

## CHAPTER FOUR

### THE PROCEDURE

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## CHAPTER FOUR

### THE PROCEDURE

In this chapter is presented a complete methodological approach adopted by the investigator to collect the data needed to get possible answers to the problem raised in the present study. Sequentially, the methodological approach required (a) obtaining three different verbal teaching behaviour patterns to represent three treatments, (b) exposing three different groups of students to the above three treatments, and (c) measuring students' achievement in terms of instructional objectives after the treatments were over, under conditions as much controlled as possible. Operationally, the methodological approach required completing a number of steps. Detailed discussion of these steps, which forms the body of this chapter, now follows. The numerical orders assigned to the different steps seek clear presentation and do not necessarily imply a sequence.

#### 4.1 STEP I - THE SAMPLE :

##### (a) Teachers :

Originally a list of names of all 19 inservice trained science graduates who were teaching general science to 7th class

as regular teachers in Hindi medium boys' Higher Secondary Schools at Ajmer was prepared. From this list, 12 teachers were selected on the basis of (i) length of teaching experience below 3 years, (ii) male teachers and (iii) willingness to participate in the study. Thereafter, two lessons on two topics other than those to be taught during the study for each of the 12 teachers were observed using the observational system developed for the present study. The classroom interaction of these teachers matched for the verbal teaching behaviour patterns revealed that, except for one teacher, the patterns were very similar for rest of the teachers. For example, the patterns of these 11 teachers were characterised by very small amount of confirmatory feedback (range 1.4 to 2.3%), small amount of cognitive memory questions (range 3.9 to 4.5%), practically no divergent and evaluative questions and a large amount of lecturing (range 63 to 66%). Some may argue that matching of teachers on similarity of verbal teaching behaviour patterns was not essential since the design of the study called for inducing systematic variations, through programming, in these patterns. But this step was taken in order to guard against any possibility of control group teachers, by chance, showing the verbal teaching behaviour patterns not very dissimilar to those the investigator wanted to manipulate in  $E_1$  and  $E_2$  groups of teachers. Of the 11 teachers thus selected, one had to be dropped because his headmaster could not spare him. Of the 10 teachers thus left 9 were randomly selected. These 9 teachers were then randomly assigned to three groups of three teachers each (Control group, C, Experimental group 1,  $E_1$  and Experimental

group 2,  $E_2$ ). These nine teachers thus selected belonged to 5 schools.

(b) Students :

VII class boy students who were taught general science in their respective classes by the nine teachers selected as in (a) above represented the sample of learners. In other words, VII class students who were taught general science in their regular sections by these teachers served as nine groups of learners' sample. Like their teachers they belonged to 5 schools. Two sections of students belonged to each of the four schools whereas one section belonged to the 5th school. As a result of this random sampling, the distribution of teachers in 9 sections of five schools is given in the following table :

Table 4.1  
Distribution of Teachers in Schools

School	Treatment		
	$E_1$ group teachers	$E_2$ group teachers	C group teachers
1	1	-	1
2	1	1	-
3	-	2	-
4	1	-	1
5	-	-	1
Total	3	3	3

Having more than one treatments in the same school created the problem of contamination between groups of students. Since complete isolation was not possible, administrative steps

such as teachers' neutrality, avoiding assigning home work, avoiding announcing the purpose of the study as well as evaluation at the end of eight lessons were taken to minimise the influence of contamination.

#### 4.2 STEP II - THE TOOLS :

In accordance with the design of the study, measurement of the following variables were considered necessary :

- (a) level of previous knowledge of the students - one covariate,
- (b) level of intelligence of students - another covariate,
- (c) level of students achievement - as product variable, and
- (d) verbal teaching behaviour patterns as treatment variables.

In the paragraphs that now follow are presented a discussion on the tools developed or selected for the measurement of the above variables. The discussion of each tool, consists of, first, a theoretical rationale in defense of the tool used in this study and, then, the description of the tool.

##### (a) Previous Knowledge Test (PKT) :

This test was specifically developed to measure previous knowledge of the students about the related subject matter content to be taught to them in the present study. The rationale underlying the use of this test was that previous knowledge possessed by the students about a given subject area do contribute to their later achievement in that content area.

The rationale for the use of PKT has been derived from the writings of Gage (1972) and Soar (1972) and the research design of Wright and Nuthall (1970). Writing about cognitive influence Gage (1972) comments, "in short, in terms of cognitive approaches to learning and teaching, the hierarchical organization of the subject matter is of extreme importance, and the learners pre-existing cognitive structure of this subject matter is the most important of his characteristics in determining the degree to which he is ready to learn, to retain, and to transfer what he learns." Soar (1972) has referred to one of the findings in which Taba and her associates, while working with social studies curriculum, found that "unless the teacher checked pupils moving to higher levels of thinking before an adequate supply of facts had been gathered, higher level of thinking could not be sustained." In a study to find relationships between teacher behaviours and pupil achievement, Wright and Nuthall (1970) developed and used the Nature/Science Concepts Test to test pupils' general knowledge of concepts and terms in elementary science "in order to avoid the probable effects of pretesting on the pupils included in this experiment." Therefore, on theoretical ground the use of PKT appears reasonable.

As no suitable test was already available to measure previous knowledge, it was decided to develop the previous knowledge test (PKT). The official syllabii in general science prescribed for the middle classes are concentric in the sense that as it moves up from class to class the concepts in a given content area become more and more difficult. Since the PKT required measurement of these "pre-existing" concepts that form

the bases for the new related content to be taught, it was decided to draw items from the general science syllabus prescribed for the 6th class through which the students had passed in the preceding academic session. Two sources for the validation of the content were used (i) the 6th class course content related to the new content to be taught and (ii) expert judgement obtained from two experts in the field of educational evaluation who were also requested to rank the items in order of difficulty. The preliminary version of the test thus obtained consisted of 21 items. An item analysis of this test was carried on after administration to a class of 45 students of 7th class and as a result 15 items were retained in the test. Split-half-reliability coefficient of this test was calculated to be .68.

This value of the coefficient of reliability of PKT which, in comparison to a standardized achievement test, is on the lower side, and which appears to have been influenced, at least, by a relatively narrow range of ability among the students (Garrett 1958) may be acceptable for our purpose. The time fixed for this 15 items test was 12 minutes decided on the basis of completion of these items by most of the students during preliminary testing.

(b) Intelligence Test :

Besides previous knowledge, intelligence of the student was also considered an important concomitant variable influencing his achievement. Thus, in order to correct students' achievement scores for initial differences, intelligence scores of the students were also required. For this purpose, "A Group Intelligence

Test" in Hindi developed by Mehta (1962) was used. One of the reasons for selecting this test was that it was "standardized on Rajasthan pupils" and so, its use in the present study appeared appropriate. The test has 60 items. 6 items each have been grouped under 10 areas such as logical selection, analogies, best answers, information, disarranged sentences, number series, classification, absurdities, inference and arithmetical reasoning. Factor analysis indicated that the test "assesses a general factor and an educational group factor." Split-half reliability reported was .93. Internal consistency reliability values using an approximate formula to the Kuder-Richardson Formula 21 ranged at the various age groups between .81 to .90. Its value for boys below 12 years was found to be .75. When validated against the annual school marks the overall validity coefficient obtained was .44. The author also reported that internal validation "indicated good homogeneity among subtests and the subtests with the total score." In the present study, this test was administered and scored in accordance with the instructions given in the manual.

(c) Achievement Test :

The term achievement used here means cognitive growth in a student resulting from teaching behaviour patterns. In this study, only verbal teaching behaviour patterns have been considered. Achievement test score represents student cognitive growth and is a measure of the product of these teaching behaviour patterns.

As three verbal teaching behaviour patterns characterized by variations between them in general indirectness, corrective



and confirmatory feedback and cognitive memory, convergent, divergent and evaluative questions were introduced as three interaction treatments, it was decided to develop an achievement test to measure cognitive growth at knowledge, understanding and application levels representing three hierarchical levels of cognitive complexity and difficulty. Conceptually, these three levels represent first three out of the six levels of educational objectives of Bloom (1963).

The achievement test items were developed on the basis of the eight lesson outlines supplied to the teachers. The investigator along with the help of two experts in item writing prepared a preliminary draft of 56 items based on the blue print developed for this purpose. The items thus prepared were ranked in order of their difficulty levels as judged by the two experts. This preliminary draft was again subjected to independent judgments of two more experts not only for content validation but also for judging item difficulty. This method of determining item difficulty is a judgemental approach as against the 'standard' statistical method (Garrett, 1958). Based on this judgemental approach, 50 items were retained in the final form of the test. Out of these 50 items, 20 items were classified under knowledge, 15 items were classified under understanding and the remaining 15 items were classified under application instructional objective and were judged to be fair to the three treatment groups by the experts. The time limit judged by the experts was around 40 minutes. Ideally, standard statistical method as used in developing PKT in this study should have been adopted in developing the achievement test. This would have meant trying out the

preliminary version of the test on pilot experimental teaching trials so as to modify items accordingly. This could not be done for want of time as also co-operation of the teachers for a longer duration. This test was, therefore, considered as a well planned teacher made test and the findings of this study may be understood in this light.

(d) The Observational Category System (OCS) :

As with other tools used in this study, the choice of the Observational Category System (OCS) was guided by the design of the study developed to search answers to the problem raised in the preceding chapter.

In order to achieve systematic variations in verbal teaching behaviour patterns characterised by general indirectness, different types of verbal feedback and questioning, an observational category system that incorporated these teaching behaviours was required. As no suitable observation system was already available, it was decided to develop a system with Flanders Interaction Analysis Category (FIAC) system as the base. FIAC system was selected to form the base of the OCS, because, besides giving an index of indirect teaching behaviour, it has been used in a number of studies that confirmed that general indirectness in teaching behaviour was positively related to pupil gains ( Flanders 1964, Lulla 1973, and Samph, 1974). Flanders category 3 was subscripted into categories 3a and 3b. Category 3a was designated as 'teacher providing confirmatory feedback' which, operationally is not different

from Flanders category 3 i.e. accepting or using ideas of student. Category 3b was designated as 'teacher providing corrective feedback' which, operationally, is very close to Spaulding's (1965) concept of "informing student about the incorrectness of his response in non-threatening manner with the intention of eliciting clarification from him or encouraging him to give another response." To obtain systematic variations in types of questioning it was decided to accept four subscripts of category 4 of FIAC System viz., asking cognitive memory questions (4a), convergent questions (4b), divergent questions (4c), and evaluative questions (4d) as suggested by Amindon and Hunter (1967a). In suggesting modifications from Flanders' Category 4, asks questions, they adopted the categories of questioning from the system developed by Gallagher and Aschner. Cognitive memory questions demand recall and require no additional thinking, convergent questions require some analysis of data, divergent questions require imagination and thinking in new direction and evaluative questions ask for judgement. Other categories of the FIAC system were accepted without modification as they were not of direct interest in the present study. The Observational Category System (OCS) thus developed is, therefore, a modification and extension of FIAC System and consists of 14 categories as given in the following table :

Table 4.2

Observational Category System ( OCS )  
(Flanders Modified)

Cat. No.	Category	Description
1.	Accepts Feeling	Accepts and clarifies the feeling tone of the students in a nonthreatening manner, feeling may be positive or negative, predicting or recalling feelings are included.
2.	Praises or Encourages	Praises or encourages students action or behaviour, jokes that release tension, not at the expense of another individual, nodding head or saying "Um hm" or "go on" are included.
3a.	Provides confirmatory feedback	Provides knowledge of correct response to the students.
3b.	Provides Corrective feedback	Tells a student that his answer is wrong in non-threatening manner with the intention of eliciting clarification from him or encouraging him to give another response. When the incorrectness of the answer can be established by means other than opinion e.g. empirical observation, definitions, customs.
4a.	Asks cognitive memory questions	These questions ask RECALL and require no additional thinking, any thing that can be retrived from the memory bank.
4b.	Asks convergent questions	These questions require some analysis of data. It is a question whose single right answer may be obtained by the application of a rule or procedure.
4c.	Asks divergent questions	These questions call for imagination and a move in new direction. The student is permitted to choose among alternatives or to create ideas of his own.
4d.	Asks evaluative questions	These question ask for judgement. Development of relevant criteria such as usefulness, desirability, social consequences is implied and then the application of the criteria to the issue.

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Cat. No.	Category	Description
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5.	Lecturing	Giving facts or opinions about content or procedure, expressing his own ideas, asking rhetorical questions.
6.	Giving direction	Directions, commands or orders to which a student is expected to comply.
7.	Criticism or justifying Authority	Statements intended to change student behaviour from non-acceptable to acceptable patterns, bawling someone out, stating why the teacher is doing, what he is doing; extreme self-reference.
8.	Student talk-- response	A student makes a predictable response to teacher, teacher initiates the contact or solicits student statement and sets limits to what the student says.
9.	Student talk-- initiations	Talk by students which they initiate. unpredictable statements in response to teacher shift from 8 to 9 as student introduces own ideas.
10.	Silence or confusion	Pauses, short periods of silence and periods of confusion in which communication can not be understood by the observer.

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#### 4.3      STEP III - PROGRAMMING THE TEACHERS

Programming of the teachers refers to training them to change their classroom verbal interaction patterns. As pointed out during the review of related literature, several studies conducted on inservice or preservice teachers have consistently reported significant "programme effectiveness" (Flanders, 1970, pp. 351-52). The attempt made in this study to change verbal interaction patterns of teachers, therefore, appears to be empirically supported.

As three treatments, this study focussed on three different verbal teaching behaviour patterns of Control (C), Experimental No. 1 ( $E_1$ ) and Experimental No. 2 ( $E_2$ ) groups of teachers. Patterns of C group of teachers measured non-programmed verbal teaching behaviours. That is, teachers in this group were not trained to change their interaction patterns which served as control. As against this,  $E_1$  and  $E_2$  groups of teachers were programmed to obtain two other treatments.

Before the start of the training, teachers belonging to C,  $E_1$  and  $E_2$  groups had been observed for their classroom interaction and had been found to be very similar in their verbal teaching behaviour patterns. Following this, the programming for  $E_1$  and  $E_2$  groups of teachers started as below:

(a) First, a common programme for about two hours per day for six days was developed for both these groups. This training programme included providing the following experiences :

- |                                      |  |
|--------------------------------------|--|
| <u>First Day</u><br>(about 2 hours)  | (i) Discussion on theory of interaction process analysis.  |
| <u>Second Day</u><br>(about 2 hours) | (i) Explanation of the category system and coding procedure,<br>(ii) practice in coding in a simulated condition.                  |
| <u>Third Day</u><br>(about 2 hours)  | (i) Further practice in coding each other teaching in simulated condition,<br>(ii) explanation of matrix preparation and analysis. |

Fourth Day  
(about 3 hours)

- (i) Coding each other teaching in a simulated condition,
- (ii) matrix preparation, analysis and getting feedback about one's verbal teaching behaviour patterns.

Fifth Day  
(about 2 hours)

- (i) Observing actual classroom teaching by the other teachers, reversing this arrangement, coding and analysing and discussing each other verbal teaching behaviour patterns along with the investigator. This again served as a feedback to one's teaching behaviour.

Sixth Day  
(about 2 hours)

- (i) Repeated the procedure used in the fifth day.

(b) Second, an additional training programme was developed for  $E_2$  group teachers. This was done with a view to bringing about more of systematic variations in general indirectness, types of feedback and questioning behaviour. This additional 5-day programme included providing the following experiences:

First Day  
(about 2 hours)

- (i) Discussing and developing, sequence-wise, an outline of all the possible cognitive, memory, convergent, divergent and evaluative questions that could be asked in the 8 lessons,
- (ii) discussing and developing the possible situations where confirmatory and corrective feedback could be provided.

Second Day  
(about 3 hours)

- (i) Practising in simulated conditions one or two lessons following the lesson outline developed the previous day. This practice session concentrated on those teaching behaviours that were considered in the present study. The practice session was accompanied by observation of interaction and was followed by feedback of teaching behaviour patterns.

Third Day  
(about 2 hours)

- (i) Further practice followed by feedback as was done on the second day.

Fourth Day  
(about 2 hours)

- (i) Further practice with one lesson each with small groups of students not included in the study followed by feedback of their teaching behaviour patterns.

Fifth Day  
(about 2 hours)

- (i) Further practice with another lesson with small groups of students followed by feedback of their teaching behaviour patterns.

#### 4.4 STEP IV - OBSERVER TRAINING :

While delimiting the study, it had been indicated that help of live observers would be taken for observation and coding the verbal teaching behaviours of the teachers included in the study. This brings us to the problem of training of observers. This problem is "two fold: first, converting men into machines, and second, keeping them in that condition while they are



observing" (Flanders, 1960). The main purpose is to ensure high reliability of observation.

In order to train reliable observers, the general outline suggested by Flanders in his manual was followed. Specifically, this programme lasted for seven days, with approximately two hours per day devoted to training. The training programme covered the following aspects :

First Day  
(about 2 hours)

- (i) A brief discussion on theory and practice of interaction process analysis,
- (ii) explanation of teacher - students interaction behaviours as measured by each of the 14 categories of the observational system used in this study. This was followed by home assignment to memorize the categories.

Second Day  
(about 2 hours)

- (i) Explanation of the procedure of coding events of teaching behaviours with approximately one code entry after every three seconds,
- (ii) practice in coding in a simulated condition followed by discussion.

Third Day  
(about 2 hours)

- (i) Introduction to ground rules suggested by Flanders (1960 and 1970),
- (ii) practice in coding in a simulated condition followed by discussion.

Fourth Day  
(about 2 hours)

- (i) Practice in observing and coding actual classroom verbal interaction in the company of the investigator who had

previously been trained in observation using FIAC system as well as the category system used in the present study,

- (ii) calculation of percentages of each category coded in the above observation,
- (iii) discussion on (i) and (ii) above.

Fifth Day  
(about 3 hours)

- (i) Practice in observing and coding actual classroom verbal interaction and calculation of percentages of each of the category coded,
- (ii) calculation of reliability of observations with respect to each of the three observers.

Sixth Day and  
Seventh Day  
(about 2 hours each)

- (i) Continued the practice activities as on fifth day.

Reliability coefficient for each of the three observers undergoing training was calculated taking the coding of the investigator, who had been earlier trained, for comparison. As suggested by Flanders (1960), the reliability coefficient for each of the observers, under training, was established by using Scott's method for calculating observer reliability, the formula for which is given below :

$$\Pi = \frac{Po - Pe}{100 - Pe}$$

whereas  $\Pi$  = coefficient of observer reliability

$$Po = \left. \begin{array}{l} \text{percent of} \\ \text{agreement} \\ \text{observed} \end{array} \right\} = 100 - \left. \begin{array}{l} \text{(Sum of percent} \\ \text{difference bet-} \\ \text{ween two obser-} \\ \text{vers.} \end{array} \right\}$$

$$P_e = \left. \begin{array}{l} \text{Percent agree-} \\ \text{ment expected} \\ \text{by chance} \end{array} \right\} = \text{Sum} \left[ \frac{(\text{Average percent of}^2)}{(2 \text{ observers})} \right] \frac{1}{100}$$

On the last day of the observers' training, Scott's reliability coefficient values for the three observers were 0.87, .90 and .91. These values were considered acceptable indices of the three observers having been trained.

#### 4.5 STEP V - TESTS ADMINISTRATION

Assuming that besides differences in verbal teaching behaviour patterns, initial differences among students in intelligence and previous related knowledge are important concomitant variables in determining final achievement scores, a test of intelligence and a test of previous knowledge, as described earlier, were administered on 9 sections of VII class students to be taught by 3 E<sub>1</sub> group teachers, 3 E<sub>2</sub> group teachers and 3 C group teachers.

Two of the three observers trained for classroom observation were also given complete practical training for 3 days about the procedure for administering the tests used in this study. These two persons along with the investigator administered verbal test of intelligence and previous knowledge test on the same day on 9 sections of the students selected for the study. First, test of intelligence was administered and then, after about 10 minutes, previous knowledge test was administered. The total testing time was about 35 minutes excluding the break of 10 minutes in-between. This means that the administration of tests in each section was completed in about an hour's time including the time spent in giving instructions.

These two tests were administered on a Saturday and from the following Monday classroom teaching started.

#### 4.6 STEP VI - TEACHING AND OBSERVATION OF TEACHING :

##### (a) Teaching :

In order to maximise classroom control on variables other than teaching behaviours so as to ensure uncontaminated cognitive gain, all the 9 teachers belonging to  $E_1$ ,  $E_2$  and C groups were supplied with outlines of the eight sequential lessons which each one of them were to teach. Outline for each lesson included objectives of the lesson, major ideas and concepts to be developed, terms to be introduced, content coverage, teaching aids to be used and a book reference for the teacher. Teachers were requested to plan their teaching in accordance with this outline. In order to ensure further uniformity teachers were requested not to discuss content concepts with their students out of the class and also not to assign home assignments to the students.

After having been programmed ( $E_1$  and  $E_2$  groups) and equipped with lesson outlines, the three groups of teachers started classroom teaching giving one lesson per day for eight continuous working days. Thus, in general, in a given day all the teachers belonging to C,  $E_1$  and  $E_2$  groups delivered the same lesson in a class period of about 30-35 minutes duration. In general, the timetable of events was as follows :

Saturday : Administration of intelligence and previous knowledge tests.

<u>Monday</u>	:	First lesson on concept of pollination, self and cross pollination, significance of pollination.
<u>Tuesday</u>	:	Second lesson on agencies of crosspollination, artificial pollination.
<u>Wednesday</u>	:	Third lesson on fertilization in plants.
<u>Thursday</u>	:	Fourth lesson on structure of seed, monocotyledonous and dicotyledonous seeds.
<u>Friday</u>	:	Fifth lesson on germination of seeds, essential conditions for seed germination.
<u>Saturday</u>	:	Sixth lesson on different types of plants, (a) bacteria - study of some harmful and harmless bacteria.
<u>Monday</u>	:	Seventh lesson on different types of plants, (b) fungi and ferns.
<u>Tuesday</u>	:	Eighth lesson on plants in the service of men, concept of inter-dependence of plants and animals.
<u>Wednesday</u>	:	Administration of achievement test.

There were, however, two exceptions to the above events of the time-table. In one case administration of intelligence and previous knowledge tests had to be conducted on Friday instead of Saturday and in another case fourth lesson had to be taught next day with the result that teaching in this class ended on Wednesday instead of Tuesday and the administration of achievement test had to be administered on Thursday.

It may be mentioned here that before the start of actual teaching of eight lessons, each teacher of  $E_1$  and  $E_2$

groups was requested to teach the way they were programmed in their classes two lessons on topics other than those included in this study. This was considered desirable so as to help students get cognitively adjusted to change in interaction patterns brought about in their teachers as a result of programming. The assumption underlying this step was that sudden change in teachers' interaction pattern might cause cognitive dissonance and thus affect cognitive gain adversely in earlier lessons.

(b) Observation :

In order to check treatment fidelity as well as to obtain data on verbal teaching behaviours of the three groups of teachers, the trained observers including the investigator himself sat, in different classrooms, for each day of teaching, in the best position to hear and see the participants of classroom interaction. Each observer observed and coded the classroom interaction with respect to the sections of students assigned to him. Thus, in general, nine lessons were observed and coded by the observers in a day using the category system adopted in this study. In all 72 lessons, 24 lessons for each of the three groups, were observed and coded in 8 days. This phase of classroom observation provided data on classroom verbal interaction of C, E<sub>1</sub> and E<sub>2</sub> groups of teachers.

4.7 STEP VII - ACHIEVEMENT TEST ADMINISTRATION :

A day following the completion of teaching by each of the nine teachers, achievement test was administered to the students by the investigator and two other observers who had

also administered intelligence and previous knowledge tests before the beginning of teaching. As described earlier, this test measures achievement at knowledge, understanding and application level.

Students who missed either the PKT or intelligence test, or achievement test or were absent in any one of the 8 lessons were dropped from the study. After taking into account this experimental mortality, the number of the students in C, E<sub>1</sub> and E<sub>2</sub> groups were 95, 93 and 80 respectively.