

## CHAPTER III

### DESIGN, INSTRUMENTATION AND PROCEDURE

=====

#### 3.0.0 Introduction

A number of studies have been cited to indicate the relationship between strategies of teaching and pupils' attainment. Additional studies presented in Chapters I and II indicate that teaching effectiveness may be reflected in pupils' attainment. On the basis of prior research this study has been designed, the nature of which has been stated at the very beginning ( caption 1.0.0 ). This chapter contains an outline of the different aspects of methods, and procedures used for the experiment. Here are given the various steps of designing the study in terms of treatment variables, criterion variables, control of intervening variables, programming of teacher according to the conditions of treatment variables, selection of teaching units, preparation of lesson plans, sample, tools for measuring the criterion and intervening variables as well as the plan of analysis of the data.

**Table 3.1.0: Schematic Outline of the Experiment Conducted**

Objectives	:	As mentioned in caption 1.8.0.
Hypotheses	:	As mentioned in caption 2.7.0.
Design	:	Parallel Group Covariance Design
No. of units taught	:	Three
Criterion Test	:	Three criterion tests
Other tools used	:	<ol style="list-style-type: none"> <li>1. Intelligence Test developed by David Hare Training College, Modified by Vinaya Bhavana, Visva-Bharati ( Scores used as covariate)</li> <li>2. Pre-achievement Test in Geography (scores used as covariate)</li> </ol>

### 3.1.0 Design

As seen from Table 3.1.0 the experiment followed the Parallel Group Covariance Design. Issues considered for finalising the design were (i) the three teaching strategies as treatment variables, (ii) four criterion variables, (iii) Randomly selected groups to be taught all the three units in Geography by using one strategy for one group and (iv) getting adequate information from a relatively small number of observation for economy of research.

After selecting groups randomly each treatment was allotted to a group of pupils. Number of pupils were not

equal in each treatment. The reason for choosing this design was (i) the non-availability of many school classes and the investigator herself acting as a programmed teacher in order to avoid inter-teacher variability which put limitation to successful implementation of other complex type of experimental design, (ii) strong statistical analysis is possible inspite of experimental errors due to treatment variables, (iii) method of analysis is not affected even if some units ( pupils ) have to be rejected due to one or other reasons.

Therefore, a Parallel Group Covariance Design was used to find out the effects of three treatments ( here three strategies of teaching,  $S_1$ ,  $S_2$ ,  $S_3$  ) on the four criterion variables ( here knowledge, comprehension, application and total achievement). Diagrammatically <sup>the</sup> design may look like the following :

Pre-Test	Treatment	Post-Test	Retention Test
..... : Intelligence : : Test : ..... : Pre-achieve- : ment Test in : : Geography : .....	..... : 3 Units of : : Geography : : taught to 3 : : different : : classes using : : 3 strategies : : of teaching : .....	..... : Post-Test : : in : : Geography : .....	..... : Retention : : Test : : in : : Geography : .....

### 3.2.0 Treatment and Criterion Variables

The three treatments were the three different strategies of teaching. Strategy  $S_1$ , (Lecturing and Questioning-Answering), Strategy  $S_2$  (Lecturing and Questioning-Answering by using Behavioural Objectives), and Strategy  $S_3$  (Discussion by using Instructional Materials).

The criterion variables considered were knowledge, comprehension, application and total achievement.

### 3.3.0 Intervening Variables

In an experimental study, where different teaching strategies have been used as independent variables the intervening variables related to the teacher may easily affect the result. The age, sex, experience, academic and professional preparation are some of the intervening variables. In the present study these variables of inter-teacher differences have been avoided by programming only one teacher to teach in all the three strategies. The study however, involves the intervening variables related to pupils. Intelligence and pre-achievement of the pupils in the subject of Geography are these variables which may again affect the results as intervening variables. In this study, these two intervening variables have been statistically controlled through the use of analysis of covariance.

### 3.4.0 Sample

The experiment required the sampling of subjects and units. The selection of teacher and pupils are discussed under the term subjects.

#### (1) Subjects :

Teacher : The experiment required such teachers who would have a good knowledge of the content to teach, who could be programmed and who could decide and change strategies of teaching as required by design. In order to avoid teacher variance, it was decided to involve only one teacher. The investigator could satisfy all the requirements needed for the study. So the investigator herself acted as the teacher.

It had to be made certain that the teacher was in a position to vary the treatment as per requirements of the design. The teacher practised teaching accordingly in a simulated situation. After sufficient practice in this condition these three strategies were tried out for three weeks on the pupils of standard IX belonging to a school other than those selected for the experiment. These lessons were observed and discussed by one training college teacher and one school teacher teaching Geography in the same school. The teacher started with the actual experiment only after the observers confirmed that the teacher could confidently change the treatment delivery in successive class periods.

Pupils : To give the details about the sampling of pupils, there were 35 schools in North Barrackpore subdivision. Schools with Bengali medium were selected as there were no English medium schools with three sections. It was found that schools were following different textbooks with different layout of the syllabus. As the content of the teaching had to be the same in all teaching strategies, the investigator selected the schools which had been following books with similar syllabus and layout as the investigator intended not to disturb the curricular set ( term syllabus ). The extent of completion of the syllabus was also considered to be one of the criteria for the selection of the schools. From among the schools, which could satisfy the above mentioned demands, two were selected. Selection was made from among the schools, again, which were willing, cooperative and timings of which suited with the sequence of the design. This was a necessity as the teacher had to teach six lessons in a day in two different schools. The selected schools were :

- (1) Annapurna Girls' High School ( C<sub>1</sub>, C<sub>2</sub>, C<sub>3</sub> )\*
- (2) Saradadevi Vidyalaya (C<sub>4</sub>, C<sub>5</sub>, C<sub>6</sub> )

Comparatively matured pupils were expected to respond to the different levels of instructional objectives ( knowledge, comprehension and application ). Hence,

\* 'C' = Class

standard IX was selected for the experiment.

Both the schools in the sample were private schools requiring the pupils to pay fees. It can hence be considered that most of the students belonged to the middle class. Another important factor to be noted that both the schools selected, were located in the heart of an industrial belt. Considering only those pupils who attended all the teaching classes and testing periods, the strength of the classes were ( in  $C_1, C_2, C_3, C_4, C_5, C_6$  ) 30, 25, 25, 25, 25, 20 respectively.

(ii) Units :

The syllabus of Geography of standard IX contains units from Regional Geography of India. Units selected for teaching were (i) The Gangetic Plains, (ii) The Brahmaputra Valley, (iii) The Desert Region.

3.5.0 Procedure

The teaching of the selected units according to the three strategies chosen for the experiment formed the treatments. To facilitate to follow the teaching strategies strictly, a detailed lesson plan for each teaching strategy, thus, forming a total of ( 15 lessons X 3 strategies ) fortyfive lessons in all, were prepared. Three lesson plans ( a sample for each strategy ) are given in Appendices. The content covered in any lesson of a unit was the same in all corresponding lessons of the three teaching strategies.

Even the general teaching aid, examples given, blackboard work were maintained to be same from strategy to strategy.

Table :3.2.0: Schematic Representation of the Strategies : Lesson Plan

Three Teaching Strategies :

1. Lecturing and Questioning-Answering
2. Lecturing and Questioning-Answering using a Behavioural Objective
3. Discussion by using Instructional Materials (maps and guidelines for study)

1. Lecturing and Questioning-Answering :

Teacher lecturing -- Teacher questioning -- Pupil answering -- Teacher receiving or rejecting the answer ---  
 Teacher lecturing -- Teacher questioning -- Pupil answering -- Teacher receiving -- or rejecting the answer -- Teacher lecturing --

2. Lecturing and Questioning-Answering using Behavioural Objectives :

Teacher lecturing ( Pointing to B.O.) -- Teacher questioning -- Pupil answering -- Teacher receiving or rejecting with B.O. -- Teacher lecturing ( Pointing to B.O.) Teacher questioning -- Pupil answering -- Teacher receiving or rejecting the answer with B.O. -- Teacher lecturing with B.O. --

3. Discussion by using Instructional Materials : ( Maps and Guidelines for Study )

- Step I - Giving maps
- Step II - Giving guideline
- Step III - Specified time for preparing guideline
- Step IV - Dividing the class into groups
- Step V - Discussion starts with the following plan

Point<sub>1</sub> Group<sub>1</sub> ; Point<sub>2</sub> Group<sub>2</sub> ; Point<sub>3</sub> Group<sub>1</sub>

Point<sub>4</sub> Group<sub>2</sub> ; Point<sub>5</sub> Group<sub>1</sub> ; Point<sub>6</sub> Group<sub>2</sub>

### 3.6.0 Tools Used

Three types of tools were used :

- (a) to describe the nature of pupils in the sample,
- (b) to measure pre-achievement,
- (c) to measure criterion variables.

To fulfil the purpose of the tool No. (a) the Intelligence Test, originally developed by the Psychological Bureau, David Hare Training College and later modified by Vinaya Bhavana, Visva-Bharati, was used, and to measure pre-achievement as well as criterion variables, the investigator developed two tools for these two stages. Pre-achievement test was developed on the unit with the Himalayan Region, and Criterion tests were developed in the following sequence,  $T_1$  on the Gangetic Plains, Criterion Test  $T_2$  on the Brahmaputra Valley Region and Criterion Test  $T_3$  on the Desert Regions of India.

#### 3.6.1 Description of the Intelligence Test - Form A

Prepared at the Bureau of Educational and Psychological Research, David Hare Training College and modified at Vinaya Bhavan, Visva Bharati, the test is found to be highly loaded with  $V_{ed}$  of Vernon's Hierarchical Structure of intelligence. On analysis of the correlations between the test and different achievement tests for class VIII, the test was found to measure primarily the aptitude in academic

subjects. The correlations between the test and Mathematics test - .81 the test and Bengali test -- .82, the test and test on environmental studies - .60, validity - teachers rating as criterion validity - .82, Reliability was found by Test-Retest Method after 3 weeks 0.78. Norms for class VIII students - Mean -28.70 ; Sd. 11.05; Average age of the group 13.89, or 13+ ; Primarily used for selection of students for academic courses ( Class IX ).

### 3.6.2 The Pre-achievement Test in Geography

There was no standardised test in Geography available which could cover the previous knowledge of the pupils according to the syllabus selected for this experiment. Though the investigator prepared a very exhaustive Pre-achievement test in Geography on the basis of VIII standard syllabus, that could not be administered as one of the schools available for experiment did not introduce the new syllabus at the eighth grade; therefore the investigator prepared a fifty item test on the basis of topics covered before launching the experiment. The test was developed at two stages - preliminary draft and final draft.

#### Preliminary Draft :

It included twenty knowledge items, eighteen comprehension items and twelve application items.

Table :3.3.0: Blue Print of the Items

Names of the Units	Objectives			Total
	Knowledge	Comprehension	Application	
The Western Himalayas	7	6	4	17
The Central Himalayas	6	6	4	16
The Eastern Himalayas	7	6	4	17
<b>Total</b>	<b>20</b>	<b>18</b>	<b>12</b>	<b>50</b>

The sample of pupils for preliminary draft administration was drawn from standard X of Bengali medium schools of North Barrackpore Subdivision.

Table :3.4.0: Distribution of the Sample drawn for the Administration of the Preliminary Draft of the Pre-achievement Test in Geography

Sr.No.	Institution	No. of students drawn
1	Annapurna Girls' High School	.. 65
2	Kanchrapara Boys' High School	.. 24
3	Saradadevi High School	.. 60
4	Mahendra High School	.. 30
5	Kanchrapara Girls' High School	.. 32
	<b>Total</b>	<b>.. 211</b>

In consultation with some geography teachers, one hour was allowed for this preliminary draft to be answered by the pupils. Item analysis, using Flanagan's Table was carried out. (Davis, 1963, Garrett 1966). Validity and difficulty indices of the items were calculated.

Final Draft :

Those items which had a minimum validity index of .25 were retained for the final draft of the text. The final draft of the test thus had sixteen knowledge, fourteen comprehension, and ten application items. ( Table 3.5.0 on the next page ).

3.6.3. Criterion Tests in Geography

As the whole pattern of syllabus was changed a year before the experiment was undertaken, no standardised test was available that could be used as a criterion test for the present experiment. Achievement tests were hence developed on the three selected units. These were :

- (a) Criterion Test ( $T_1$ ) - Tests on the lesson unit-  
The Gangetic Plains
- (b) Criterion Test ( $T_2$ ) - Tests on the lesson unit-  
The Brahmaputra Valley Region
- (c) Criterion Test ( $T_3$ ) - Tests on the Desert Regions  
of India

The development of the tests are discussed under two sub-headings - Preliminary draft and the final draft.

Table 3.5.0: Validity and Difficulty Indices of the Items Finally Selected to form the Pre-achievement Test in Geography

Sr. No.	Group I		Group II		Group III		Group IV			
	Difficulty Index	Sr. No.								
1	.82		.51	A1	.64	1	.72	1	.52	.65
2	.72		.41	2	.57	2	.58	2	.43	.72
3	.61		.70	3	.40	3	.53	3	.38	.79
4	.51		.77	4	.39	4	.49	4	.23	.64
5	.45		.48	B1	.41	5	.46		-	-
6	.36		.45	2	.29	6	.42		-	-
7	.26		.61	3	.28	7	.38		-	-
8	.26		.26	4	.22	8	.36		-	-
9	.24		.47	5	.18	9	.25		-	-
10	.23		.45	6	.16	10	.24		-	-

  

Group V		
Sr.No.	Difficulty Index	Validity Index
1a	.34	.59
1b	.28	.53
1c	.27	.69
2a	.43	.72
2b	.38	.79
2c	.23	.64

Preliminary Draft :

Criterion variables considered were knowledge, comprehension and application aspects of instructional objectives. The investigator analysed all three units on the basis of objectives to be attained and selected suitable types of objective tests for different types of content. Five experts from the area of evaluation and geography were consulted to find out the content validity as well as the validity of objectives. In the beginning there were 180 items, and after consultation with the experts total number of items were reduced to 150. The items which were not agreed upon regarding criterion validity were rejected.

Table :3.6.0: Blue Print of the Preliminary Drafts of the Three Criterion Tests (T<sub>1</sub>, T<sub>2</sub>, T<sub>3</sub>) in Geography

Sr. No.	Criterion Tests	Objectives			Total No. of Items
		K	C	A	
1	The Gangetic Plains	40	30	30	100
2	The Brahmaputra Valley	8	6	6	20
3	The Desert Region	12	12	6	30
Total		60	48	42	150

K = Knowledge    C = Comprehension    A = Application

The preliminary drafts of the three criterion tests  $T_1$ ,  $T_2$ ,  $T_3$ , were administered on pupils of standard X from various schools taking care that the contents of the tests were taught to the pupils by geography teachers. Table 3.7.0 gives the distribution of the sample drawn.

Table :3.7.0: Distribution of the Sample drawn for the Administration of the Preliminary Drafts of the Criterion Tests in Geography (  $T_1$ ,  $T_2$ ,  $T_3$  ).

Sr. No.	Institutions	No. of pupils drawn for different tests			
		$T_1$	$T_2$	+	$T_3$
1	Annapurna Girls' High School	68			65
2	Kancharapara Girls' High School	36			30
3	Kanchrapara Boys' High School	25			23
4	Saradadevi High School	60			60
5	Mahendra High School	33			33
Total ..		232			211

With a general understanding of the nature of pupils of standard X and in consultation with some geography teachers of secondary schools, a time duration of 90 minutes was allowed for  $T_1$ , and fifty minutes for  $T_2$  and  $T_3$ . This was found to be sufficient. These tests were administered in two parts. As  $T_2$  and  $T_3$  comprised of lesser number of items, that was administered in the second session and  $T_1$

was administered in the first session. Scoring was done on the principle of 1 for correct answer and 0 for wrong answers. Marshall and Hales (1971) Tenbrink (1974) put very strong arguments why a correction for chance-formula should not be applied to the scores. Marshall and Hale (1971) observe that, (1) the ranking of the students in a class is not changed by the use of correction formula, (2) these students who choose an incorrect response as a result of misinformation are penalised twice by this formula, (3) those who are poor guessers are penalised by having their scores reduced while those who are good guessers ( 'test sophisticats' ) are not penalised, (4) since it is usually possible for the examinee to eliminate one or two of the fails on those items which are not known, the student who disregards instructions is rewarded by this 'correction', while the student who follows the instruction not to guess is penalised, (5) an assumption of the correction formula is that the answer is either known or is not known, but partial knowledge is not considered, (6) the use of correction formula tends to lead to the erroneous assumption that the corrected scores are somehow 'true' scores. Following these arguments, correction formula for guessing the answers was not applied. The items were subjected to item analysis using Flanagan's Table, (Davis, 1963 ; Garrett 1966 ). Validity and difficulty indices of the items in each of the tests were calculated.

Final Draft :

'In a teacher-made test items with discriminating indices between 0.20 and 0.40 are of some value in discriminating between examinees. Items with indices between 0.40 and 0.66 are good discriminators. These with indices about 0.60 are usually good' (Marshall and Hale) keeping this in consideration, items which had a minimum validity index of 0.25 were included in the final drafts of the criterion tests.

The final drafts of the criterion tests  $T_1$ ,  $T_2$ ,  $T_3$ , contained 50, 10, 15 items respectively. Table 3.8.0 which follows on the next page, gives the validity and difficulty indices of these items selected for the final drafts of criterion tests. ( Items : Knowledge - 30, Comprehension - 24, and Application - 21 )

The final drafts of the three criterion tests are given in Appendices ( $B_1$ ,  $B_2$ ,  $B_3$ ). On consultation with some geography teachers, the time for criterion test was allowed 90 minutes. This time  $T_1$ ,  $T_2$  and  $T_3$  were administered in one session, as students of this standard were used to take test for longer duration. The tests were developed to satisfy the requirements of the experiment. Hence, all sophisticated steps were not taken to standardise the tests. Teacher educators competent in evaluation and comments of Geography endorsed the objectives and content validity of each item.

Table 3.8.0: Validity and Difficulty Indices of the Items Finally selected to form the Post-achievement Test (Criterion Test 1 The Gangetic Plains)

Item No.	Group I		Group II		Group III		Group IV	
	Difficulty Index	Validity Index	Difficulty Index	Validity Index	Difficulty Index	Validity Index	Item No.	Difficulty Index
1	.83	.33	.88	.28	.81	.42	1a	.38
2	.80	.35	.45	.31	.76	.36	1b	.35
3	.75	.41	.43	.40	.66	.61	1c	.33
4	.72	.41	.40	.27	.65	.42	2a	.27
5	.67	.33	.21	.42	.62	.57	2b	.17
6	.58	.33	.67	.55	.58	.29	2c	.14
7	.58	.38	.57	.50	.54	.45	3a	.31
8	.51	.42	.56	.40	.31	.30	3b	.27
9	.51	.37	.52	.27	.31	.35	3c	.25
10	.48	.32	.40	.26	.25	.32	4a	.27
11	.46	.42	-	-	-	-	4b	.21
12	.44	.26	-	-	-	-	4c	.19
13	.39	.33	-	-	-	-	5a	.27
14	.36	.31	-	-	-	-	5b	.25
15	.22	.26	-	-	-	-	5c	.18

Table :3.9.0: Validity and Difficulty Indices of the Items finally selected to form the Post-achievement Test (Criterion Test,<sup>2</sup>The Brahmputra Valley)

Item No.	Group I		Group II		Item No.	Group III	
	Difficulty Index	Validity Index	Difficulty Index	Validity Index		Difficulty Index	Validity Index
1	.70	.42	.55	.32	1a	.19	.68
2	.57	.25	.45	.51	1b	.18	.66
3	.40	.31	.33	.29	1c	.18	.40
4	.34	.59	-	-	-	-	-

Table :3.10.0: Validity and Difficulty Indices of the Items Finally selected to form the Post-achievement Test (Criterion Test<sub>3</sub> - The Desert Regions)

Item No.	Group I		Group II		Group III		Item No.	Group III	
	Difficulty Index	Validity Index	Difficulty Index	Validity Index	Difficulty Index	Validity Index		Difficulty Index	Validity Index
1	.76	.35	.48	.59	.49	.39	1a	.30	.27
2	.66	.48	.46	.62	.43	.43	1b	.27	.55
3	.58	.29	.40	.57	-	-	1c	.20	.40
4	.51	.39	.38	.49	-	-	-	-	-
5	.40	.31	-	-	-	-	-	-	-
6	.39	.49	-	-	-	-	-	-	-

#### 3.6.4 Instructional Material

For the group, taught by using Strategy  $S_3$  (Discussion by using Instructional Materials ) thirteen special maps were prepared. Contents of the map were collected from different sources, as due to the change of syllabus no atlas or wall map was available to the date. Each student of this group was provided with a cyclostyled copy of the map for each lesson. Map No.1 and Map No. 10 were used for more than one lesson. Photographic copy of one map with samples of superimposition used is given in the Appendices.

#### 3.7.0 Main Experiment

The pupils of six classes of standard IX of the two selected schools formed the units for experiment. Each class was randomly assigned to treatments. Before applying this treatment Group Intelligence Test prepared at the Psychological and Research Bureau of David Hare Training College, later modified at Vinaya Bhavana, Visva-Bharati, was administered to all the groups of pupils. The groups were taught 15 days for a period of five weeks, 3 lessons per week. One lesson was covered in each class per day. For the unit, 'The Gangetic Plains' 10 lessons, for the 'Brahmaputra Valley' 2 lessons and for the 'Desert Regions' 3 lessons were imparted. Care was taken to ensure that

content covered in each unit of lesson was the same in all the corresponding lessons of the three teaching strategies. Even the examples given, teaching aids used ( general ), blackboard work done, were same for all the strategies. Five days after the experiment the Post-Achievement Test was administered on the total sample. Retention Test in geography was administered after 10 days of Post-Achievement Test. It was in a surprise Test condition. Those pupils were considered for the analysis of results who appeared in all the tests.

As the whole experiment was conducted in the normal school condition, no control could be made in the beginning, it was decided to control the effect of two intervening variables, namely, intelligence and pre-achievement ones. This was statistically controlled with the help of analysis of covariance, where the effect of both the intervening variables was simultaneously analysed for each of the criterion measures, namely, scores for knowledge, comprehension, application and total achievement.

Table :3.11.0: A Schematic Representation of the Procedure followed in the Experiment

Administered Group Intelligence Test ( Developed by Psychological Bureau at David Hare Training College and Modified at Vinaya Bhavana, Visva Bharati).						
Pre-achievement Test in Geography						
Day	Classes					
	C <sub>1</sub>	C <sub>2</sub>	C <sub>3</sub>	C <sub>4</sub>	C <sub>5</sub>	C <sub>6</sub>
	S <sub>1</sub>	S <sub>2</sub>	S <sub>3</sub>	S <sub>1</sub>	S <sub>2</sub>	S <sub>3</sub>
	Taught by Strategy					
	Week I					
1	do	do	do	do	do	do
2	do	do	do	do	do	do
3	do	do	do	do	do	do
	-----					
	Week II					
1	do	do	do	do	do	do
2	do	do	do	do	do	do
3	do	do	do	do	do	do
	-----					
	Week III					
1	do	do	do	do	do	do
2	do	do	do	do	do	do
3	do	do	do	do	do	do
	-----					
	Week IV					
1	do	do	do	do	do	do
2	do	do	do	do	do	do
3	do	do	do	do	do	do
	-----					
	Week V					
1	do	do	do	do	do	do
2	do	do	do	do	do	do
3	do	do	do	do	do	do
	-----					
	Post-Achievement Test after 5 days of 5-week Experiment (Under planned Testing condition)					
	Retention Test after 10 days of Post-Achievement Test under surprise testing condition.					