CHAPTER V

CONDUCT OF THE EXPERIMENT

The present study is an experimental investigation as cited earlier. This Chapter on 'conduct of the experiment' contains a detailed outline of the different aspects of the methods and procedures followed in conducting the entire experiment. Broadly speaking, the main aspects covered for designing the present investigation are : (i) selection of the experimental design, (ii) selection of the sample, (iii) selection of the teaching units, (iv) the tools used, (v) classification of the variables, (vi) formulation of the hypotheses, and (vii) procedure of the experiment. Also stated is the brief discussion regarding the statistical techniques used.

SELECTION OF THE EXPERIMENTAL DESIGN

The entire experiment involved two designs; (i) Latin square design, and (ii) Randomized group design. Latin square design was used to achieve the objective 2, it being, to find out the relative effectiveness of the three instructional strategies viz. strategy one (S_1), strategy two (S_2) and strategy three (S_3), in terms of the achievement of the instructional objectives in case of all the students together. Randomized group design was used for the fulfilment of the objective no.3, i.e. to find out the differences in the

effective use of the three strategies viz. strategy one (S_1), strategy two (S_2) and strategy three (S_3), as judged in terms of the achievement of the instructional objectives, by the students of any of the three levels of intelligence separately i.e. high level, low level and average level of intelligence. Both the designs have some advantages and disadvantages because of the different variables that act in an experiment in education. The Latin square design is superior in its efficiency over even some sophisticated designs. In its efficiency it has a gain of a forty five percent over complete randomization and a gain of a nine percent over randomized block experiment, (Snedecor and Cochran). But the design requires an assumption that the interactions are zero. It involves three units to be taught and hence, it is not certain to what extent the assumption holds good implicity. In order to find out which strategy is useful to the students of which particular level of intelligence, the complete randomized group design was preferred to randomized block design; because of the difficulty in having the three equal groups for the three levels of intelligence.

The issues considered before finalising the Latin square design were as follows:

1. In all, three instructional strategies were chosen as the experimental treatments. All the three strategies are discussed in details in Chapter III.
2. It was decided that these three instructional strategies should be tested over three teaching units, which were

to be taught to randomly selected three groups of students (groups were selected by drawing lots).

3. If one group of students is taught one teaching unit, through one instructional strategy, then a great number of classes are needed. Even if sufficient number of classes are available, all the classes cannot be taught by a single teacher.

4. If only one group of students was taught all the three units through all the three instructional media, the difference in the teaching units would have proved to be a major source of variance. The same unit cannot be taught repetedly to a single group, because of the resultant carry over effects.

5. If only one unit was taught to the three different groups of students through the three instructional strategies, the pre-treatment differences of the groups would have proved to be a major source of variance. Therefore a way out was to have one teacher teaching the different groups of students which would help avoiding a variance due to different teachers.

6. It was possible to form three random groups of students by drawing lots. It was also feasible to expose all the three teaching units to all the three groups of students, through the three instructional strategies.

7. Economy from the point of research, that is to get much information from a relatively small number of observations, was kept in view.

With all the above considerations the experiment involved a Latin square design to achieve the objective no.2, as stated earlier.

There were three instructional strategies and to fit these into the design, the three groups of students and the three teaching units of content were taken up, and the design turned out to be a 3 X 3 Latin square design, having 9 cells in all. Each cell had 35 replicates in it. By arranging the observations in this form, a large amount of information can be extracted from a relatively small number of observations, (Walker and Lev, 1953). Out of the many possible 3 X 3 Latin square one which was used in the experiment is given below in the table 2.

Table 2 : Experimental Plan of the 3 X 3 Latin Square

A	C	B
B	A	C
C	B	A

The above Latin square design followed in the experiment runs as given in table 3.

Table 3 : Latin Square Design followed in the experiment

	U_1	U_2	U_3
G_1	S_1 (T_1)	S_3 (T_2)	S_2 (T_3)
G_2	S_2 (T_1)	S_1 (T_2)	S_3 (T_2)
G_3	S_3 (T_1)	S_2 (T_2)	S_1 (T_2)

U_1, U_2, U_3 are the three teaching units taught.

G_1, G_2, G_3 are the three groups involved.

S_1, S_2, S_3 are the three instructional strategies used.

T_1, T_2, T_3 are the three criterion tests on the three corresponding units, U_1, U_2 and U_3 respectively.

Table 3 clearly indicates that the students in each group studied the three different units by the three different instructional strategies. To be specific each cell represents an experimental situation involving a particular unit being taught through a particular strategy (treatment variable). Each such combination, along with the corresponding criterion test would take 6 hours, that is an hour per day. Out of these 6 hours, 5 hours were used for the actual communication. Last one hour was assigned for the criterion test which was administered at the end of teaching each unit. It is important to note here

that this design has got an underlying assumption that interactions are zero.

The design envisages in overcoming certain common difficulties. Since each group is exposed to all the teaching strategies, the environmental variance can be considered as having no serious influence on the treatment. Same and only one teacher, after being sufficiently programmed, teaches through all the instructional strategies and so it can be assumed that the variance due to teacher on the treatment variable is negligible.

Besides, as the table 3 reflects the raws are being assigned to the three different groups of students and the columns to the three different units taught, and the cells representing each of the three treatments or strategies; the obvious advantage is that the students in each group get a chance of being taught under each of the three strategies (treatment variable) in different orders as specified by the Latin Square Design arrangement, thus equalizing individual differences as well as practice or fatigue effects.

A fundamental condition in the analysis of variance of Latin square design is that the observations for the different treatments be independent in the sense that the value of an observation for one treatment at a given period is not dependent on the effects of the treatments applied during the earlier periods. In the experiments in education there is always the possibility of carry over effects when the same

subjects are tested under a series of all the treatments. It is suggested that one way in which the experimentor may eliminate the possibility of carryover effects, when the same subjects are tested under all treatments, is to increase the time interval between the two successive treatments (Edwards, 1968). Keeping in view these considerations, a gap of two weeks was planned between two consecutive treatments in a group, in this experiment.

Further, here, it is not the same group receiving different treatments as per the different cells. Instead, there are three groups of subjects covering all the nine experimental conditions. In the design followed the rows represent the groups. The same groups are subjected to the different treatments as they occur in the design. Hence this design can also be classified under repeated measures designs, which may be expected to be more powerful than the randomized group or randomized block designs. The use of repeated measures also reduces the number of experimental subjects required to conduct an experiment, (Dayton, 1970).

Major reasons for deciding upon this design are (i) non-availability of many local college classes, as this study involves content on the subject of 'nutrition' taught in English, only in Home-Science Faculty of the M.S. University of Baroda; and (ii) the investigator alone acts as a programmed teacher in order to avoid inter-teacher variability which puts limitation to the successful implementation of other complex type of experimental design.

SELECTION OF THE SAMPLE

The experiment necessitated sampling of the teachers and the students. Below are discussed the procedural details of the sampling.

Teacher:

The experiment needed a teacher who had the thorough knowledge of the content matter to teach, who could be programmed and who could decide and change strategies of teaching as demanded by the design in the study. The instructional strategy two (S_2) required active participation of the teacher; in that she forms the main component of the instructional process. In instructional strategies one (S_1) and three (S_3), the role of the teacher is very much limited, since they were mostly auto-instructional or mechanical as the case may be. But the teacher did have the role of initiating and directing the discussion, laboratory work and the library reference work. In order to avoid inter-teacher variation, as has been mentioned earlier, it was decided to involve only one teacher. The investigator satisfied all the above mentioned requirements, and herself acted as the teacher during the entire experiment. The investigator did not think it safe to rely on other teachers because they may or may not have the good knowledge of the content matter, they would differ in their presentation style and they may not operate the procedural details of the experiment in the way they are scheduled. The investigator has been in charge of teaching

the same content matter since the last ten years. Try-out study too was undertaken by the investigator herself to practice and test the working of the experiment as mentioned earlier.

Students:

The sample of the students comprised the second year class, Home-Science girls, of the faculty of Home-Science of the M.S. University of Baroda City. The total strength of the class was 105 girls. The average age of the girls was 18 years. An English medium girls were selected considering the language in which the software materials were prepared. There were some reasons in doing the experiment in one college. This would control the extraneous variables that might come into play due to the inter college differences in the class-room atmosphere. Besides there is only one English medium faculty in city of Baroda which teaches the course in nutrition. In case, the experiment was to be carried out in different colleges in different cities, the investigator would have to travel a lot which would end up into waste of time, money, and energy. Moreover different colleges would not have permitted randomization of the students into three groups due to administrative difficulties. Experiment for the present investigation, lasted for 10 weeks; because the teaching of the selected content matter was to be done only by one teacher, within the regular schedule of the college. For randomization, the students had to be regrouped which

puts the regular college work into strain. Only a highly co-operative college could have allowed this kind of experiment to be conducted on their students. Home Science College of Baroda, satisfied all the above conditions. Slecting the aforesaid college students alone, for the experiment, might have put limitation to the generalisability of results of the experiment, since the sample subjects seemed to have come from the middle and the upper socio-economic group. But judging from the achievement of the students in their first semester terminal examination on "Elementary Foods and Nutrition" including only the units on foods; they were found to be normally distributed. It was hence though that selecting one college students, as the sample, would be much better than sampling from different colleges inviting more serious differenciating influence of the college environment upon the instructional strategies (treatment variables) which might vitiate the results. These students were selected to suit the purpose as they were optimally mature to interact with the content matter in the selected mediated forms.

SELECTION OF THE TEACHING UNITS

The "Elementary Foods and Nutrition" syllabus of II year Home-Science, contains units from the field of foods and nutrition. The units on 'foods' are quite simple; and short too; whereas the units on nutrients viz. proteins, carbohydrates, fats, etc. are quite lengthy, full of new concepts and facts; difficult for the students to understand easily on their own and which therefore need a thorough communication. The

selection of the units was done on the following criteria namely, dependent on the previous basic knowledge of the students on the subject of foods; independent of each other and within the competance of the teacher who conducted the experiment. Three units on nutrients - 'proteins' (Unit U_1), 'carbohydrates' (Unit U_2) and 'fats' (Unit U_3); were thus selected for the experiment.

Since the purpose of the present study was to compare the effectiveness of the three instructional strategies, the teaching units were meant to serve as mere carriers for them. Therefore care was taken not to introduce any extraneous variables due to the teaching units. Though the experimental design selected by itself could introduce sufficient control in this regard, it was felt that effort should be made at the time of selection of the teaching units, to minimize extraneous variables. Therefore the investigator maintained the following considerations at the time of their selection:

(1) There was similarity in the structure of the three units taught. This was considered to make these units equally adaptable, to each of the three strategies under comparison. This was done to avoid interaction effects, if any, between the strategies and the teaching units.

(2) The difficulty level of the three teaching units were almost equal. This was kept in view so that the play of their differential interactions with the attributes of the learners could be avoided.

(3) There was minimum inter-relationship between the selected teaching units. This was taken into consideration, so that the carry-over effects from one unit to another, during the course of the experimentation, could be avoided.

As stated earlier, content experts were consulted to edit the units planned for the present investigation.

TOOLS USED

Two types of tools were used:

(a) to describe the nature of the pupils in the sample, and

(b) to measure the criterion variable.

For the former purpose, the Ravan's Standard Progressive Matrices were used and for the latter, the three criterion tests were used.

(a) The Ravan's Standard Progressive Matrices:

As stated in Chapter III, one of the objectives of the present investigation was to identify a suitable instructional strategy (out of the three strategies under comparison) for the students of particular level of intelligence. The measure of students' intelligence was obtained by administering to them the Ravan's Standard Progressive Matrices. It is a culture fair, non-verbal test to measure one's intellectual capacity. The matrices consists of designs which require completion. The testee chooses from multiple choice options, the design or a design part, which best fits. An answer

which fits may : (a) complete a pattern, (b) complete an analogy, (c) systematically alter a pattern, (d) introduce systematic permutations, or (e) systematically resolve figures into parts. The number of items correctly solved is the score which is then translated into a percentile rank. There is no time limit for this test.

The Progressive Matrices have been subjected to extensive research in several countries and with a wide variety of groups. The author describes the scale as a test of observation and clear thinking. The test-scale has a re-test reliability, varying with age, from 0.83 to 0.93. It correlates 0.86 with the Terman-Merrill Scale, and has been found to have a 'g' saturation of 0.82. The scale is intended to span the whole range of intellectual development, rather than to differentiate clearly between individual persons.

(b) The Criterion Tests:

The three criterion tests namely criterion test (T_1) - test on 'proteins'; criterion test (T_2) - test on 'carbohydrates' and criterion test (T_3) - test on 'fats' were developed to measure the criterion variable. The detailed account of these tests, has been given in the previous chapter.

CLASSIFICATION OF THE VARIABLES

(i) Treatment Variable:

The three instructional strategies namely strategy one (S_1), strategy two (S_2) and strategy three (S_3) served as the

treatment variables. The details regarding the nature and selection of these treatment variables have already been given in Chapter III.

(ii) Criterion Variable:

The criterion variable in this study has been the measure of the students' achievement in terms of the instructional objectives. Three criterion tests for the three teaching units were developed for the purpose. The details for the same are stated in Chapter IV.

(iii) Intervening Variable:

In the present investigation in which case, the instructional strategies have been subjected to experimentation, the intervening variables related to teachers whould easily pile up. The experience, age, sex and the qualifications of the teachers, are some intervening variables. It was therefore taken care to avoid these variables of inter-teacher differences in this study, by programming only one teacher to teach through all the three instructional strategies. The investigation however includes one intervening variable concerning students and that is intelligence. This intervening variable was made use of to discover which instructional strategy was used effectively by the students of which particular level of intelligence.

FORMULATION OF THE HYPOTHESES

The three main null hypotheses which have been formu-

lated for the purpose of the present study are as follows:

1. There will be no significant differences among the three instructional strategies viz. strategy one (S_1), strategy two (S_2) and strategy three (S_3), in their effectiveness in terms of the achievement of the instructional objectives.

2. There will be no significant differences in the achievement of the instructional objectives amongst the students, belonging to the three levels of intelligence, viz. high level, average level and low level of intelligence when taught through any of the three instructional strategies viz. strategy one (S_1), or strategy two (S_2) or strategy three (S_3).

OR

3. There will be no significant differences in the effective use of the three instructional strategies viz. strategy one (S_1), strategy two (S_2) and strategy three (S_3) by the students of any of the three levels of intelligence namely high level, average level, or low level, as judged from their scores on criterion tests.

These three main null hypotheses can further be specified as nine hypotheses to be tested, which are as follows:

1a. There will be no significant difference between the strategy one (S_1) and strategy two (S_2) in their effectiveness in terms of the achievement of the instructional objectives, (in case of all the students together).

1b. There will be no significant difference between the strategy two (S_2) and strategy three (S_3) in their effectiveness in terms of the achievement of the instructional objectives, (in case of all the students together).

1c. There will be no significant difference between the strategy one (S_1) and strategy three (S_3) in their effectiveness, in terms of the achievement of the instructional objectives, (in case of all the students together).

2a. There will be no significant difference in the achievement of instructional objectives amongst the students of high level of intelligence when taught through either strategy one (S_1) and strategy two (S_2) or strategy two (S_2) and strategy three (S_3); or strategy one (S_1) and strategy three (S_3).

2b. There will be no significant differences in the achievement of the instructional objectives amongst the students of average level of intelligence when taught through either strategy one (S_1) and strategy two (S_2), or strategy two (S_2) and strategy three (S_3); or strategy one (S_1) and strategy three (S_3).

2c. There will be no significant difference in the achievement of instructional objectives amongst the students of low level of intelligence when taught through either strategy one (S_1) and strategy two (S_2), or strategy two (S_2) and strategy three (S_3); or strategy one (S_1) and strategy three (S_3).

OR

3a. There will be no significant difference in the achievement of the instructional objectives between the students of high and average level of intelligence, or average and low level of intelligence or high and low level of intelligence when taught through strategy one (S_1).

3b. There will be no significant difference in the achievement of the instructional objectives between the students of high and average level of intelligence or average and low level of intelligence or high and low level of intelligence when taught through strategy two (S_2).

3c. There will be no significant difference in the achievement of the instructional objectives between the students of high and average level of intelligence or average and low level of intelligence or high and low level of intelligence when taught through strategy three (S_3).

PROCEDURE OF THE EXPERIMENT

The investigator embarked on the actual experimentation since all the preliminaries were now ready to serve the purpose undertaken. In the beginning all the students were oriented in the procedure to be followed for studying the three selected units through three different instructional strategies. Also a detailed schedule for the full period of experimentation was given to them. The experiment started with a total number of 105 students who were randomly divided into three equal groups that is to say there were 35 students in each group.

To begin with the experiment Ravan's Standard Progressive Matrices, the test of intelligence was administered to all the students in the three groups. The purpose of giving this test was to measure the intelligence level of each student who participated in the experiment. Next the oral pre-test was conducted. This was followed by the administration of the written pre-test. Both oral and written pre-tests were given with a prior announcement about the administration of the tests. These tests were administered with a view to ascertaining the entering behaviour of the students. A feed back session was then planned to discuss the performance on the written pre-test. This discussion was mainly to give feedback to the students and to provide further clarifications to the concepts where they had gone wrong as revealed by the said test.

The three groups were then subjected to the treatment as per the design presented in table 3. To be more specific, each instructional session was of 6 hours per each unit. Out of these six hours, three hours were meant for actual instructional presentation either through PLM in strategy one (S_1), or structured lecture with black board work in strategy two (S_2), or taped commentary with charts and work-sheets in strategy three (S_3), as the case may be; one hour was reserved for laboratory demonstration, irrespective of any strategy the students learnt through; one hour was fixed for discussion or library reference work depending upon the strategy used for communication; and the last hour was utilized for the administration of the corresponding criterion test which the students

wrote immediately on completion of the particular teaching unit.

It may be noted here that as the investigator was alone in the charge of the entire experiment, only one group of students, was managed by the investigator at a time for one week; and hour a day; to complete the work of one unit. Naturally this helped in introducing a sufficient time interval of two weeks between the two consecutive treatments in a group, which in turn aided in minimizing the carry over effects. The whole experiment including teaching and administration of the criterion tests, was thus extended to a period of 9 weeks. A schematic representation of the procedure followed is given in the table 4 on the next page.

This was followed by the assessment of the criterion tests' papers and the intelligence test sheets. Criterion and the intelligence scores were then recorded to be analysed.

STATISTICAL TECHNIQUE USED

The experimental data were analysed by using the technique of Analysis of Variance for the scores on criterion achievement tests and also for the scores on intelligence test. The entire analysis was done by the investigator herself with the aid of a desk calculator.

Chapter VI presents the analysis and results of the Experiment.

TABLE : 4

A SCHEMATIC REPRESENTATION OF THE PROCEDURE FOLLOWED IN THE COMPLETE EXPERIMENT

↓

THE RAVAN'S STANDARD PROGRESSIVE MATRICES ADMINISTERED TO ALL THE STUDENTS.

↓

ORAL PRE-TEST CONDUCTED

↓

WRITTEN-PRE-TEST ADMINISTERED TO ALL THE STUDENTS

↓

DAYS	WEEK I	WEEK II	WEEK III
	GROUP I	GROUP II	GROUP III
	UNIT U_1	UNIT U_1	UNIT U_1
	STRATEGY (S_1)	STRATEGY (S_2)	STRATEGY (S_3)
1ST DAY	PLM	ST.LECTURE + BB	TAPE + CHARTS + WORK SHEET
2ND DAY	.....DO.....	.....DO.....	.....DO.....
3RD DAY	LAB.DEMONSTRATION	LAB.DEMONSTRATION	LAB.DEMONSTRATION
4TH DAY	PLM	ST.LECT. + B.B.	TAPE + CHARTS + WORK SHEETS
5TH DAY	DISCUSSION	LIBRARY REF.	DISCUSSION
6TH DAY	CRITERION TEST (T_1)	CRITERION TEST (T_1)	CRITERION TEST (T_1)
	WEEK IV	WEEK V	WEEK VI
	GROUP I	GROUP II	GROUP III
	UNIT U_2	UNIT U_2	UNIT U_2
	STRATEGY (S_3)	STRATEGY (S_1)	STRATEG. (S_2)
1ST DAY	TAPE + CHARTS + WORK SHEETS	PLM	ST.LECTURE + B.B.
2ND DAY	.....DO.....	.....DO.....	.....DO.....
3RD DAY	LAB.DEMONSTRATION	LAB.DEMONSTRATION	LAB.DEMONSTRATION
4TH DAY	TAPE + CHARTS + WORK SHEETS	PLM	ST.LECTURE + BB
5TH DAY	DISCUSSION	DISCUSSION	LIBRARY REF.
6TH DAY	CRITERION TEST (T_2)	CRITERION TEST (T_2)	CRITERION TEST (T_2)
	WEEK VII	WEEK VIII	WEEK IX
	GROUP I	GROUP II	GROUP III
	UNIT U_3	UNIT U_3	UNIT U_3
	STRATEGY (S_2)	STRATEGY (S_3)	STRATEGY (S_1)
1ST DAY	ST.LECTURE + BB	TAPE + CHARTS + WORK SHEETS	PLM
2ND DAY	.....DO.....	.....DO.....	.....DO.....
3RD DAY	LAB.DEMONSTRATION	LAB.DEMONSTRATION	LAB.DEMONSTRATION
4TH DAY	ST.LECTURE + B.B.	TAPE + CHARTS + WORK SHEETS	PLM
5TH DAY	LIBRARY REF.	DISCUSSION	DISCUSSION
6TH DAY	CRITERION TEST (T_3)	CRITERION TEST (T_3)	CRITERION TEST (T_3)

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