mean percentage occurrence of the category	Direction of difference	Significance of difference
1	2	3	4	5
1	C	0.00	Occurrence of this category was absent in C group of teachers. This category was used by all the E_2 group of teachers, though in small amount.	--
	E_2	0.50		
2	C	0.66	In all the three combined matrices category 2 was above common median in E_2 group of teachers.	Sig. at .05 level
	E_2	3.76		
3a	C	2.58	In all the three combined matrices category 3a was above common median in E_2 group of teachers.	Sig. at .05 level
	E_2	10.47		
3b	C	1.72	In about 67% of the combined matrices category 3b was below common median in E_2 group of teachers.	N.S.
	E_2	2.77		

1	2	3	4	5
4a	C	6.04	In about 67% of the combined matrices category 4a was above common median in E_2 group of teachers.	N.S.
	E_2	9.82		
4b	C	2.55	In about 67% of the combined matrices category 4b was above common median in E_2 group of teachers	N.S.
	E_2	4.65		
4c	C	0.70	In all the three combined matrices category 4c was above common median in E_2 group of teachers.	Sig.at .05 level
	E_2	3.71		
4d	C	0.00	Occurrence of this category was absent in C group of teachers. This category was used by all the E_2 group of teachers.	--
	E_2	1.69		
5	C	83.06	In about 67% of the combined matrices category 5 was below common median in E_2 group of teachers.	N.S.
	E_2	61.33		
6	C	2.28	In about 67% of the combined matrices category 6 was below common median in E_2 group of teachers.	N.S.
	E_2	1.21		
7	C	0.37	In general occurrence of this category was rate. However, this was so more in E_2 groups of teachers.	--
	E_2	0.04		

Note : (1) N.S. = Not significant
(2) Sig. = Significant

The results obtained in table 6.4 above with respect to 11 teacher-talk categories revealed that, except for category 5, lecturing, the trend was the same as obtained in the case of

analysis of 14 categories representing classroom interaction of C and E_2 groups of teachers. Significant difference at .05 level of significance between these two groups of teachers was observed with respect to category 2 (praising and encouraging), 3a (providing confirmatory feedback,),and category 4c (asking divergent questions). As regards category 1(accepting feelings of the students) and category 4d (asking evaluative questions) none of the teachers in ≡ C group used these behaviours whereas all the E_2 group teachers used these teaching behaviours while interacting with their students. Occurrence of category 4a (asking cognitive memory questions), and 4b (asking convergent questions) was not found significantly different in these two groups of teachers although the direction of difference was in favour of E_2 groups of teachers. Occurrence of category 5, lecturing, was also not found significantly different whereas occurrence of this category was found significantly different when all the 14 categories had been considered. This shift in the values of significance of difference was due to the fact that percentage occurrence of this category got increased in the case of 1 out of the 3 E_2 groups of teachers when student-talk (Cat. 8 and 9) and silence and confusion (Cat. 10), were not considered. As in the case of 14 category analysis, category 6 (giving direction and command) and category 7 (criticising and justifying authority) were rare in both the groups of teachers although this was so more in the case of E_2 groups of teachers. Difference in the occurrence of category 3b (providing

corrective feedback), though not significant, was found in favour of C group of teachers which was contrary to what was expected to happen after E_2 groups of teachers had been given training to use this category more.

3. Direction and Significance of Difference in Selected Verbal Teaching Behaviour Patterns

As discussed in the procedure of the study, E_2 group of teachers were given planned training in the theory and practice of interaction process analysis and in using selected verbal teaching behaviour patterns. This was done with a view to achieving systematic difference between C and E_2 groups of teachers in the selected verbal teaching behaviour patterns such as general indirectedness, confirmatory and corrective feedback, and cognitive memory, convergent, divergent and evaluative questions. The results obtained with respect to these selected verbal teaching behaviour patterns in C and E_2 groups of teachers are given in the table below :

Table 6.5 on next page

Table 6.5

Percentage Occurrence of Selected Verbal Teaching Behaviour Patterns in C and E_2 groups of Teachers

Teachers		PATTERNS									
		TRR	TIFbR -89 (total)	TIFbR -89 (Con.)	TIFbR -89 (Cor.)	TQR (Total)	TQR (4a)	TQR (4b)	TQR (4c)	TQR (4d)	CCR
C	1.	60.09	67.44	27.81	39.53	18.80	11.42	7.54	2.06	0.00	75.91
	2.	92.34	97.14	75.24	21.90	5.52	5.21	0.34	0.00	0.00	97.08
	3.	60.93	91.03	59.31	31.72	6.27	4.17	1.61	0.68	0.00	80.89
Mean		71.12	85.20	54.12	31.05	10.20	6.93	3.16	0.91	0.00	84.63
E_2	1.	96.92	83.10	60.45	22.64	39.53	22.20	14.99	10.18	7.29	61.56
	2.	81.70	88.68	84.27	4.40	16.47	10.17	3.58	3.68	0.84	60.49
	3.	92.70	92.51	77.53	14.97	21.23	12.11	5.57	5.13	1.81	71.26
Mean		90.44	88.10	74.08	14.00	25.74	14.83	8.04	6.33	3.31	64.44

Note :

TRR	=	Teacher Response Ratio
TIFbR-89(Total)	=	Teacher Instantaneous Feedback Ratio(Total)
TIFbR-89(Con.)	=	Teacher Instantaneous Feedback Ratio(Confirmatory)
TIFbR-89(Cor.)	=	Teacher Instantaneous Feedback Ratio(Corrective)
TQR(Total)	=	Teacher Question Ratio (Total)
TQR(4a)	=	Teacher Question Ratio (Cognitive memory)
TQR(4b)	=	Teacher Question Ratio (Convergent)
TQR(4c)	=	Teacher Question Ratio (Divergent)
TQR(4d)	=	Teacher Question Ratio (Evaluative)
CCR	=	Content Cross Ratio

Mean test was applied to the results obtained in the table 6.5 to test the direction and significance of difference in selected verbal teaching behaviour patterns between C and E_2 groups of teachers. The findings are given below :

Table 6.6

Mean percentage occurrence of selected verbal teaching behaviour patterns, direction of difference and significance of difference in C & E_2 groups of teachers

Patterns	Teachers	Mean percentage occurrence of patterns	Direction of difference	Significance of difference
1	2	3	4	5
TRR	C	71.12	In about 67% of the combined matrices TRR was above common median in E_2 group of teachers	N.S.
	E_2	90.44		
TIFbR89 (Total)	C	85.20	In about 67% of the combined matrices TIFbR89(Total) was below common median in E_2 group of teachers.	N.S.
	E_2	88.10		
TIFbR89 (Con.)	C	54.12	In about 67% of the combined matrices TIFbR89(Con.) was above common median in E_2 group of teachers.	N.S.
	E_2	74.08		
TIFbR89 (Cor.)	C	31.05	In about 67% of the combined matrices TIFbR89(Cor.) was below common median in E_2 group of teachers.	N.S.
	E_2	14.00		
TQR(Total)	C	10.20	In about 67% of the combined matrices TQR(total) was above common median in E_2 group of teachers.	N.S.
	E_2	25.74		
TQR(4a)	C	6.93	In about 67% of the combined matrices TQR(4a) was above	N.S.
	E_2	14.83		

1	2	3	4	5
			common median in E_2 group of teachers.	
TQR(4b)	C	3.16	In about 67% of the combined matrices TQR(4b) was above common median in E_2 group of teachers.	N.S.
	E_2	8.04		
TQR(4c)	C	0.91	In all the three combined matrices TQR(4c) was above common median in E_2 group of teachers.	Sig.at .05 level
	E_2	6.33		
TQR(4d)	C	0.00	TQR(4d) absent in C group of teachers whereas in E_2 group of teachers this category was used by all the three teachers.	--
	E_2	3.31		
CCR	C	82.69	In about 67% of the combined matrices CCR was below common median in E_2 group of teachers.	N.S.
	E_2	64.44		

Note : (1) N.S. = Not significant
(2) Sig. = Significant

The values of ten different ratios in the table 6.5 were obtained on the basis of the formulae suggested by Flanders (1970) as was done when comparing C and E_1 groups of teachers (table 5.5). For the calculation of some of these ratios, some of the formulae had to be suitably modified. These ten ratios and the results of median test obtained in table 6.6 are explained as below :-

(i) The teacher response ratio(TRR) is an index which "corresponds to the teacher's tendency to react to ideas and feelings of the pupils." It gives an estimate of general indirectedness in teaching behaviour. The TRR was calculated

by adding category frequencies 1 + 2 + 3a + 3b, multiplying by 100, and dividing by the sum of category 1, 2, 3a, 3b, 6 and 7. Table 6.6 revealed that in about 67% of the combined matrices TRR was above common median in E_2 group of teachers. This means that although the difference in the occurrence of TRR in C and E_2 groups of teachers was not significant, the direction of this difference was in favour of E_2 group of teachers meaning thereby that 2 out of 3 E_2 group of teachers used this verbal teaching behaviour pattern more as compared to 1 out of 3 C group of teachers.

(ii) The teacher instantaneous feedback ratio (TIFbR89 Total) is an index of the tendency of the teacher to provide confirmatory and corrective feedback to the students at the moment they stop talking. The value of TIFbR89(Total) was calculated by adding the cell frequencies in rows 8 and 9, columns 3a and 3b, multiplying this sum by 100 and dividing the product by the total tallies in the cells of rows 8 and 9, columns 1, 2, 3a, 3b, 6 and 7. The result revealed that in about 67% of the combined matrices TIFbR89(total) was below common median in E_2 group of teachers. This indicates that despite training to use more of verbal feedback only 1 out of 3 E_2 group of teachers used this behaviour more frequently as compared to 2 out of 3 teachers in C group of teachers who used this behaviour more frequently. The difference was, however, not found to be significant.

(iii) The teacher instantaneous confirmatory feedback ratio (TIFbR89-confirmatory) is an index of the tendency of the teacher to provide confirmatory feedback to the pupils at the

moment the pupils stop talking. The TIFbR(con.) was calculated by adding cell frequencies in rows 8 and 9, column 3a, multiplying this sum by 100, and dividing the product by the total tallies in the cells of rows 8 and 9, columns, 1, 2, 3a, 3b, 6 and 7. The result revealed that in about 67% of the combined matrices TIFbR89(con.) was above common median in E_2 group of teachers. Thus, though, the difference in the occurrence of TIFbR(con.) in C and E_2 groups of teachers was not significant, the direction of this difference was in favour of E_2 group of teachers. This means that 2 out of 3 E_2 group of teachers provided confirmatory feedback more as compared to 1 out of 3 C group of teachers.

(iv) The teacher instantaneous corrective feedback ratio (TIFbR-89 corrective) is an index of the tendency of the teacher to provide corrective feedback in a non-threatening way to the pupils at the moment they stop talking. The TIFbR89 (cor.) was calculated by adding the cell frequencies in rows 8 and 9, column 3b, multiplying this sum by 100, and dividing the product by the total tallies in the cells of rows 8 and 9, columns 1, 2, 3a, 3b, 6 and 7. The obtained result indicated that in about 67% of the combined matrices TIFbR89(cor.) was below common median in E_2 group of teachers meaning thereby that despite training 2 out of 3 E_2 group of teachers were below common median in using this behaviour whereas 2 out of 3 C group of teachers were above common median. Thus, contrary to the expectation, the direction of difference, though not significant, was in favour of C group of teachers so far as this teaching pattern was concerned.

(v) The teacher question ratio, TQR(total), is an index of the tendency of the teacher to use four different types of question when "guiding the content oriented part of the class." The TQR (total) was calculated by adding category frequencies 4a, 4b, 4c and 4d, multiplying by 100, and dividing by the sum of category frequencies 4a, 4b, 4c, 4d and 5. It was found that in about 67% of the combined matrices TQR(total) was above common median in E_2 group of teachers. Although the difference in the occurrence of TQR(total) in C and E_2 groups of teachers was not significant, the direction of this difference was in favour of E_2 group of teachers indicating that 2 out of 3 E_2 groups of teachers asked the four types of questions more as compared to 1 out of 3 C group of teachers.

(vi) The teacher question ratio, TQR(4a), is an index of the tendency of the teachers to ask cognitive memory questions. The value of TQR(4a) was calculated by multiplying cell frequencies in 4a by 100 and dividing this value by frequencies in cells 4a and 5. It was found that although the difference in the occurrence of TQR(4a) in C and E_2 groups of teachers was not significant, the direction of this difference was in favour of E_2 group of teachers. This means that in about 67% of the combined matrices TQR(4a) was above common median in E_2 group of teachers.

(vii) The teacher question ratio, TQR(4b), is an index of the tendency of the teachers to ask convergent question. The value of TQR(4b) was calculated by multiplying cell frequencies in 4b by 100 and dividing this value by frequencies in cells 4b and 5. The result revealed that in about 67% of the combined

matrices TQR(4b) was above common median in E_2 group of teachers. This means that although the difference in the occurrence of TQR (4b) in C and E_2 groups of teachers was not found to be significant, the direction of this difference was in favour of E_2 group of teachers. This means that 2 out of 3 E_2 group of teachers used this verbal teaching behaviour pattern more as compared to 1 out of 3 C group of teachers.

(viii) The teacher question ratio, TQR(4c), is an index of the tendency of the teachers to ask divergent questions. The TQR(4c) was calculated by multiplying cell frequencies in 4c by 100 and dividing this value by frequencies in cells 4c and 5. The result revealed that in all the three combined matrices TQR(4c) was above common median in E_2 group of teachers. That is, the difference in the occurrence of TQR(4c) in C and E_2 groups of teachers was found to be statistically significant at .05 level of significance.

(ix) The teacher question ratio, TQR(4d), is an index of the tendency of the teacher to ask evaluative questions. This ratio was calculated by multiplying cell frequencies in 4d by 100 and dividing this value by frequencies in 4d and 5. It was found that this category was altogether absent in C group of teachers whereas it was used by all the three E_2 group of teachers. It appears training in the use of asking evaluative questions resulted in bringing about systematic variation in favour of E_2 group of teachers with regard to this teaching behaviour.

(x) The content cross ratio, CCR, gives an indication of the focus of class discussion of subject-matter. If CCR is exceptionally high it reveals that the teacher took active role in the class discussion. CCR is calculated by adding all frequencies in column and row of category 4a, 4b, 4c, 4d and 5, multiplying by 100, and dividing by sum of all the categories. It was found that in about 67% of the combined matrices CCR was below common median in E_2 group of teachers. This means that although the difference in the occurrence of CCR in C and E_2 groups of teachers was not significant, the direction of this occurrence was in favour of E_2 group of teachers indicating thereby that 2 out of 3 E_2 group of teachers did not dominate the classroom discussion but allowed students also to participate in this discussion. As against this, 2 out of 3 C group teachers took active role in the class discussion.

6.2 COMPARISON OF DIFFERENCE IN MEAN ACHIEVEMENT AT KNOWLEDGE, UNDERSTANDING AND APPLICATION LEVELS:

Now the second part of the results obtained on the basis of analysis of the data of students' achievement at K, U and A levels is presented as below :

1. Observed and Adjusted Mean Differences in Achievement :

Observed mean differences in achievement between C and E_2 groups of students were computed to get an idea of the general trend in these mean differences with respect to all the three levels of achievement. Similarly, the adjusted

mean differences at three levels of achievement were obtained following the application of covariance analysis to the relevant data. These results are given in the following table in a comparative perspective :

Table 6.7

Summary of the Observed and Adjusted Mean Differences in Achievement

Achievement levels	Observed mean differences C and E_2 groups of students			Adjusted mean differences C and E_2 groups of students		
	C	E_2	Diff.	C	E_2	Diff.
K	11.315	11.575	0.260	11.582	11.258	0.324
U	4.632	5.800	1.168	4.655	5.772	1.117
A	5.232	6.262	1.030	5.258	6.230	0.972

Note : K = Achievement at Knowledge level
U = Achievement at Understanding level
A = Achievement at Application level

2. Calculation of Significance of Difference between Mean Achievement at K, U and A levels in C and E_2 Groups of Students :

In order to find out the significance of the difference between mean achievement of these two groups of students, after adjusting for initial differences in previous knowledge and intelligence, analysis of covariance technique was applied to the relevant data. The stepwise summary of the results obtained for each of the K, U and A levels are presented below :

(a) Significance of difference at knowledge level(K) :

Step (i) - Sums of Squares

Variables	Source of variation	d.f.	S.S.
y = Achievement(K)	Between groups	1	2.916
	Within groups	173	1559.079
	Total	174	1561.995
$x^{(1)}$ = Intelligence	Between groups	1	7.202
	Within groups	173	11771.735
	Total	174	11778.937
$x^{(2)}$ = Previous Knowledge	Between groups	1	53.305
	Within groups	173	1626.032
	Total	174	1679.337

Step (ii) - Sums of Products

This involves obtaining all possible sums of products (two variables at a time) in a manner analogous to that by which the sums of squares were obtained. A summary of the results obtained is presented below :

Sums of Products

Product of two variables	Source of variation	Sum of Products
$yx^{(1)}$ Achievement(K) x Intelligence	Between groups	- 4.596
	Within groups	1157.333
	Total	1152.737
$yx^{(2)}$ Achievement(K) x Previous Knowledge	Between groups	12.472
	Within groups	938.837
	Total	951.309
$x^{(1)}x^{(2)}$ Intelligence x Previous Knowledge	Between groups	- 19.594
	Within groups	522.171
	Total	502.577

Step (iii) - Sums of Squares and Sums of Products Matrix

Now, between groups (treatments) sums of squares and sums of products matrix is presented as below :

$$T = \begin{pmatrix} Tyy & Tyx^{(1)} & Tyx^{(2)} \\ Tx^{(1)}y & Tx^{(1)}x^{(1)} & Tx^{(1)}x^{(2)} \\ Tx^{(2)}y & Tx^{(2)}x^{(1)} & Tx^{(2)}x^{(2)} \end{pmatrix} = \begin{pmatrix} 2.916 & -4.596 & 12.472 \\ -4.596 & 7.202 & -19.594 \\ 12.472 & -19.594 & 53.305 \end{pmatrix}$$

Similarly within groups (error) sums of squares and sums of products matrix is :

$$E = \begin{Bmatrix} Eyy & Eyx^{(1)} & Eyx^{(2)} \\ Ex^{(1)}{}_y & Ex^{(1)}{}_x{}^{(1)} & Ex^{(1)}{}_x{}^{(2)} \\ Ex^{(2)}{}_y & Ex^{(2)}{}_x{}^{(1)} & Ex^{(2)}{}_x{}^{(2)} \end{Bmatrix} = \begin{Bmatrix} 1559.079 & 1157.333 & 938.837 \\ 1157.333 & 11771.735 & 522.171 \\ 938.837 & 522.171 & 1626.032 \end{Bmatrix}$$

Step (iv) - Regression Coefficients and Adjusted Means

Source of variation	Regression Coefficients				Adjusted Means	
	b_1	b_2	$\bar{b}_1$	$\bar{b}_2$	$\bar{y}_1 A$	$\bar{y}_2 A$
Between Groups (Treatments)	-	-	.068584	.544022	-	-
Within Groups (Error)	.073752	.553658	-	-	11.582	11.258

Step (v) - Adjusted Sums of Squares, Degrees Freedmom, Adjusted Mean Squares F-Ratio

Source of variation	Adjusted S.S.	d.f.	Adjusted M.S.	F-Ratio
Between Groups (Treatments)	11.673	1	11.673	2.09
Within groups (Error)	953.930	171	5.578	

From the table d.f. 1/171
F at .05 level = 3.89

Since the obtained value of F, 2.09, is less than the table value of 3.89 at .05 level of significance, the hypothesis (2.1) that there is no significant difference in mean achievement at knowledge level between students exposed to verbal teaching behaviour patterns of C and E_2 groups of teachers is retained.

(b) Significance of difference at understanding level(U):

Step (i) - Sums of Squares

Variables	Source of variation	d.f.	S.S.
y = Achievement (U)	Between groups	1	59.289
	Within groups	173	566.905
	Total	174	626.194
$x^{(1)}$ = Intelligence	Between groups	1	7.202
	Within groups	173	11771.735
	Total	174	11778.937
$x^{(2)}$ = Previous knowledge	Between groups	1	53.305
	Within groups	173	1626.032
	Total	174	1679.337

Step (ii) - Sums of Products

This involves obtaining all possible sums of products (two variables at a time) in a manner analogous to that by which the sums of squares were obtained. A summary of the results obtained is presented below :

Sums of Products

Product of two variables	Source of variation	Sums of Products
$yx^{(1)}$	Between groups	- 20.665
Achievement(K) x Intelligence	Within groups	698.516
	Total	677.851
$yx^{(2)}$	Between groups	56.217
Achievement(K) x Previous knowledge	Within groups	138.874
	Total	195.091
$x^{(1)}{}_x{}^{(2)}$	Between groups	- 19.594
Intelligence x Previous Knowledge	Within groups	522.171
	Total	502.577

Step (iii) - Sums of Squares and Sums of Productive Matrix

Now, between groups (treatments) sums of squares and sums of products matrix is presented below :

$$T = \begin{pmatrix} Tyy & Tyx^{(1)} & Tyx^{(2)} \\ Tx^{(1)}{}_y & Tx^{(1)}{}_x{}^{(1)} & Tx^{(1)}{}_x{}^{(2)} \\ Tx^{(2)}{}_y & Tx^{(2)}{}_x{}^{(1)} & Tx^{(2)}{}_x{}^{(2)} \end{pmatrix} = \begin{pmatrix} 59.289 & -20.665 & 56.217 \\ -20.665 & 7.202 & -19.594 \\ 56.217 & -19.594 & 53.305 \end{pmatrix}$$

Similarly within groups (error) sums of squares and sums of products matrix is :

$$E = \begin{Bmatrix} Eyy & Eyx^{(1)} & Eyx^{(2)} \\ Ex^{(1)}{}_y & Ex^{(1)}{}_x{}^{(1)} & Ex^{(1)}{}_x{}^{(2)} \\ Ex^{(2)}{}_y & Ex^{(2)}{}_x{}^{(1)} & Ex^{(2)}{}_x{}^{(2)} \end{Bmatrix} = \begin{Bmatrix} 566.905 & 698.516 & 138.874 \\ 698.516 & 11771.735 & 522.171 \\ 138.874 & 522.171 & 1626.032 \end{Bmatrix}$$

Step (iv) - Regression coefficients and Adjusted Means

Source of variation	Regression Coefficients				Adjusted Means	
	b_1	b_2	$\bar{b}_1$	$\bar{b}_2$	$\bar{y}_1 A$	$\bar{y}_2 A$
Between groups (Treatments)	-	-	.049742	.100161	-	-
Within Groups (Error)	.056351	.067305	-	-	4.655	5.772

Step (v) - Adjusted Sum of Squares, Degree of Freedom, Adjusted Mean Squares, F-Ratio

Source of variation	Adjusted S.S.	d.f.	Adjusted M.S.	F-Ratio
Between Groups (Treatments)	54.741	1	54.741	18.08
Within Groups (Error)	518.196	171	3.030	

From the table d.f. 1/171
F at .01 level = 6.76

Since the obtained value of F, 18.08, is more than the table value of 6.76 at .01 level of significance, the hypothesis

(2.2) that there is no significant difference in mean achievement at understanding level between students exposed to verbal teaching behaviour patterns of C and E_2 groups of teachers is rejected.

(c) Significance of difference at application level(A)

Step (i) - Sums of Squares

Variables	Source of variation	d.f.	S.S.
y = Achievement(A)	Between groups	1	46.156
	Within groups	173	616.393
	Total	174	662.549
$x^{(1)}$ = Intelligence	Between groups	1	7.202
	Within groups	173	11771.735
	Total	174	11778.937
$x^{(2)}$ = Previous Knowledge	Between groups	1	53.305
	Within groups	173	1626.032
	Total	174	1679.337

Step (ii) - Sums of Products

This involves obtaining all possible sums of products (two variables at a time) in a manner analogous to that by which the sums of squares were obtained. A summary of the results thus obtained is presented below :

Sums of Products

Product of two variables	Source of variation	Sum of Products
$yx^{(1)}$	Between groups	- 18.232
Achievement(A) x Intelligence	Within groups	914.878
	Total	896.646
$yx^{(2)}$	Between groups	49.659
Achievement(A) x Previous Knowledge	Within groups	167.924
	Total	217.583
$x^{(1)}{}_x{}^{(2)}$	Between groups	- 19.594
Intelligence x Previous Knowledge	Within groups	522.171
	Total	502.577

Step (iii) - Sums of Squares and Sums of Products Matrix

Now, between groups (treatment) sums of squares and sums of products matrix is presented below :

$$T = \begin{Bmatrix} Tyy & Tyx^{(1)} & Tyx^{(2)} \\ Tx^{(1)}{}_y & Tx^{(1)}{}_x{}^{(1)} & Tx^{(1)}{}_x{}^{(2)} \\ Tx^{(2)}{}_y & Tx^{(2)}{}_x{}^{(1)} & Tx^{(2)}{}_x{}^{(2)} \end{Bmatrix} = \begin{Bmatrix} 46.156 & -18.232 & 49.659 \\ -18.232 & 7.202 & -19.594 \\ 49.659 & -19.594 & 53.305 \end{Bmatrix}$$

Similarly within groups (error) sums of squares and sums of products matrix is :

$$E = \begin{Bmatrix} Eyy & Eyx^{(1)} & Eyx^{(2)} \\ Ex^{(1)}{}_y & Ex^{(1)}{}_x{}^{(1)} & Ex^{(1)}{}_x{}^{(2)} \\ Ex^{(2)}{}_y & Ex^{(2)}{}_x{}^{(1)} & Ex^{(2)}{}_x{}^{(2)} \end{Bmatrix} = \begin{Bmatrix} 616.393 & 914.878 & 167.924 \\ 914.878 & 11771.735 & 522.171 \\ 167.924 & 522.171 & 1626.032 \end{Bmatrix}$$

Step (iv) - Regression Coefficients and Adjusted Means

Source of variation	Regression Coefficients				Adjusted Means	
	b_1	b_2	$\bar{b}_1$	$\bar{b}_2$	$\bar{y}_1 A$	$\bar{y}_2 A$
Between Groups (Treatments)	-	-	.066843	.108075	-	-
Within Groups (Error)	.074192	.079440	-	-	5.258	6.230

Step (v) - Adjusted Sum of Squares, Degrees of Freedom, Adjusted Mean Squares and F-Ratio

Source of Variation	Adjusted S.S.	d.f.	Adjusted M.S.	F-Ratio
Between Groups (Treatments)	43.923	1	43.923	14.04
Within Groups (Error)	535.177	171	3.129	

From the table d.f. 1/171
F at .01 level = 6.76

Since the obtained value of F, 14.04, is more than the table value of 6.76 at .01 level of significance, the hypothesis (2.3) that there is no significant difference in mean achievement at application level between students exposed to verbal

teaching behaviour patterns of C and E_2 groups of teachers is rejected.

A summary of the results showing significance of difference in mean achievement at knowledge, understanding and application levels between C and E_2 groups of students is given in the following table :

Table 6.8

Summary of Results (Groups C and E_2)

	Achievement	Degree of Freedom	F	Level of Significance
(a)	Knowledge	1/171	2.09	Not significant
(b)	Understanding	1/171	18.08	Significant at .01 level
(c)	Application	1/171	14.04	Significant at .01 level

From the above table it is observed that C and E_2 groups of students did not differ significantly (at .05 level of significance) in mean achievement at knowledge level. However, these two groups were found to differ significantly (at .01 level of significance) in mean achievement at understanding and application levels meaning thereby that there is a real difference in the mean achievement scores both at understanding and application levels between C and E_2 groups of students.

6.3 DISCUSSION :

Three null hypotheses were laid down for statistical testing in chapter three. First, the results of the testing of these hypotheses are presented which are then followed by discussion :

H_o 2.1 Retained

There is no significant difference in mean achievement at knowledge level of students exposed to verbal teaching behaviour patterns of C and E_2 groups of teachers.

The obtained value of F was 2.09. This value is not significant at .05 level of significance and, thus, the above hypothesis (H_o 2.1) is retained. This means that there is no true difference in the mean achievement scores at knowledge level between C and E_2 groups of students and, that, whatever difference was obtained, that could be expected by chance.

H_o 2.2 Rejected

There is no significant difference in mean achievement at understanding level of students exposed to verbal teaching behaviour patterns of C and E_2 groups of teachers.

The obtained value of F was 18.08. This value is significant at .01 level of significance and, thus, the above hypothesis (H_o 2.2) is rejected. This means that there is a real difference in the mean achievement scores at

understanding level between C and E_2 groups of students.

H_o 2.3 Rejected

There is no significant difference in mean acheivement at application level of students exposed to verbal teaching behaviour patterns of C and E_2 groups of teachers.

The obtained value of F was 14.04. This value is significant at .01 level of significance and, thus, the above hypothesis (H_o 2.3) is rejected. This means that there is a real difference in the mean achievement scores at application level between C and E_2 groups of students.

The results of the comparison of verbal teaching behaviour patterns of C and E_2 groups of teachers that represent two treatments are presented in the next paragraph so as to draw an inference about no true difference in the mean achievement at knowledge level and real difference in the mean achievement at understanding and application levels between C and E_2 groups of students.

In 14-category comparison (table 6.2) significant difference at .05 level of significance in the mean percentage occurrence in favour of E_2 group of teachers was found with respect to (i) teacher praising and encouraging (Cat.2), (ii) providing confirmatory feedback (Cat.3a), (iii) asking divergent questions (Cat. 4c) and (iv) lecturing (Cat. 5). Student response (Cat. 8) was also found significant in favour of E_2 group of

teachers. Accepting students' feelings, though rare, and asking evaluative questions were used by all the E_1 group of teachers whereas these teaching behaviours were absent in C group of teachers, Comparison of 11 teacher-talk categories also revealed similar trend in results except for lecturing (table 6.4). However, when mean percentage occurrence of teaching behaviour patterns were compared in terms of ratios (table 6.6) it was found that tendency to ask divergent question (TQR 4c) was significant at .05 level of significance in favour of E_2 group of teachers and also that all of them showed tendency for asking evaluative questions (TQR 4d) as compared to C group of teachers who did not use this teaching behaviour.

Despite significant difference in the above teaching behaviour patterns in favour of E_2 groups of teachers, no true difference was observed in the mean achievement at knowledge level between C and E_2 groups of students. However, real difference was observed, at .01 level of significance, between these two groups in mean achievement at understanding and application levels (table 6.8). Research on questioning and achievement surveyed earlier indicated contradictory results. For example, Hutchinson (1963) reported no significant difference in the mean achievement scores of the two groups of students in which one of the groups had been given training in the increased use of convergent, evaluative and divergent questions. Miller (1966) reported no significant difference in the mastery of facts and higher understanding of subject matter between pupils whose teachers used 'directive' vs. 'responsive' modes. By 'responsive' mode he meant teacher asking more high

level questions and elaborating student responses. Beseda(1972) reported that experimental group teachers increased significantly their divergent questions after training without corresponding increment in student achievement. As against the results of the above studies, Sharma (1972) reported that narrow questions were effective in the realization of knowledge and comprehension objectives of instruction. Kleinman (1964) found positive and significant relationship between high level vs. low level questions and achievement in science in high ability students and also reported positive, though not significant, relationship in the case of average and low ability students. Soloman (1963) reported that both interpretative and factual questions had significant loading on a factor related to gain in comprehension. Chasas (1973) concluded that discussion stimulated by narrow questions were less effective for achievement than discussion stimulated by broad questions.

Besides divergent and evaluative questioning considered as treatment variables in this study, two other treatment variables viz., providing confirmatory feedback (Cat. 3a) and praising and encouraging (Cat. 2) were found significantly different at .05 level of significance in favour of E_2 groups of teachers when 14-category comparisons were considered. They were, however, not significant when TRR or TIFbR89(con.) were compared.

In the case of E_2 group of students achievement at knowledge level that reflects psychological process of memory and involves cognitive operations characterised by recall and recognition of facts, terms, definitions, concepts etc., was not differentially affected to a significant degree by such

teaching behaviour patterns of E_2 group of teachers as asking divergent questions, asking evaluative questions, providing confirmatory feedback and praising and encouraging. This may be due to the fact that achievement at knowledge level involves simple mental processes of recall and recognition that is not necessarily developed more by higher levels questioning such as asking divergent and evaluative questions and by providing confirmatory feedback and praising and encouraging. Perhaps a conventional style of instruction not characterised by more of these teaching behaviour patterns is as good for achieving instructional objective at knowledge level as those that are characterised by these patterns.

But, so far as comparisons of achievement at understanding and application levels, which reflect higher cognitive operations, are concerned such teaching behaviour pattern as asking divergent and evaluative questions, providing confirmatory feedback and praising and encouraging appear to be important treatment variables. Understanding objective reflects cognitive operations characterised by ability to translate, interpret and extrapolate whereas application objective reflects cognitive operation characterised by the ability to apply ideas, rules of procedures and methods to new situations. The obtained significant difference in favour of E_2 group of students in mean achievement at understanding and application levels may be attributed to significant difference in such teaching behaviour patterns as asking divergent and evaluative question and providing confirmatory feedback and praising and encouraging. Asking divergent and evaluative questions assumes higher level mental

operations on the part of the students and are similar to high level questions (Klienman, 1964), interpretative questions (Soloman,1963) and broad questions (Chasas, 1973) although the above investigators, who reported significant relationship between these questioning behaviours and achievement, considered achievement as a global concept and did not study it in terms of K, U and A levels. E_2 groups of teachers providing confirmatory feedback and encouraging and praising students (though significant only when category comparisons were made) seem to have more feedback and reinforcing effect on their students and, thus, perhaps contributed to significant achievement at understanding and application levels of E_2 group of students.